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EFFECTS OF A CRITICAL ELEMENT TRAINING PACKAGE USING SELF-INSTRUCTION ON ELEMENTARY INSERVICE TEACHERS' ABILITY TO ANALYZE, DIAGNOSE, AND PROVIDE FEEDBACK FOR THE STRIKING SKILL OF BATTING

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

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The Ohio State University 1998

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ABSTRACT

It was presumed that physical education teachers develop the ability to analyze sport skill performances through professional preparation courses (Biscan & Hoffman, 1978). Additionally, teacher educators have maintained that a direct and vital link between the science of kinesiology and the process of teaching is inherent (Hoffman, 1977). Programmatic research with performance principle and critical element training at The Ohio State University has demonstrated that preservice teachers can be instructed to identify and discriminate sport skill performances (Matanin, 1993; Rush, 1990; Williams, 1995). The purpose of this study was to examine the effects of a critical element training package using self-instruction on the ability of elementary inservice physical education teachers to analyze, diagnose, and provide feedback for the striking skill of batting. Subjects participated in a 2-week, self-paced, videotape instructional program to measure the components of the skill analysis process. Data were analyzed using single subject research methodology. A multiple baseline across behaviors design was used to present the percentage of
correct responses as a ratio of points awarded. Critical element training in analysis demonstrated no functional relationship but slight increases in subjects' ability to improve analytic behaviors. Training in diagnosis represented a weak to moderate functional relationship in three of four subjects. A moderate to high functional relationship existed for three subjects during feedback. All subjects demonstrated improvement for all behaviors of the skill analysis process.
ACKNOWLEDGMENTS

Though at times we walk solitary in the shadows of darkness, we can never be alone in our thoughts. For it is in our thoughts that we embrace the beauty of life, the vessels of strength, our friends new and old. To this, my sincerest thanks and gratitude to the following individuals who offered their valuable time, efforts, and patience throughout this seemingly endless but challenging endeavor. Without you, there would not be.

To my subjects - time was the ultimate gift and yet more generous were you to share it to the end.

To Tom - it was a great experience working with you.

To Clive and Nancy - three years spent with two great minds - who could ask for anything more.

To AC, Julie, and Lynn - may the curse of "what else can happen" never plague your drive to the finish line.

To Kathy - for all those times you stood by me, your friendship and understanding was a need fulfilled.

To Dr. Heron - one's behavior can truly be predictable, verified, and replicated as a result of your expertise.

To Dr. Tannehill - how could I forget our first meeting and the start of a whole new career at OSU.
To Dr. Stroot - patient and understanding you were through it all, making me believe it will happen.

To my family - Zivili Hrvati!
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CHAPTER 1
INTRODUCTION

It is no surprise that physical education teachers face multiple challenges within the gymnasium setting. Despite these seemingly various dilemmas with context and learner, teachers are held accountable for student learning. Developing proficiency for the procedures of observation, analysis, diagnosis, and feedback will be critical if teachers are to play a pivotal role in improving student performance. Accurate interpretation of significant events occurring in the gymnasium would require teachers to develop an observation plan, determine effective observational strategies, and have a clear understanding of the correct and incorrect components of a performance (Barrett, 1983; Knudson & Morrison, 1997; McPherson, 1990). Bell, Barrett, and Allison (1985) suggested that observations be guided and clearly defined to observe critical elements. Teachers who provide students with accuracy in these components enhance the learning environment, as well as supplement the teacher/student learning process. Training physical education teachers to integrate these competencies can produce positive effects in the context of their teaching.
Past decades of research have assisted researchers to examine the traditional assumption that physical education teachers are trained to develop the ability to analyze sport skill performance through their professional preparation courses (Biscan & Hoffman, 1978; Knudson & Morrison, 1997; Locke, 1972). Furthermore, research findings have indicated that once teachers complete the formal experience of educational preparation, teaching effectiveness is based on their retention of mechanical knowledge and ability to recognize common errors (Biscan & Hoffman, 1978). "Teacher educators have assumed the existence of a direct and vital link between the science of kinesiology and the process of teaching" (Hoffman, 1977a, p. 39). Hoffman further described kinesiology courses as "excellent introductory courses for students who aspire to careers in kinesiology. But as courses which train teachers how to analyze the responses of their students, they are disasters" (p. 41). It is the revival of interest in the science of pedagogy that has created a challenge for those in professional preparation programs to take a more serious look at developing teachers' analytic competency (Knudson & Morrison, 1997).

Transferring kinesiology away from its original discipline and integrating it with various subdisciplines in physical education, as well as consistency in terminology, will provide a more meaningful contribution in the
preparation of teachers (Knudson & Morrison, 1997). Furthermore, teachers should experience training in simulated and clinical scenarios to develop their capacity to identify and discriminate the abnormalities in movement patterns of children (Beveridge & Gangstead, 1988; Gangstead, 1984). Hoffman (1977a) contended that aside from being factual and technical, pedagogical kinesiology must be practical for teachers as the connection between student performance outcomes and teacher instruction and feedback becomes apparent.

Recognized as an instrumental proponent and setting the standard for research in the study of applied sport skill analysis, Hoffman's (1977a) classic study provided six characteristics connecting the attributes of knowledge and practice through a pedagogical kinesiology. Pedagogical kinesiology would require preservice teachers to interact with their students, while accurately diagnosing and providing the students with appropriate information relative to their response. Preservice teachers would be schooled in proper positioning techniques as they observe and monitor large groups of students, in addition to developing appropriate techniques for providing feedback to student responses.

A second characteristic emphasizes how students acquire skills. Teachers must be trained to recognize and understand the task structure, the relationship of task
components, and changes that occur between task components and the environment. Significant to the acquisition of skill is the ability of the teacher to recognize and understand variance in student response, factors affecting skill acquisition, and the internal processing of students as they begin to learn new skills.

Third, teachers must acknowledge a myriad of challenges when developing their analytic knowledge of a motor response derived from the application of qualitative criteria. This development of knowledge should fall specifically within the parameters of each response.

A fourth characteristic of pedagogical kinesiology is the emphasis on observational training. Accurate interpretation when identifying correct and incorrect performances suggests that the teacher be in the right place at the right time. Accurate perception is a vital link to accurate interpretation and is developed through perceptual training programs. "Teachers must also be taught to observe the outcome of the learner's response and to use that information to assist them in diagnosing the learner's problem" (Hoffman, 1977a, p.45-46).

The fifth characteristic contends that effective modes of communication must compliment the knowledge and observational skills demonstrated by the teacher. Valid and accurate messages from the teacher can nourish the entire movement-communication process for the learner.
Finally, a performance-based approach to analyzing movement is the foundation of pedagogical kinesiology. The careful selection of concepts of movement and mechanical laws create an environment conducive for an effective pedagogical kinesiology.

As the ability to observe well (Barrett, 1979) becomes increasingly fundamental in the analysis of sport skills, physical education teachers must continuously recognize that analysis, diagnosis, and appropriate feedback are critical for effective teaching and student learning. Barrett (1983) 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). Effective skill analysis requires that teachers consider a multi-step procedure initiated by proper observation. Barrett (1979) indicated that the rate of speed and occurrence of the skill movement being observed often appeared more difficult for subjects to analyze. Consequently, observing may be the key component if a teacher's interpretation and subsequent teaching are influenced by what is observed (Allison, 1985).

The ability to analyze and diagnose skill performance is often related to previous teaching and coaching experiences. Biscan and Hoffman (1978) investigated the capabilities of physical education teachers, physical education majors, and classroom teachers in their analysis
of motor responses of students. Results indicated that analytic proficiency was related more to an individual's specific experience and exposure to a movement skill rather than to a generalized analytic ability. Additional research indicated that experience gained from coaching (Harari, 1986; Imwold & Hoffman, 1983) and the effects of teaching experience, knowledge of performer competence, and performance outcome (Armstrong & Hoffman, 1979) had positive effects on analytic ability.

Jensen and Schultz (1977) stated that "a mechanical analysis of one skill has great carryover value in understanding other skills which involve some of the same laws and principles" (p. 272). Though most sport skills utilize more than one mechanical principle, it is necessary for teachers to be cognizant when stressing gradual improvement of specific points (Jensen & Schultz, 1977). Williams (1995) indicated that a sport specific critical element approach may not be the most practical for developing analytic competencies in physical education teacher education programs. With time as a limiting factor to learning a vast array of sport skills in undergraduate programs, development of a "generic" approach and performance principle approach has provided some promising results (Johnson, 1990; Matanin, 1993; Williams, 1995).

Past research studies have indicated that proper and specific instruction improves the ability to analyze
performance in a qualitative manner (Gangstead & Beveridge, 1984; Morrison & Reeve, 1988, 1992). Interventions incorporating verbal identification, visual discrimination, diagnostic training, and computer-assisted technology have all contributed to the development of effective teaching competencies in sport skill analysis of undergraduate physical education majors. Various forms of media have been utilized in the promotion of skill analysis research, which includes videotape (Halverson, 1987; Johnson, 1990; Kniffin, 1985; Matanin, 1995; Morton, 1989), diagrammatic profiles of skills (Imwold & Hoffman, 1983; Rush, 1990), still photographs (Morton, 1989), computer generated graphics (Chou, 1990), and most recently the combination of computer and laser disc (Williams, 1995).

Decisions on what to observe, how to plan the observation, and recognizing the factors that influence observational expertise requires the ability to identify critical features (Barrett, 1983). Knowing what to look for during sport skill performance and developing the ability to perceive such actions provides a strong base for effective analysis and diagnosis. "Some of the most important prerequisite information that an analyst needs are the critical features of the movements" (Knudson & Morrison, 1997, p. 74).

Various studies at The Ohio State University have supported the premise that preservice teachers can be
trained to identify critical elements of a skill, as well as analyze and diagnose various sport skill performances (Halverson, 1987; Morton, 1989; Rush, 1990; Wilkinson, 1986). Furthermore, inservice teachers can be trained in the use of component specific instruction (CSI) and in recognizing that instruction in some sport skill components may produce more immediate affects than others (Oslin, Stroot, & Siedentop, 1997).

Referring to the well-established study conducted in skill analysis, Hoffman (1977a) stated that "teachers need to be trained to discriminate performance errors in the skills they will be teaching in the schools" (p. 41). Training teachers not only involves addressing analysis and diagnosis of sport skill performances but also requires the inclusion of feedback for continued learner improvement.

The programmatic line of research conducted at The Ohio State University provided multiple studies examining the effectiveness of various instructional strategies for improving prospective physical education teachers' ability to analyze and diagnose motor skills. Focusing on the use of component specific feedback statements for enhancing a learner's motor performance, Stroot and Oslin (1993) reported that preservice teachers demonstrated limited ability to assess performance and provide appropriate feedback. The use of corrective feedback is a critical aspect of actual instruction and a vital factor in students'

The amount of feedback given, the appropriateness or inappropriateness of feedback, and the ability of the students are important aspects when students engage in and learn different sport skills (Lee, Keh, & Magill, 1993). Consequently, students begin to develop an understanding of the established techniques as well as direction for demonstrating skill performance. Stroot and Oslin (1993) reported that children were better prepared to respond and improve performance in overhand throwing activities when appropriate feedback was provided. Magill (1994) suggested that feedback can play a variety of roles in skill learning, enabling a student to learn a skill faster or achieve a higher level of performance. No matter how feedback is provided, "the role it plays depends largely on certain characteristics of the skill being learned and of the person learning the skill" (Magill, 1994, p. 318).

Teachers who possess the ability to observe, analyze, diagnose, and provide appropriate feedback of the critical elements of sport skills can begin to make a difference in contributing to the development of students' skills, as well as their own teaching effectiveness. Knudson and Morrison (1997) described critical elements as the "points defining good form that are used in teaching and should also be used to help determine the teacher's focus in the qualitative
analysis of skill" (p. 71). As a result, teachers who provide qualitative feedback highlighting the critical elements of sport skills promote a more productive learning environment for students. Development of the skill analysis process can prove to be fruitful for teachers in their quest to fulfill the responsibilities for becoming competent observers, critical analysts, diagnostic investigators, and feedback agents for their students. Consequently, knowledge of critical elements will enhance the teacher's ability to analyze and diagnose sport skill performances of students, as well as provide them with the necessary knowledge for disseminating appropriate feedback.

**Statement of the Problem**

The purpose of this study was to examine the effects of a critical element training package using self-instruction on the ability of inservice physical education teachers with a minimum of three years teaching experience for analyzing, diagnosing, and providing appropriate feedback for the striking skill of batting. As part of the training package, a pretest was included to measure subjects' knowledge of content prior to the instructional program and maintenance of content knowledge for each day attended. Subjects observed videotapes of various performances of the manipulative skill of batting demonstrated by second-grade elementary students in their natural physical education
environment using a batting tee. The critical element training package using self-instruction included videotaped performances and an instructional manual to measure the subjects' ability to analyze, diagnose, and provide appropriate feedback for the batting skill. Thirteen critical elements were taught to the inservice teachers.

Research Questions

1. What is the impact of the critical element training package using self-instruction on subjects' ability to analyze correct and incorrect batting performances?

2. What is the impact of the critical element training package using self-instruction on subjects' ability to diagnose correct and incorrect batting performances?

3. What is the impact of the critical element training package using self-instruction on subjects' ability to provide appropriate feedback specific to correct and incorrect batting performances?

Limitations of the Study

This study will be restricted and affected by the following limitations:

1. Subjects for the study will be limited to volunteer inservice physical education teachers with a minimum of three years teaching experience at the elementary level.
2. The striking skill, specifically batting, will be performed using a stationary batting tee.
3. The compilation of videotaped performances will be limited to second-grade elementary students of low, medium, and high skill ability, based on a qualitative analysis of skill performance.

Assumptions of the Study

1. Videotaped batting performances by students will provide a clear demonstration of low, medium, and high skill ability, and are representative of the skills at the elementary level.
2. Selected critical elements can be observed and measured in a correct or incorrect manner when demonstrated in all batting performances.
3. The ability to analyze, diagnose, and provide feedback for videotape batting performances is measurable.

Definition of Terms

The following terms and definitions will be included to provide assistance and clarification for the reader:
Analysis- The degree of correctness or incorrectness of a skill performance (Matanin, 1993).
Baseline- Original data used to objectively determine the effects of an independent variable and evaluate changes in
subject behavior and serves as the prediction phase (Cooper, Heron & Heward, 1987).

Batting Tee- "A large adjustable pole on which the ball rests, allowing a player to practice without the services of a batting practice pitcher. Also used for playing tee-ball" (Dickson, 1989, p. 47).

Critical Element- "A specific feature that is necessary in the execution of a physical skill that is used to judge the proficiency of the performance" (Morton, 1989, p. 7). For example, a critical element in the swing phase of the batting swing would be "wrists turn over as the ball is contacted."

Diagnosis- The process of identifying the cause of a discrepancy between correct and incorrect performance and determining which error to intervene upon to improve learner performance (Hoffman, 1982).

Feedback- Information that is provided to individuals or groups of individuals about the quality of their movement or behavior based on observation (Graham, Holt-Hale, & Parker, 1993).

Intervention- Self-instruction using a critical element training package to augment subjects' ability to analyze, diagnose, and provide feedback for batting skill performances.

Maintenance- "The extent to which the learner continues to perform the target behavior after a portion or all of the
intervention has been terminated" (Cooper et al., 1987, p. 558).

Manipulative Skill- Involves the utilization and control of the hands, feet, and implement to either receive or propel an object. For purposes of this study, the manipulative skill will involve imparting a force on a stationary object (Gabbard, 1996).

Multiple Baseline Across Behaviors Design- "A method of analyzing the relationship between the independent variable and the acquisition of a successive approximation or chain sequence; simultaneous baseline measurement is begun on two or more target behaviors of the same subject" (Cooper, et al., 1987, p. 224).

Observing- An ability to accurately perceive both the movement response of the learner and the environment in which the response is taking place (Barrett, 1983).

Skill Analysis- "A process in which the teacher or coach systematically observes the responses of students and identifies discrepancies between actual and desired response characteristics based on the particular observation" (Hoffman, 1977a, p. 1).

Striking- "An action in which a part of the body or an implement is used to give impetus to an object. Striking skills can also be performed using various movement patterns, the most common being the overhand, sidearm, and underhand" (Gabbard, 1996, p. 283-84). For the purpose of
this study, striking will involve the use of a bat for hitting a ball positioned on a tee.

**Significance of the Study**

Findings of this study will provide information on the effectiveness of a critical element training package using self-instruction in the development of inservice physical education teachers to analyze, diagnose, and provide feedback for the striking skill of batting. The concept of training inservice teachers, as well as examining the use of feedback, has never been examined in the programmatic research in skill analysis at The Ohio State University.

Information from this study suggests that inservice teachers can improve in their present ability to analyze, diagnose, and provide feedback for batting skills. The critical element approach provides a more detailed account and an alternative to a performance principle approach in the skill analysis process. This study also suggests that training inservice teachers will assist them in this essential component and further develop teaching competencies leading to increased student performance.
CHAPTER 2

REVIEW OF RELATED LITERATURE

The review of related literature presented in this chapter is presented in four sections: qualitative skill analysis, comprehensive models for qualitative analysis, training in analysis and diagnosis, and the effectiveness of feedback.

Qualitative Skill Analysis

Traditionally, a teacher's analytical skill was unrecognized as a prioritized teaching behavior in the classroom and had very little effect on teaching in physical education (Hoffman, 1977). Furthermore, Hoffman (1977) indicated that the act of skill analysis was overshadowed by many other responsibilities of the physical education teacher while conducting class. Several reasons for this phenomenon in teaching were related to the ability of the teacher to project a commanding voice, organize the classroom students and simultaneous activities, maintain an attractive physical and social appearance, and undertake the requirements for daily attendance. Recognizing these various teaching duties supports the label of "ringmaster"
as Locke (1975) indicated in his observation of the ecological setting of a gymnasium.

Moving beyond some of the routine duties of the classroom, Hay and Reid (1988) suggested that it is essential for physical education teachers to have knowledge of the anatomical and mechanical bases of human movement so that teachers might better prepare themselves professionally to become effective teachers. Additionally, physical education teachers are "repeatedly faced with the task of observing a performance and offering suggestions as to how that performance might be improved" (Hay & Reid, 1988, p. 243). As a result of multiple and immediate occurrences within the classroom setting, teachers were required to develop practices in which to be more proficient observers of actively engaged students despite the lack of time and resources available. Barrett (1983) indicated that "observing may be the teaching skill that others revolve around" (p. 29).

A term most widely associated with the study of human movement is kinesiology. In the classical and often-cited research data, Hoffman (1977) reported that through a kinesiological view of pedagogy, accurate interpretation of significant events occurring in the classroom requires a teacher to have a clear understanding of correct and incorrect components of a performance. Teachers who maintain knowledge of critical aspects of a skill can
increase their level of competency in their ability to analyze that skill. But what may be viewed as a "technical flaw" to some may just be a "harmless idiosyncracy in style" to another (Hoffman, 1977). Certainly, the question remains as to the consistency and effectiveness of any sport skill training program. If teachers are trained to interpret a variety of sport skills accurately and the training program is consistent in content and practice, why are students not reaping the rewards of this representation of professional preparation?

In support of Hoffman's (1971) kinesiological viewpoint, Hall (1995) maintained that biomechanical knowledge is required of those who analyze skill to detect any causes of error within a performance. Understanding the purpose of a skill, as well as maintaining the ability to relate the cause and effect of movements involved, further enhances future observational and analytical skills of the teacher. Gangstead and Beveridge (1984) suggested that in the process of analysis, correct and incorrect performances should be recognized so errors can be detected.

In addition to having knowledge of biomechanics, it is important that physical education teachers recognize differences and similarities in students. Teachers must be able to recognize students' various strengths and weaknesses, and that all students will vary in their ability to perform sport skills. Barrett (1983) supported the
contention that success is built upon what teachers know about movement principles and ultimately, how students perform their individual skills.

Accurate and continuous observation is a skill required for effective teaching and one that develops and enhances the environment for learning, thus fostering individual differences of students (Barrett, 1977). To recognize these differences, a teacher must be well aware of the skill being performed and recognize the multifarious variables present when analyzing the techniques of an individual or group of learners. As teachers present lesson material to their students, questions remain as to what and how material is being presented. Based upon quality presentation of lesson content, James and Dufek (1993) reported that teachers would be required to observe performances of individuals, assess their movement patterns in an expedient and accurate fashion, and then devise some form of constructive feedback for each learner. Teachers implementing this type of systematic and qualitative process can enhance the teaching/learning environment.

Qualitative analysis has been recognized as a subjective interpretation based on the observation and judgment of the observer (Knudson & Morrison, 1997). Just as coaches use qualitative analysis to evaluate athletic performances, teachers use qualitative analysis to evaluate student movement and sport skill performance, as well as a
standard for assigning grades (Knudson & Morrison, 1997). For example, a student who experiences difficulty in catching a thrown ball due to improper positioning of the hands may revert to repositioning the body to stop the ball. Based upon an accurate observation, a teacher might provide a feedback statement relative to the position of the fingers to point either up or down depending on the incoming flight of the ball. The analysis of the performance thus provides a qualitative and descriptive statement for application to subsequent trials by the student. In qualitative analysis, positioning of the hands may only be one factor contributing to the original performance.

Qualitative analysis provides teachers and coaches with a plethora of terms from which to extrapolate meaning. Terms often viewed as synonymous with qualitative analysis have included observation, systematic observation, diagnostic process, clinical diagnosis, skill analysis, and skill assessment. Because of this wide array of labeling, barriers have emerged for understanding and solidifying qualitative analysis. Consequently, qualitative analysis can be defined as the "systematic observation and introspective judgment of the quality of human movement for the purpose of providing the most appropriate remediation to improve performance" (Knudson & Morrison, 1996, p. 31).
Comprehensive Models for Qualitative Analysis

A variety of approaches to qualitative skill analysis exist in the study of human movement. The purpose of this section is to acclimate the reader with a few of the comprehensive and observational models within the subdisciplines of kinesiology, the study of human movement.

Barrett (1979) argued for the necessity of teachers and coaches to maintain an ability to observe and accurately perceive not only movement but also the environment. In a study involving junior physical education majors, subjects practiced observational strategies both as participants and nonparticipants and reflected on their progression toward becoming skillful observers. As a result, three "principles of observation" emerged: 1) the principle of analysis; 2) the principle of planning; and 3) the principle of positioning. For analysis, subjects made reference to the ability to select the critical features of a movement, thereby knowing what to specifically look for. Observation without planning resulted in missing more than was planned. Subjects agreed on a plan that included observing the entire group, as well as focusing on specific individuals. In response to positioning, subjects agreed that recognition of floor position directly influenced the ability to observe and that "being in the right place at the right time" improved observational strategies.
Proposing a hypothetical model for observation (Figure 2.1), Barrett (1983) suggested three basic components necessary for effective teaching. Initially, teachers must decide what to look for in a student's motor response. The ability to identify the critical features of a skill is eventually "critical to the outcome of the performance at a particular point in time" (p. 25). Second, planning how to observe involves careful selection of critical features, identification of appropriate floor positioning, and deciding on what, when, and duration of the observation. Third, importance of knowing what factors influence the ability to observe and avoiding distraction or diversion suggests the need for practice under different conditions.

Gangstead (1984) suggested the need for a training paradigm to reduce complexities for observational and diagnostic responsibilities of teachers and coaches. Use of the Conceptual Observational Model (Figure 2.2) focused a subject's attention on temporal and spatial aspects of a performance. Temporal aspects of a performance includes preparation, action, and follow-through of the movement. Spatial aspects of performance relates to the body components involved in the movement. Keen to the spatial aspect was emphasis in attending to movement from the hub (slowest moving part) and progressing outward to the motion of the extremities (fastest moving parts). Although practicality of the model may jeopardize time constraints
DECIDING WHAT TO OBSERVE

PLANNING HOW TO OBSERVE

Figure 2.1: Hypothetical Observation Model by Barrett (1983, p.23)
<table>
<thead>
<tr>
<th>Body Components</th>
<th>Temporal Phasing</th>
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<tbody>
<tr>
<td></td>
<td>Preparation</td>
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<td>Path of the Hub</td>
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<td>Body Weight</td>
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<td>Arm Action</td>
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<td>Impact/Release</td>
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Figure 2.2: Observational Model used by Gangstead (1984, p. 62)
within undergraduate training programs, Gangstead (1984) suggested that "utilization of the model under skill specific conditions enhances observational performance to a greater extent than a generic patterning approach" (p. 13).

McPherson (1990) proposed a comprehensive model (Figure 2.3) to a systematic approach of skill analysis for coaches that included four phases: 1) preobservation, 2) observation, 3) diagnosis, and 4) remediation. In the preobservation phase, a sound understanding of basic biomechanical concepts is required for identifying critical features of a skill prior to observing and analyzing. This stage rests on the ability of a coach to visually and mentally categorize components of a skill. A second stage to the preobservation phase is development of an observation plan. Observation must be systematic to be effective and attends to the questions of how, when, and where to observe. Designing observation relating to a specific task includes: 1) identifying the task and selecting relevant critical features of the skill; 2) determining scanning strategies for particular skills; 3) selecting the number of observations to determine characteristic consistency; and 4) selecting a position from which to gain a vantage point.

In the observation phase, coaches maintain a complete categorical movement breakdown of skills and a plan clearly specifying the how, when, and why of each selected critical feature. Recording observations can either be accomplished using
Figure 2.3: Systematic Approach to Skill Analysis by McPherson (1990)
stick figures or checklists, depending on the intent or requirements to be satisfied.

The third phase in developing analytic competency involves diagnosis, the ability to identify primary errors. Although the intent is to address the source of the problem, diagnosing secondary errors will help eliminate some of the symptoms. The starting point for identifying primary errors is in noting differences between an observed performance and the desired performance. Implementation of the final phase of remediation or skill correction ensues once primary errors are determined.

Pinheiro and Simon (1992) proposed a motor skill diagnostic model based on an information processing approach for qualitative analysis. Information processing emphasizes short- and long-term memory systems of the diagnostician, thus developing a schema for which new information can be applied. Pinheiro and Simon (1992) stated:

The diagnosticians' knowledge of a motor skill is evoked by the critical feature of a performance error that is recognized when seen in the athlete's behavior and that is compared to the performance standard stored in the diagnosticians' long-term memory (p. 293).

According to Pinheiro and Simon (1992), the motor skill diagnostic model includes three processes: a) cue acquisition, b) cue interpretation, and c) diagnostic decision. Cue acquisition is the result of the systematic
observation of a motor skill with a determination made between actual and ideal performance. Because motor skills are performed at a high rate of speed, focus must be "exclusively on cues that are critical for diagnosis" (Pinheiro & Simon, 1992, p. 296). Selection of cues immediately affects the remaining two diagnostic processes.

During the second stage of cue interpretation, inferences and evaluations culminate as a result of previously learned information stored in long-term memory. Differences in cue interpretation between novice and expert diagnosticians is a result of differing experiences in sport skills. As a result, there exists a direct link between cue interpretation and diagnostic accuracy.

In the third stage, a diagnostic decision results in identification of an error based on information converted from the first two stages of the diagnostic process. In summary, diagnostic accuracy depends largely on extensive content knowledge of a task performance and the ability to identify critical cues related to performance errors. Recognizing differences between actual and ideal performance can only be gained through extensive observational experiences and on-going application.

One of the first steps in the decision-making process is in determining what type of analysis to utilize for acquiring the intended results. James and Dufek (1993) indicated that most practitioners find qualitative
assessment more useful when providing feedback to students. The seven-step biomechanically-based assessment scheme incorporates a dual-function approach for actual analysis and a mechanism for the correction and reinforcement of the performance. The significance of this qualitative process is that it enables teachers and coaches to concentrate on correct performance as a prerequisite to correcting faults. The seven steps in observing movement are as follows:

1. Classify skills
2. Divide into phases
3. Evaluate each phase critically
4. Focus attention
5. Assess movement
6. Refine strengths
7. Correct weaknesses (James & Dufek, 1993, p.19)

The Ecological Task Analysis (ETA) approach presented by Balan and Davis (1993) provides an alternative to traditional approaches for teaching physical education using four basic steps. Based on the dynamic interaction between the task goal, environmental condition, and capacity of the learner, ETA is in sharp contrast to direct styles of teaching. Aside from providing strategies for individual instruction and providing students with choices, ETA increases teachers' observational opportunities. Teachers who utilize the ETA approach "are encouraged to be careful
observers and to compare changes in student performance outcomes with changes in movement patterns and in task conditions" (Balan & Davis, 1993, p. 55). When observing, teachers are recommended to make notations rather than verbal instruction where future intervention is necessary when students do not satisfy task dimensions. Qualitative analysis of the task, environment, and learner allows teachers to restate, emphasize, or modify the task goal. Once students understand the task goal, instruction and feedback should be specific, positive, or corrective.

Knudson and Morrison (1996) suggested that many of the subdisciplines of physical education play a fundamental role in the qualitative analysis of motor skills and are at the very foundation of the comprehensive, integrated model (Figure 2.4). The integrated model involves four major tasks of qualitative analysis: 1) preparation in identifying the critical features of the observed movement or skill; 2) systematic observation from vantage points behind and beside the performer; 3) evaluation/diagnosis for identifying the range or correctness, as well as strengths and weaknesses; and 4) intervention for providing feedback. Significant to the integrated model is the circular nature for providing continual learning and improvement, flexibility for moving from one task to another without disruption, and postponing intervention until additional information can be acquired from subsequent performances.
Figure 2.4: Comprehensive, Integrated Model by Knudson and Morrison (1996, p. 32)
Abendroth-Smith, Kras, and Strand (1996) introduced a method for developing observational skills through the use of biomechanics known as B-BOAT (biomechanically-based observation and analysis for teachers). The methodology aids physical education teachers in identifying and prioritizing the critical features of a skill, a component often lacking in teacher development (Abendroth-Smith et al., 1996). Rather than perusing the limited information on using knowledge for observation and analysis in biomechanics textbooks, teachers resort to the coaching literature for confirming critical features of a skill (Abendroth-Smith et al., 1996).

Replicated from a model developed by Hay and Reid (1988) as a tool for qualitative analysis, Abendroth-Smith et al., (1996) suggested that no more than three critical elements were included for each skill that is divided into three phases: pre-execution, execution, and post-execution. Using three critical elements for a specific skill can be advantageous in many ways: 1) existence of a logical division of critical elements according to skill level and degree of difficulty; 2) effortless and immediate visualization of the critical elements of a skill; and 3) elimination of expendable critical elements making the observation process easier.

Further suggestions for the model replicates the hub-to-extremity style of observation proposed by Gangstead and
Beveridge (1984) that indicated efficient movement when large body parts drive more detailed movements of the limbs. In support of the hub-to-extremity style, Abendroth et al., (1996) indicated "the major problems with a skill performance are related to the gross motor movements, so attending to fine motor movements first is an ineffective approach" (p. 22).

In light of the abundance of observational models of qualitative analysis in kinesiology, all share four commonalities conducive to any profession implementing a qualitative approach (Knudson & Morrison, 1997):

1. Good qualitative analysts are very knowledgeable about the movements and the performers.
2. Qualitative analysts use this knowledge to plan the observation of performance.
3. Qualitative analysts evaluate the strengths and weaknesses of performance and diagnose the steps needed for improvement.
4. Qualitative analysts provide intervention to improve performance (p. 25).

Just as terminology has created barriers and challenges in defining qualitative analysis, terminology has provided some confusion in defining the skill analysis process. As previously mentioned, Barrett's (1979) three "principles of observation" include deciding what to observe (analysis), planning how to observe (positioning), and knowing the

Training in Analysis and Diagnosis

The approach to skill analysis has been defined using a variety of components and terms, including observation, preobservation, evaluation, analysis, and visual analysis. Programmatic research at The Ohio State University has defined analysis as discrimination between correct and incorrect movements (Matanin, 1993; Rush, 1990; Williams, 1995). Additional research at The Ohio State University has defined analytic ability as correct identification of critical elements of a sport skill and indicating each element as either correct, incorrect, or missing (Halverson, 1986; Harari, 1986; Kniffin, 1985). Johnson (1990)
described analytic ability as "the teacher's competence in detecting performance errors, diagnosing learning difficulties, communicating information, and prescribing remedial activities for motor skill responses" (p. 12).

Separate from analysis is the ability to diagnose skill movements. Diagnosis has been defined as the process of identifying the cause of a discrepancy and determining which errors to intervene upon to improve learner performance (Hoffman, 1977, 1982). McPherson (1990) suggested that diagnosis is the ability to recognize differences between desired and actual performances, and to identify primary and secondary errors. Pinheiro and Simon (1992) defined diagnosis as recognizing a problematic performance and comparing it with a standard long-term memory performance based on previous experience and learning. Knudson and Morrison (1997) described diagnosis as critical scrutiny and judgment in differentiating a problem from its symptoms, with a focus on the single most important intervention.

Programmatic research at The Ohio State University addressed concerns related to diagnostic ability. Correctly specifying the cause of performance errors as diagnosis, Matanin (1995) and Rush (1990) concluded with analysis and diagnosis as two different tasks in the skill analysis process. Further suggestions indicated that errors must be identified initially to provide different results in the performance. Williams (1995) suggested diagnosis required
subjects to determine the first error of a sequenced movement (Rush, 1990). For the purpose of the present study, diagnosis is viewed as the process of identifying the cause of a discrepancy between correct and incorrect performance and determining which error to intervene upon to improve learner performance (Hoffman, 1982).

Competent instruction can determine whether a skill will be performed effectively. "Within the framework of a diagnostic-prescriptive teaching model, the importance of the ability of the teacher to analyze and evaluate motor performance is obvious" (Gangstead, 1982, p. 1). In a study to determine the effects of specific instruction guided by the use of an observational model, Gangstead (1982) reported that 40 undergraduate physical education majors displayed proficiency in analytical, diagnostic and perceptual performance as a result of experience gained through sport skill analysis instruction.

Bell, Barrett, and Allison (1985) examined the effects of a 15-minute observation made by 21 preservice teachers of a games lesson involving 4th-grade students. Void of having any previous experience in observation, the preservice teachers focused their attention on the students and the teacher 76% of the time. Only one teacher focused attention on the student and the lesson, and no teachers made a statement about the entire setting of teacher, student, and lesson. Concluding results indicated that observations of
preservice teachers need to be guided and clearly defined to enhance the observational techniques for critical elements of the intended performer and performance.

The significance of analysis has a direct relationship to the observation process imposed by teachers. As Haywood (1986) indicated, "the observation process requires a disciplined, systematic focus on the critical features of a skill pattern rather than the tendency to focus on the outcome or product of a skill" (p. 138-139). Teachers should consider the use of qualitative assessment when providing students with effective instruction and appropriate feedback. For example, instructing a student to extend the arm when throwing a ball has far more qualitative connotation to the feedback statement as opposed to instructing the student to throw the ball higher and with more force. As a result, the student is now able to synthesize the feedback with the process of the throw and begins to develop an understanding of the elements that support the outcome of the performance.

In the first of a series of studies by Morrison and Reeve (1986), effectiveness of videotape instruction was examined for teaching two groups of elementary education majors to analyze two categories of skills: 1) throwing, catching, and striking; and 2) a soccer instep kick. The third group was excluded from any instructional protocol. Upon viewing skill performances, subjects were asked to
indicate whether each performance was correct or incorrect and respond with a teaching cue to correct inappropriate performances. Morrison and Reeve (1986) concluded that subjects were unable to transfer knowledge from viewing soccer skills to the skills of throwing, catching, and striking. What may be specific to skill acquisition and development may also apply to the ability of the observer to analyze sport skills (Morrison & Reeve, 1986).

Morrison and Reeve (1988) tested the effectiveness of an instructional videotape for teaching undergraduates qualitative analysis of elementary students' movement skills. Subjects were classified into three groups: 1) elementary education majors, 2) double majors in elementary education and elementary physical education, and 3) undergraduates in a sports science group. Two experimental groups were shown the videotape, followed by a test tape containing different performances of throwing, catching, and striking. The first group viewed only correct examples, while the second group viewed both correct and incorrect examples. Results of the study were consistent with previous studies in qualitative skill analysis incorporating correct and incorrect examples (Beveridge & Gangstead, 1988; Gangstead, 1984; Gangstead & Beveridge, 1984; Morrison & Reeve, 1986) and further support the need for specific instruction in the skill analysis process.
Further investigation by Morrison and Reeve (1989) examined the effectiveness of videotape instruction of throwing, catching, and striking skills for 29 undergraduate physical education students. Critical features and sequence of the three skills were included in the instructional videotape. The Group Imbedded Figures test and a qualitative analysis test were used to measure subjects' perceptual style and analytic ability in a pre- and posttest. Subjects were assigned in one of two treatment groups: 1) good examples only, and 2) good and bad examples. Results indicated instruction assisted both groups, with the "good examples only" group demonstrating a slightly higher improvement rate. These results were contradictory to groups receiving both correct and incorrect examples (Gangstead, 1984; Gangstead & Beveridge, 1984; Hoffman & Armstrong, 1975) but similar to results from previous studies using qualitative skill analysis (Morrison & Reeve, 1986; 1988). Combining perceptual style and knowledge of content may be associated with the ability to analyze movement skills qualitatively (Morrison & Reeve, 1992).

To further support the effects of instruction, significance in analyzing skills is based upon teacher observation. Beveridge and Gangstead (1988) reported that being accurate in analytical judgments constitutes the effectiveness of teachers as feedback agents providing the ability to discriminate and retain images of a skill is
retained. The study included 31 experienced physical educators and 29 inexperienced preservice physical education majors who were administered the Utah Skills Analysis Test (USKAT) to assess both visual retention of performance and knowledge of correct motor patterns. Even though both groups demonstrated the ability to improve performance in qualitative skill analysis, results of the study indicated that: 1) undergraduates exhibited greater gain on analytical tasks more than their counterparts; 2) undergraduates appeared more responsive to specific instructional protocol; and 3) entry level performance may have influenced the impact of the protocol on skill analysis performance.

Training in visual discrimination and verbal identification of critical elements of sport skills was shown to have significant effects and further assisted prospective teachers in developing their analytic skill proficiency. Numerous studies in a programmatic line of research on skill analysis conducted at The Ohio State University provided various options by which sport skill performance can be analyzed.

Harari (1986) analyzed the relationships between subjects' knowledge of content, teaching knowledge, and practical knowledge of gymnastics and their ability to analyze performances of gymnastics skills. This non-experimental research was conducted without the application of a training program on skill analysis, unlike other
dissertations conducted at Ohio State. Volunteer subjects for the study included 18 elite gymnasts, 11 physical education inservice teachers from various levels, 14 physical education majors in their final methods course prior to student-teaching, 10 prospective physical education majors, and 6 individuals with competitive experience in gymnastics.

All subjects completed a gymnastics knowledge test that included terms, skill technique, principles and safety procedures, and rules and officiating; this was followed by a visual skill analysis test. Harari (1986) concluded that individuals with competitive backgrounds and knowledge of critical elements in gymnastics were more proficient and competent to analyze skills and discriminate between efficient and inefficient movement. Differences in the level of experience and familiarity of skills were in direct correlation with their ability to analyze, detect skill deficiencies, provide feedback, and suggest subsequent learning activities.

Halverson (1987) examined how peer tutoring can have an effect on the ability of undergraduates to perform and analyze sport skills effectively, and the relationship between the subjects' performance. Undergraduate students enrolled in a movement fundamental and basic gymnastics course were required to analyze "live" performances of their peers. Pictures of student skill performances were included
in the pre-test (20), maintenance test (20), and the probe (14). So that each subject could recognize the correct and incorrect critical elements of a skill, multiple baseline data were presented in the form of worksheets, direct instruction, peer tutoring, and performance practices.

Results of Halverson's (1987) study indicated that the peer tutoring program was effective when learning to identify critical elements both verbally and visually. The experimental group revealed a significant effect for both verbal and visual discrimination. Ability to identify critical elements in the control group showed very little difference, indicating that instruction of critical elements is crucial to learning sport skills. Subjects in peer tutoring skill analysis programs support this combination style of learning. A significant point in the study indicated that subjects were not initially concerned with analyzing skills upon entering the classroom. Subjects unfamiliar with skill analysis were ill-equipped with knowledge to identify critical elements.

Morton (1989) used a self-paced instructional program that featured the utilization of photograph and videotape interventions of skill performances in children ranging in age from three to five years. The purpose of the study was to investigate if the analytic skills of subjects would develop through training protocols of young children and generalize to an analysis of the same skills as performed by
subjects 15 years of age. Participants in the study were six prospective physical education majors, and upon completion of a profile, were trained to analyze four different movement patterns: a) place kick, b) standing long jump, c) running, and d) overarm throw.

Findings from Morton (1989) indicated improvement in subjects' analytic ability to identify critical elements upon receiving photographic and videotape intervention. Upon completion of the videotape intervention, criterion tests indicated the transfer of analytic proficiency to performances and an increase in error detection, resulting in successful generalization of analytic skills to older students.

In her skill analysis series that included the overarm throw (Morton, 1990) and striking (Morton, 1991), Morton ascertained that teachers must have the capacity to analyze skill performance systematically and accurately so that appropriate feedback can be given to students. As a result, Morton suggested that the study and application of critical elements of skills provide a way in which to enhance analysis technique. Teachers who recognize these critical elements play an instrumental role in determining the effectiveness and efficiency of future instruction for developing learner competency of sport skills.

Rush (1990) implemented graphic and video instructional protocols in an attempt to train 14 volunteers with an
interest in the areas of diving, swimming, and physical education. The purpose of the study was to investigate the effectiveness of these protocols on the analytic and diagnostic ability of novice subjects. Diagrams of four dives were included in the graphics package intended to teach and train subjects to discriminate critical performance elements. The video package, recorded in normal and slow-motion speed, was comprised of three sections to assist in the identification process of correct versus incorrect dives and to diagnose selected performances: a) critical element identification b) error identification, and c) diagnosis to determine correction of initial errors.

As one of the introductory studies at The Ohio State University for training subjects to diagnose performance, Rush (1990) indicated that while baseline performance levels were low and stable for critical performance elements and error discrimination, levels of improvement in diagnosis and proficiency occurred following graphics and video instruction. Individuals with diving experience maintained an advantage over those with no experience. Follow-up questionnaire data suggested that additional time was needed for diagnosis, a concern when teaching critical performance elements. Graphics and video training may share a common bond in the development of visual and verbal identification, a finding also supported by Morton (1989). A self-instructional training package would benefit preservice
teachers in developing and/or supplementing their ability to demonstrate analytic ability.

Wilkinson (1991) used a visual-discrimination training program in reporting the effectiveness of skill analysis training of preservice physical education majors in acquiring analytic proficiency for three basic volleyball skills. Subjects for the study were 18 undergraduates enrolled in a volleyball class designed for physical education majors. The videotape instructional package included the volleyball components of the forearm pass, the overhand serve, and the overhead pass viewed in stop-action, slow-motion, and normal speed. A multiple baseline across behaviors design was used to determine subjects' analytic ability to discriminate between correct and incorrect critical performance features used in each component.

Results of the study indicated subjects' ability to maintain analytic ability of the three volleyball skills following the visual-discrimination training program. A slight induction effect was noted at the conclusion of the forearm pass instructional component. Data from this study support findings of previous studies utilizing specialized training programs in skill analysis (Halverson, 1987; Kniffin, 1985; Wilkinson, 1986).

Wilkinson (1991) further suggested that "skill analysis might well be taught more efficiently by training preservice teachers to analyze sport skills that share common
performance features" (p. 191). In so doing, preservice teachers could learn to analyze multiple sport skills within a limited time frame.

In a study that included novice subjects, Johnson (1990) investigated skill analysis based upon the effectiveness of a performance principle training program, replicating methodologies developed by Kniffin (1985), Wilkinson (1986), and Morton (1989). Secondary in this study was examining generalizability of acquired behaviors to different performances of skills previously experienced and those skills not previously experienced in this study. The study involved 15 volunteer undergraduate physical education majors not having any previous courses related to skill analysis. Subjects analyzed 35 videotaped sport skill performances. They were tested based on content material and depending on the exam score, were either required to review the material or continue on to observe the videotape.

The study included a single subject multiple baseline design and programmed interventions of text-based and videotaped materials. Five performance principles were introduced in this study: (a) stretch-explode, (b) long level swing, (c) opposition, (d) trunk rotation, and (e) blocking. Despite the minimal amount of instructional time involved in the study, results indicated that visual discrimination and verbal identification improved through the training intervention.
Continuing on the line of performance principle training in skill analysis research, Matanin (1993) investigated the effectiveness of subjects' ability to analyze and diagnose various sport skills. Four performance principles commonly cited in similar research were used in this study: (a) magnitude of force, (b) point of application force, (c) direction of force, and (d) maintaining and regaining stability. Performance principle interventions and a multiple probe baseline across behaviors design were also included. Eight prospective physical education and recreation undergraduates not having any previous experience in skill analysis volunteered for the study which lasted over an eight-week period and included 20 training sessions.

Matanin (1993) concluded that success in skill analysis can be accomplished using a performance principle training approach. It is possible that preservice teachers can benefit in their ability to observe a skill effectively, formulate an analysis of that skill, and provide necessary feedback to the learner.

Using a multimedia performance principle training program, Williams (1995) investigated the analytic and diagnostic proficiencies of six undergraduate students enrolled in physical education classes on six throw-like skills: a) overhead softball throw, b) tennis smash, c) volleyball serve, d) football throw, e) basketball javelin throw, and f) modified javelin throw. Participants had not
experienced any courses in skill analysis, biomechanics, kinesiology, or physics-related classes. Two training sessions were conducted to familiarize the subjects with use of a computer and mouse, and with the multimedia capabilities of computer technology.

A multiple probe baseline design across behaviors and subjects was used to analyze the effects of the multimedia package with subjects attending 16 sessions over a 6-week period. Multimedia included the use of videotaped student performances transferred to laserdisc to be used on a computer and displayed on a television monitor. Use of multimedia provided the opportunity to integrate video, text, graphics, animation, and test score tracking capabilities (Williams, 1995).

Four performance principles determined to be directly related to unique properties of all forces (Kreigbaum & Barthels, 1985) were selected for the study: 1) magnitude of force, 2) point of application of force, 3) horizontal direction of force, and 4) vertical direction of force. Subjects were required to discriminate between correct and incorrect throwing movements, analyze which performance principle was most deficient, and diagnose the phase of the throwing performance that contained the initial error. Williams (1995) concluded that intervention managed to improve subjects' analytic and diagnostic ability of multiple sport skills although concern for addressing
Subjects' diagnostic ability involves more than incorporating diagnostic content into training and suggested the following:

Examining a motor skill movement in terms of a sequential chain of smaller movements (critical elements), and directly training subjects to discriminate between acceptable and unacceptable form in each of the successive phases of the movement from early preparation phases to follow through phases, may result in greater gains in diagnostic proficiency (p. 164-165).

Research in training in analysis and diagnosis at The Ohio State University has provided favorable results in both the critical element approach and the performance principle approach. Subjects were able to demonstrate improved performance for various sport skills using a variety of instructional methodologies. Additional research has supported the use of videotape instruction for developing analytic skill proficiency.

Eckrich, Widule, Shrader, and Maver (1994) examined the effects that video observation training had on the analytic proficiency of 23 physical education and movement/sport science majors. Observations included live and videotaped performances of elementary students in grades kindergarten through three batting a ball off a stationary tee. Each of the batting performances were matched with a particular
question related to the performance. Live batting performances were observed during an actual lesson. The researchers concluded that effectiveness in observation skills improved with the use of video performance but was not significant when observing live demonstrations which did not include training. It was further suggested that use of live demonstrations and more realistic environmental settings be considered when training preservice teachers.

Wilkinson (1996) examined the effects of a visual-discrimination training program on participants' ability to analyze overarm throwing performances and the extent to which transfer of learning occurred in three untreated related skills (the badminton overhand clear, a tennis serve, and the volleyball serve) and one untreated unrelated skill (the standing long jump). Twenty-six undergraduate physical education majors were designated to either the control group or the experimental group, where participants were required to visually discriminate between correct and incorrect overarm throwing performances. Six critical components were determined by the researcher for the overarm throwing pattern. Results of the study were similar to previous research data for improving undergraduates' analytic ability of motor skills. Training group participants demonstrated significantly higher analytic ability for the overarm throw and throw-related skills compared to the control group. Prior to training,
participants were unable to recognize even the most obvious performance errors.

As an initial attempt for discovering a time efficient procedure of incorporating qualitative skill analysis training into the professional development of physical educators, Wilkinson (1996) sought to examine a transfer of learning to untreated skills. No significant differences in analyzing errors were prominent between groups for the unrelated skill, the standing long jump. Weak transfer of learning associated with the standing long jump suggests that analysis of overarm performances does not support analysis of skills unrelated to the general movement pattern. As a result, Wilkinson (1996) indicated that "skill-specific intervention techniques can be extended to a general movement approach that emphasizes the critical components of skill-related movements" (p. 76).

Effectiveness of Feedback

Several factors account for many complications involved with and affecting the efficiency of analytic skills of teachers. In considering that one of the most common strategies employed by teachers for analyzing skill is through visual observation, the question of how much teachers see and when they see it affects their ability when providing a response to their students. Difficulty in analyzing a skill has a strong connection with the amount of
time a teacher has to witness the skill. This process is further compounded as teachers are compelled to give immediate and precise feedback, based on their content knowledge, in a matter of seconds to students who perform a skill. Consequently, the type of feedback and how it is delivered are important factors to a student's initial skill development (Boyce, Markos, Jenkins, & Loftus, 1996).

In research for improving the use of feedback and the efficacy of classroom instruction, Van Houten (1984) suggested the importance of feedback as both a reinforcer for a previous behavior and as a discriminative stimulus for the behavior it precedes. Despite the significance of feedback, the use of feedback by teachers is minimal, and when used, is not specific and effective (Van Houten, 1984).

Prerequisite to the application of feedback requires a teacher to recognize two important stages of the learning process: acquisition and practice of a skill. Application of teacher feedback depends largely on the stage at which a student is functioning. Van Houten (1984) proposed nine rules governing the proper use of feedback.

1. Teachers should provide immediate feedback as new skills are learned. Avoiding the delay of feedback prevents students from practice mistakes and the onset of learning poor habits that are often difficult to replace.

2. Provide precise feedback to enhance modest improvements in performance, thereby acknowledging increased
effort for larger improvements in the future. Furthermore, precise feedback should be quantitative, enabling students to see improvement in small increments. Precision continues to strengthen behaviors and improve proficiency when success is magnified.

(3) Challenge students by giving them shorter time segments during the practice phase of a learned skill. Once competency is achieved, extend the time interval. Consequently, students will not become frustrated with difficult skills for long periods of time.

(4) Provide feedback that is differential, placing emphasis on improvement of a learned task as opposed to an absolute level of performance. Students performing at varying levels are furnished opportunities to develop at their own level of competence and experience success at improving their individual scores. In general, prompting a correct performance becomes more efficient than singling out performance mistakes.

(5) Allow students access to either self-score their performance or collaborate with a peer for generating their own feedback. Teachers who provide adequate instruction on scoring hold students accountable for self-scoring and often produce higher scoring accuracy rates.

(6) Publicly posting individual and group performance results allows all students to check their achievements, as well as their contribution to overall class results. Not
only do students distinguish between their own and the efforts and accomplishments of others but recognize the importance in the development of overall team performance.

(7) As students begin to acquire and develop skills, the use of qualitative praise statements is necessary. Appropriate timing for providing individual and group feedback is essential, with a suggested time just prior to beginning a task. Descriptive praise statements by the teacher provides students with more exact information relative to a specific component of their performance.

(8) Encourage peer interaction to increase the probability of peers providing commentary on their performance, as well as the performance of others. Multiple interactions increases the frequency of comments between students and their peers related to academic performance. Further multiplication of frequency can occur when teachers acknowledge and intensify student comments.

(9) Combine the use of performance feedback with instruction for the intended behavior. Students who receive the combined effect of the two methods show superior results in contrast to performance feedback alone.

While the performance feedback system produces changes in students at varying achievement levels, the largest changes have been demonstrated by students who initially perform at the bottom of the class (Van Houten, 1984). Using the performance feedback system enhances the
teaching/learning environment and stimulates self-competition among students which leads to greater personal challenges and acts as a reinforcer for future performances.

Feedback relative to sport skill performance has been represented by such terminology as remediation (Knudson & Morrison, 1996; McPherson, 1990) and intervention (Knudson & Morrison, 1997). Two modes of feedback, intrinsic and extrinsic, are common to the majority of motor skills. Extrinsic, or augmented feedback, is the most predominant form of feedback used by teachers. Fishman and Tobey (1978) defined augmented feedback as a "teaching behavior dependent upon the motor response of one or more students and intended to provide information related to the acquisition or performance of a motor skill" (p. 52). Physical education teachers experience multiple opportunities to provide augmented feedback because motor skills are highly visible in the gymnasium.

Further classification of feedback in motor learning literature has identified feedback as knowledge of performance (KP) and knowledge of results (KR). Knowledge of performance (KP) information, usually augmented (Siedentop, Herkowitz, & Rink, 1984), yields beneficial suggestions to the student about movement processes. Knowledge of performance (KP) "provides physical educators and coaches with a vehicle to correct movement patterns and
enhance motor skill performance and learning" (Boyce, 1991, p. 54-55).

Knowledge of results (KR) information, plentiful in the majority of physical education skills, provides comments relative to the movement outcome (Boyce, 1991). Oslin (1990) noted that "knowledge of results (KR) has been hypothesized as being most appropriate for skills performed in open environments, whereas KP has been suggested for skills executed in closed environments" (p. 41). Frequent use of augmented feedback is not only invaluable but is recognized as an influential variable for teaching movement skills (Fishman & Tobey, 1978). Teachers incorporating augmented feedback in their lessons "help a learner repeat correct actions and movement, eliminate incorrect actions, and attain desired skills" (Tobey, 1992, p. 19).

Creating a positive and favorable atmosphere for students embellishes the potency of feedback statements. The use of positive as well as corrective feedback statements containing specific information and value to the skill magnifies a favorable atmosphere where learning physical education skills is apt to occur (Siedentop, 1976). In the physical education teaching environment, Siedentop (1979) suggested that 50 to 70 percent of feedback statements verbalized should contain specific information related to the skill. Once feedback elicits a desired response, the use of verbal prompts begin to shape students'
responses during activity (Ormond, 1992). Students who receive feedback in this manner not only begin to understand key components of the skill but are provided with verbal cues they themselves can deliver to their peers (Siedentop, 1979; Van Houten, 1984). In this reciprocal process, a teacher fulfills the role of feedback agent while simultaneously providing the opportunity for students to develop their own communication skills when developing their motor skills.

Feedback is most effective when it coincides with the instructional intent of a lesson and the moment of demonstrated performance (Siedentop, 1979). Tobey (1992) suggested "the moment you 'catch a student doing something good' is the best time to offer specific, immediate, and positive feedback" (p. 19). Aside from the immediacy of the feedback response, providing corrective feedback is a vital factor in motor skill learning, and one of the tasks physical education instructors must implement in order for students to develop competence in their performance (Nielson & Beauchamp, 1992; Ormond, 1992).

Although providing immediate feedback for prevention of practice mistakes is vital (Siedentop, 1979; Sidentop, Herkowitz, & Rink, 1984; Tobey, 1992; Van Houten, 1984), feedback may not always be a provider for developing positive skill performances in the learner. Learners act and react in various ways when responding to teacher
feedback. In a review of feedback literature, Magill (1994) suggested the existence of four different relationships with regard to augmented feedback and skill learning, having both positive and negative influences on skill performance. First, augmented feedback is necessary for skill learning to occur. For learners who lack prior knowledge for assimilating the process and product of a skill performance, essential augmented feedback from the teacher is required so students can properly demonstrate a sport skill performance. Feedback must also be provided when learners attempt skills where essential sensory feedback is undetectable. When learners encounter difficulty in comprehending skills, teacher feedback is warranted.

Second, augmented feedback is not necessary for skill learning to occur when the environment or non-feedback related source provide information relative to the skill. In this manner, learners assess information directly from the task. Learners also develop their skills when observation of a skilled performance is modeled, thus establishing a memory-based reference for comparing performances. In both situations, "an external referent is available that enables the performer to determine the correctness of an action" (Magill, 1994, p. 320).

A third relationship between augmented feedback and skill learning indicates that learners who receive augmented feedback can attain skills at a faster rate and at a higher
level of performance. Although augmented feedback does not always have the same effect on skill learning, information that is passed on to the learner must provide a basis on which to change some response characteristic to allow for improvement in future performances. Once initial skill improvement becomes apparent, learners receiving additional augmented feedback continue to develop at an accelerated rate.

Finally, Magill (1994) indicated that use of augmented feedback can impede skill learning. Some learners develop a dependency on augmented feedback and consequently, fail to perform sport skills accordingly when feedback is either withdrawn or is not available given a different environment or time frame. Dependency on teacher augmented feedback also occurs when task-intrinsic sensory feedback goes unrecognized by the learner. Negative effects on skill learning have also been the result of erroneous feedback, whereupon the learner develops incorrect techniques based on inaccurate augmented feedback.

According to Magill (1994), feedback provisions can be addressed by evaluating the intended skill, characteristics of the skill, and the meaningfulness of augmented feedback. Consequently, teachers evaluating their own teaching effectiveness should consider more than the frequency of response. Recognizing the importance of the appropriateness of feedback, the individual learning the skill, and the
learning environment are necessary factors to appraise when using feedback (Magill, 1994).

Careful examination on the role of feedback in instructional settings has guided researchers and teachers toward a better understanding of how feedback affects the learning process. Despite previously stated contradictions in the literature, the following studies have demonstrated a direct correlation between the use of teacher feedback and enhanced student motor skill acquisition.

Imwold and Hoffman (1983) asserted that one of the most important yet least investigated operations in motor skill instruction is the ability to give corrective feedback through the accuracy of observation of a learner's response. In comparing three groups of subjects labeled as generalists (physical education teachers), specialists, (gymnastic coaches), and novices (undergraduates) having varying degrees of expertise and competitive experience, Imwold and Hoffman (1983) confirmed previous studies indicating that experience and familiarity of a skill enhances the ability to analyze performance. Teaching and/or coaching experience demonstrates the likelihood that developing and maintaining an array of task-specific knowledge over a period of time produces effective teacher feedback. Of particular interest in this study was the fact that generalists performed almost equal to that of novices.
Petrakis (1987) investigated novice and expert dance teachers and their ability to view a live performance of a dance composition. Using cinematography with the NAC Eye Mark Recorder that focused on the duration and location of eye fixations, Petrakis was able to detect eye movements during the teachers' observation of the performance. Upon observation, five novice and four expert teachers were instructed to provide feedback with the intent to critique a dance performance. Even though scanning patterns of the teachers varied as a result of their experience, it was concluded that various movements or tasks being observed can influence the number and duration of each eye fixation without regard to the level of expertise. It is a matter of what segment of the skill you are observing that indicates how effective your analysis will be.

Rikard (1991) explored differences in practice success of low and high-skilled students resulting from varied instructional tasks, and the likelihood that practice success would occur before and after teacher feedback was provided. Two experienced physical education teachers were observed throughout a 4-5 lesson unit on striking skills for fourth graders. The intent of instruction was for students to continuously strike a ball by the end of the unit. Data were collected through a multistep analytic process which included coding and video recording teacher instructional tasks, student motor-skill responses before and after
feedback, and teacher feedback. Instructional tasks were cataloged as informing, extending, refining, or applying. Motor-skill responses were coded successful when subjects practiced according to criteria and unsuccessful when not a result of the teacher's stated expectation. Teacher feedback was defined as "an event in which the teacher monitors a single student or group of students and gives information on performance" (p. 277).

Findings of the Rikard (1991) study indicated teacher feedback was presented in two distinct constructs: 1) individual, specific, and corrective; and 2) individual, specific, and evaluative. Low-skilled students were recipients of more individual, specific, and corrective feedback statements, demonstrating an increase in practice success as a result. High-skilled students received more individual, specific, and evaluative feedback, demonstrated by a decrease in overall practice success. Both groups maintained a comparable high percentage of response success prior to feedback being provided. Increase in low-skilled students performance after feedback may have been attributed to close teacher monitoring, more opportunities to practice, and twice the number of feedback episodes received. Decreases in high-skilled student performance may have been a result of initial practice success, an absence of application tasks, fewer practice attempts following feedback, and teacher expectations to self-correct.
Implications of the Rikard (1991) study recommended expansion of subject unit content and providing feedback in initial tasks to accommodate low-skilled students, in addition to providing more complex refining tasks and application tasks to challenge high-skilled students. Rikard (1991) further suggested that content development requires the use of refinement tasks due to the importance "to emphasize mechanical aspects of skills so that students know the expectations for performance standards" (p. 283).

In a follow-up study addressing the relationship of task refinement and feedback to students' practice success, Rikard (1992) compared differences in practice success when teachers used refining, extending, and applying tasks. Two experienced elementary physical education teachers were observed throughout a 6-7 lesson unit on striking skills using paddles. The focus group consisted of fourth-grade students from two different schools, selecting two students from a low-skilled group and two from a high-skilled group. In summary, Rikard (1992) reported the four low-skilled subjects experienced similar success rates regardless of tasks or feedback, but elevated practice success with feedback after a refining task. High-skilled subjects demonstrated similar success rates regardless of the teaching condition. Overall, teacher feedback was presented as immediate, specific, and corrective at a rate of 94%, a significant factor for subject skill acquisition. Subjects
receiving the lowest amount of feedback performed at lower levels, whereas subjects receiving the highest amount of feedback performed consistently at high levels. Significant to practice success was the amount of practice time afforded to subjects. A pivotal factor observed in low-skilled subjects was their lack of appropriate practice, thus affecting practice opportunities and resulting in a negative effect on achievement.

Patterns of feedback have a tendency to differ with regard to familiarity of an observable skill. In their investigation to examine whether feedback patterns differed when subjects observed a novel skill or one familiar to them, Nielson and Beauchamp (1992) described how preservice teachers displayed feedback provision patterns when involved in a generic conceptual movement analysis training program. The study involved 48 students majoring in secondary-school physical education not having any previous formal teaching experience and enrolled in a required conceptually-based course on movement analysis. The course objective was to provide generic knowledge and experience for observation, analysis, and feedback provision demands of multiple skills and activities for future physical education teachers. The course spanned 12 weeks and included a 45-minute training session three times per week.

Results of the Nielson and Beauchamp (1992) study supported the importance and use of conceptual movement-
analysis training in development of feedback-provision of preservice teachers. Regardless of students' capacity to perform at a certain level, the training program was beneficial and increased teachers' ability to give feedback that was precise and directly related to the skill. Changes in feedback patterns for novel skills were more spectacular than for more familiar skills, indicating improvement in subjects' ability to provide and communicate information about movement. Benefits of the training program were associated with subjects' level of achievement, as well as learning demonstrated during the training course. The high achievement group entered the training better prepared to provide corrective feedback and coincidentally exhibited better feedback patterns and received better grades in the training course. Finally, effects of such training can be generalized to novel skills that teachers may be required to teach as part of the curriculum. These findings support similar results indicating that differences in performance experience (Armstrong, 1986) do not necessarily relate to one's ability to analyze movement and provide appropriate feedback.

Smith, Kerr, and Meek (1993) examined the use of clinical supervision techniques in a natural teaching environment to determine whether this technique could be implemented to increase levels of performance feedback and motivational feedback given by a physical education teacher.
to students. The single subject research design utilized one male physical education teacher who was regarded as an excellent and progressive physical educator. The teacher was observed in 10 consecutive lessons during one week of the summer term that included swimming, track, and rounders activities. The major goal of the physical education teacher was to enhance the physical skill level of his pupils. Teaching behaviors targeted for intervention were systematically observed using a modified form of one section of the Physical Education Teacher Assessment Instrument (PETAI) (Phillips, Carlisle, Steffen, & Stroot, 1986).

Results of Smith et al., (1993) indicated intervention effect produced an instantaneous increase in the rate of feedback. Three factors supported the effectiveness of intervention: 1) a dramatic increase in performance feedback was evident, while a minor increase in motivational feedback occurred; 2) a marked increase in the rate of behavior for motivational feedback once intervention was introduced; and 3) close relationship of two teaching behaviors produced a positive effect on the subjects' attention to focus on motivational feedback.

Smith et al., (1993) suggested that clinical supervision may be a feasible method for improving teaching behaviors. While this study utilized an experienced teacher, the authors suggested that "knowledge of results" intervention may not produce similar results as
inexperienced teachers may require additional descriptions of action to produce certain levels of feedback performance and advice on improving behaviors.

Stroot and Oslin (1993) examined the proficiency of preservice teachers using component-specific feedback statements to enhance motor performances of overhand throwing for elementary age children. During a clinical field experience, three preservice teachers were observed and coded using the sport skill process variable assessment (SSPVA) instrument that included feedback codes and overhand throwing components. Preservice teacher information was presented in five categories: 1) verbal feedback, 2) cueing, 3) modeling, 4) praising, and 5) manual manipulation. Data analysis presented three major patterns of instructional feedback statements: 1) skills performed at a high level of efficiency continued to receive component-specific feedback; 2) skill components not demonstrated at high levels received minimal or no feedback; and 3) recognition of low and intermediate component efficiency resulted in improved throwing performance. Although preservice teachers maintained declarative knowledge of throwing components, inability to accurately assess performance led to limitations for providing appropriate feedback. These results further suggest the significance of content knowledge, observational technique, and analytic ability when providing appropriate and specific feedback.
Pellett and Harrison (1995) examined immediate effects of practice success of low and high-skilled students in response to a teacher's specific, congruent, and corrective feedback for extending, refining, and applying tasks. Participants included 68 female seventh and eighth-grade students engaged in an 11-day volleyball unit involving instruction for the forearm pass, set, and underhand serve. Instruction for the unit was presented by one physical education specialist who participated in a 4-hour intervention which included review for providing appropriate feedback and planning standardized lessons to represent equal lesson content and practice opportunities. Each lesson was videotaped and required the teacher to wear a wireless microphone for recording instructional tasks and feedback responses. Particular emphasis was directed to the point at which students received feedback before and after practice response.

Results of skills test scores indicated both groups of students demonstrated significant improvement from pre-test to posttest, with low-skilled students' mean scores significantly lower than high-skilled students for all skills. While overall practice success was evident for all three skills, no significant increase was noted during extending tasks for the set nor during any task for the serve. Facilitation of immediate practice success was supported by teacher feedback that was specific, congruent,
and corrective for extending, refining, and application tasks. The present results contradict the findings of Rikard (1991) in that students were able to apply teacher feedback in relation to specific mechanics of a skill. In response to the Rikard (1991) study, Pellett and Harrison (1995) reported the teacher provided feedback when performance success was low, regardless of ability level. Furthermore, performance success may have been a result of the teacher who "was adept at analyzing those in her class who needed help and in providing information that was meaningful to them at the moment" (p. 61).

Bram and Feltz (1995) investigated effects of differing batting statistical feedback on the batting efficiency, batting performance, enjoyment, satisfaction, and persistence of young baseball players ranging in age from 10 to 12 years. The sample group, approximately 95% boys and 5% girls, were randomly assigned to three conditions of feedback. The first group received feedback on contact average which included cumulative times at bat, number of times making contact, and contact average, in addition to the corresponding information for the game prior to the one just played. The second group received feedback relative to batting average which included times at bat, base hits, and batting average for the game prior to the one just played, as well as for the season. The third group in the study received no feedback.
Upon collecting baseline measures as an additional basis for judging batting ability of participants, the experiment commenced with the second game of the season through the tenth game. The original intent of the researchers was to present feedback cards to participants prior to the next game but coaches objected to this procedure indicating it would disrupt pregame preparation. After completion of a game, researcher assistants computed and recorded statistics on a performance index card, returned cards in a sealed envelope to the coach, who then forwarded the information to the players. This procedure occurred for games three through ten for all teams except for one team in the batting average feedback group, citing player discouragement upon receiving feedback information.

Bram and Feltz (1995) concluded that correlations between measures of batting performance and efficacy had a tendency to be stronger for the group receiving contact average feedback, and furthermore suggested that contact average may be a less ambiguous mode of feedback compared to batting average. In addition, participants who increased batting efficacy over the course of the season were most likely to come from the contact average feedback group. Participants who decreased in batting efficacy were most likely to come from the batting average feedback group.

Several limitations in the study were noted as possible contributors for adequately testing the hypotheses.
Participants were not provided with feedback immediately after a completed game or prior to the subsequent game. Feedback was provided privately to all participants on index cards in place of the typical one-sheet handout including all members, thereby diminishing feedback in terms of its natural social-comparison component.

Feedback delivery systems have a significant bearing on student performance. Boyce et al., (1996) examined the impact of three feedback methods for skill development: 1) feedback delivered by teachers; 2) feedback delivered by peers; and 3) feedback through videotaped performances. Subjects in the study included 51 third-graders in a 3-day skill development unit on the basketball overhand pass and 53 fifth-graders on the forehand strike. All students were pre- and posttested on their skills prior to and after the instructional unit using a qualitative component checklist. Three classes for each grade level were randomly assigned to one of the three feedback methods.

Results of the three methods of feedback indicated teacher feedback to be the most effective source for improvement on the overhand pass for third-graders and videotaped feedback for fifth-graders on the forehand strike. The researchers concluded that teachers should provide feedback on few skill components at a time to avoid confusion for students in the pre-stage of skill acquisition. Teachers may also find it helpful to question
student performance relative to skill components. When using videotape analysis, students' attention should be directed to simple yet specific components, followed by teacher questioning to elicit student response. Although peer feedback was effective for older students, peer dialogue should remain minimal and informal in content, and without the use of scoring checklists so as to deter animosity and defensive behavior between peers. Overall, all three methods of feedback were effective as students demonstrated continued improvement throughout the three-day instructional unit.

Occasionally, complex and unstructured environmental circumstances affect the manner in which teachers provide feedback to their students. To answer which perceptual cues are responsible for precipitating augmented feedback responses in teachers, Tan (1996) provided a descriptive analysis of augmented feedback patterns and perceptual maps of five experienced and five inexperienced physical education teachers. All teachers were free to choose lesson content with required objectives for increasing motor skill performance of students in three 25-minute lessons. Videotaped observations recorded all verbal interactions and were coded quantitatively and qualitatively using a modified version of the Fishman and Tobey (1978) augmented feedback observation system. Feedback was coded according to content, direction, intent, focus, and type. Modifications
in the observational system for the present study included the addition of a content category, nonspecified category in focus, and adding an other subcategory to intent.

Provisions for dimension of feedback for experienced and inexperienced teachers were classified into five categories. Feedback performance was measured according to: a) total occurrences; b) intervention rate; c) corrective feedback; d) evaluation feedback; and e) affective feedback. Results of the Tan (1996) study indicated no significant difference between the two groups for occurrences and intervention rates, nor in content, direction, or focus. Experienced teachers directed more evaluative feedback toward individual students, whereas inexperienced teachers directed more corrective than evaluative feedback based primarily on past performances. Experienced teachers demonstrated a greater awareness of relevant stimuli within the teaching environment, as well as advanced and organized perceptual maps described as "an elaborate network containing clusters of related information hierarchically organized" (Tan, 1997, p. 166).

Continuing the research to probe the efficacy of component-specific instruction (CSI), Oslin, Stroot, and Siedentop (1997) tested the instructional proficiency of an experienced physical education teacher on five components of the overhand throw. Force-production sequence (FPS) and forward-chaining sequence (FCS) were included in the testing
as well. Instruction for FPS and FCS consisted of three applications of component-specific feedback: 1) augmented feedback, 2) corrective feedback, and 3) manual guidance. Results supported the effectiveness of CSI as subjects in FPS and FCS groups generally demonstrated improvement in overhand throwing. Using critical components for developing sport skills appears to have significant effects. The question remains as to the number of critical components teachers should use to deliver effective instruction.

In a study directly comparing teacher and student expectations and perceptions of task difficulty and performance, and perceptions of student performance and teacher feedback, Tjeerdsma (1997) conducted stimulated recall interviews to examine the degree of congruency between explanation and practice of motor skill tasks and skill-related feedback by the teacher. Subjects included eight 6th-grade students (4 females and 4 males), selecting one male and one female to represent each group classified as high ability-high motivation, low ability-high motivation, high ability-low motivation, and low ability-low motivation. One male inservice teacher considered to be an effective teacher with six years experience was included.

All subjects were videotaped during a 14-lesson volleyball unit on the overhead pass and forearm pass. The instructional climate was considered to be positive, businesslike, and task-oriented. Throughout the unit, the
teacher focused on specific skill development and provided students with high levels of positive feedback.

Following the initial videotape procedures, student subjects then viewed a videotape that included four task presentations and four clips when receiving skill-related feedback from the teacher. Based on the observation, stimulated-recall interviews consisted of closed and open-ended questions related to: a) task difficulty and performance; b) perceptions of actual task difficulty, performance, and effort; and c) affective reaction to skill-related feedback. Feedback responses were categorized in the following manner: 1) for improvement of performance; 2) to reinforce correct performance in a positive manner; and 3) for motivation and encouragement.

Results of the Tjeerdsma (1997) study reported high agreement on performance expectation with teacher expectations and perceptions for tasks much harder than the students. Teacher expectations relied on knowledge of student ability levels and motivation or effort when performing the tasks. Overwhelmingly, student and teacher perspectives of feedback revealed a direct link for improving student performance, followed by the need to positively reinforce correct performance. Students indicated that motivation and encouragement was one of the purposes for teacher feedback. The use of feedback also resulted in increased effort and positive feelings for the
student. Although similarities between students and teacher exist in relation to the purpose of and feelings produced by feedback, little is known about feedback and mediating student performance due to teacher promotion of a positive instructional climate.

**Summary**

The ability to analyze, diagnose, and provide feedback are considered to be essential and significant fundamentals for effective teaching. Physical education teachers play a pivotal role in improving student performance when students are engaged in motor skills. Necessitating the need to develop competent and effective teachers, Hoffman's (1977) classical study suggested provisions for training preservice teachers in the analytic process. Aside from emphasis on observational training and accurate interpretation, the need for developing effective modes of communication is warranted (Hoffman, 1977). Furthermore, ensuring the use of qualitative criteria would enable teachers to provide quality feedback statements to improve student learning and performance (Hoffman, 1977; James & Dufek, 1993; Knudson & Morrison, 1997; Ormond, 1992; Tobey, 1992).

Various approaches to qualitative analysis of sport skill performance have been suggested. Systematic and comprehensive models have emphasized distinct observational procedures (Barrett, 1983; Gangstead, 1984; Knudson &
Morrison, 1996; McPherson, 1990). Temporal and spatial aspects of performance suggested a focus on particular skills and movements of body parts (Abendroth-Smith et al., 1996; Beveridge & Gangstead, 1984; Gangstead, 1984). Information processing required the development of a schema based on performance cues (Pinheiro & Simon, 1992). In all cases, the ability for teachers to envision a "correct performance" and maintain a systematic observational plan is necessitated throughout the analytical process.

Past research has indicated the positive effects training has had on subjects' ability to analyze and diagnose sport skill performance (Bell et al., 1985; Beveridge & Gangstead, 1988; Gangstead, 1984; Gangstead & Beveridge, 1984; Morrison & Reeve, 1986, 1988, 1989). Programmatic research at The Ohio State University demonstrated that training in analysis and diagnosis was not only beneficial but that the two were recognized as separate instructional constituents (Halverson, 1987; Harari, 1986; Johnson, 1990; Kniffin, 1985; Matanin, 1993; Morton, 1989; Rush, 1990; Wilkinson, 1991; Williams, 1995).

Subsequent to analyzing and diagnosing sport skill performance is the necessity of providing feedback to develop and improve student performance (Boyce, 1991; Boyce et al., 1996; Lee et al., 1993; Siedentop et al., 1984). Although feedback may not be appropriate under certain conditions (Magill, 1994), research has indicated that
feedback should be positive, corrective, and immediate (Bram & Feltz, 1995; Nielson & Beauchamp, 1992; Oslin et al., 1997; Pellett & Harrison, 1995; Rikard, 1991, 1992; Siedentop, 1979; Siedentop et al., 1984; Tobey, 1992; Van Houten, 1984). The need for various training procedures for developing and enhancing teachers' visual and verbal competencies in the teaching environment is essential.
Chapter 3 will be divided into three major sections. Section one will describe two major components of the study: subject selection and selection of the critical elements. Section two will describe instrumentation and related procedures of the study that include: selection and construction of videotape performances, critical element training package, construction of the training videotape, implementation of the training videotape, and accuracy check for the instructional videotape. Section three will describe research methodology and include the following: independent variable, dependent variable, research design, data collection, and data analysis.

**Major Components of the Study**

**Subject Selection**

The selection of subjects for this study focused on one target group. Four inservice teachers were selected by the researcher as subjects from a composite list of physical education specialists from elementary schools in Franklin County. All subjects were required to have a minimum of
three years teaching experience at the elementary level. Final selection of subjects was established by the researcher based on teacher availability, with consideration to class schedules and other out-of-school commitments.

Subjects were reminded their participation was voluntary and were able to withdraw at any point in the study. Participation and completion of the study resulted in receiving three graduate credit hours of Independent Study (PAES 893). A grade of "S" (satisfactory) was awarded to each subject based on completion of the study; failure for subjects to complete the study resulted in a grade of "U" (unsatisfactory). All subjects successfully completed the study.

All subjects were required to complete a consent form developed by the Human Subjects committee at The Ohio State University (Protocol No. 95B0001) (see Appendix A). Completion of additional forms required by the researcher included a contract describing the terms of the study (see Appendix B), and a personal history profile (see Table 3.1) regarding information of previous experiences in teaching and coaching, skill analysis, and educational background (see Appendix C).

Second-grade students considered to be of low, medium, and high-skilled ability from two elementary schools in central Ohio were videotaped to create the master tape for this study. Elementary school selection corresponded with
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Key: U - Undergraduate Course  
G - Graduate Course

Table 3.1: Subject Profile

the teaching of a manipulative skills unit and consent of the physical education teacher and school principal. After an initial meeting with the principal of the first school selected, a confirmation letter (see Appendix D) and consent form was presented for verification of the study by the researcher. As a result of the meeting between the researcher and the school principal, permission was granted and students were subsequently given verbal notification by their physical education teacher regarding the videotaping sessions to be conducted during their regular class activity. Students were provided with follow-up paperwork which required them to forward an information letter (see Appendix E) and a Human Subjects consent form (Protocol No. 81.
95B0001) (see Appendix A) to their parent and/or guardian for permission to participate in the videotape segment of the study. Consent form returns from all students confirmed 100% participation. Prior to and during the videotaping sessions, students were verbally reminded that their participation was voluntary and they could withdraw at any point in the study without penalty.

To gain a more representative sample of batting performances, the researcher solicited the services of a second elementary school. Following a phone interview, confirmation letter, and meeting with the school principal, permission to videotape students was granted. Due to the nature of multiple videotaping events at the second elementary school, a blanket consent form was signed by parents at the beginning of the school year. As a result, individual consent forms for each student were not required for the present study. Participation of students from the second elementary school was confirmed at 100%.

**Critical Element Selection**

The fundamental pattern of striking is performed in various planes, in the presence or absence of an implement, and in contacting either a stationary or moving object (Gallahue, 1996). Following a comprehensive review of the motor learning and development literature, 13 critical elements for the striking skill of batting (see Table 3.2) were selected from the verbal description and skill concepts
I. Preparatory Phase

1. Stand at the side of the plate with the side of the body facing the pitcher
2. Feet are spread about shoulder-width apart
3. Knees are slightly bent and body weight is evenly distributed
4. Bat is gripped with the hands touching each other (right above left for a right-handed batter; left above right for a left-handed batter)
5. Bat is in a position over the shoulder, pointing up and back
6. Elbows are held away from the body

II. Swing Phase

1. Short step is taken and weight shifts forward
2. Hips rotate toward the pitcher
3. Bat is brought around parallel to the ground in line with the ball
4. Arms are fully extended with contact of the ball
5. Wrists turn over as the ball is contacted
6. Hip and shoulder rotation continue with weight transfer to forward foot on follow through
7. Back foot remains grounded

Table 3.2: Critical elements of a striking skill. Modified from Gallahue (1996)

Presented by Gallahue (1996). For the purpose of this study, some critical elements were modified to represent the batting skill performed from a stationary tee position as opposed to swinging at a pitched ball. Students at the six-
to-seven year age range are capable of demonstrating a horizontal striking pattern when swinging at a stationary ball (Gallahue, 1996). The six-to-seven year range is representative of the second-grade students used to demonstrate the striking skill for this study.

Critical elements selected by the researcher were presented to a panel of three experts with proficiency in the areas of motor learning and development, elementary school teaching, and principles and methods of elementary physical education. Based on recommendations of the panel, content validity of the critical elements of batting was established.

The striking skill of batting was chosen for the following reasons:

1. Two-handed sidearm striking patterns in the horizontal plane are commonly used by elementary children (Gabbard, 1996).

2. Various striking skills have commonly been taught as a unit of instruction in the elementary school curriculum.

3. Batting from a tee is a closed skill that occurs in a predictable, stable, and controlled environment (Gangstead & Beveridge, 1984; Halverson, 1987; Kniffin, 1985).
Instrumentation and Related Procedures

Selection and Construction of Videotape Performances

The fundamental motor pattern of striking, specifically the skill of batting, was selected because of the wide variety of usage in recreation and sport skills, the association as a predominant skill taught at the elementary level, the efficiency of capturing a closed skill on videotape, and the experience of the researcher. Second-grade elementary students were selected for the batting performances to represent a low, medium, and high range of skill, and were also considered to be age-appropriate participants in recreation tee-ball leagues.

Videotaped sessions of seven class periods were conducted at two elementary schools in Franklin County. Written permission for videotaping was acknowledged through the elementary physical education teacher and administrative official of the elementary school, and completion of a Human Subjects consent form. Upon completion of the videotaped performances, second-grade students were not involved in any data collection or analysis procedures, and their identity remained confidential.

Equipment used for the construction of the performance videotape was furnished by the investigator and the physical education teacher. Two portable Panasonic VHS color videotape cameras were used to videotape all students. Two positions were selected to provide two angles so that
critical elements were clearly visible (Nielsen & Beauchamp, 1992). One camera was positioned directly behind the performer, and the second camera was positioned perpendicular to and facing the performer. Both cameras were mounted on a tripod and positioned 10 to 15 feet (three to five meters) from the performer to allow for viewing the entire striking movement. The zoom lens was fixed to assure an accurate and precise view and to make each performer appear as large as possible. The audio portion of videotaping was omitted to eliminate any representation of interference that might affect the observation process of subjects involved in the critical element training program.

A portable hitting target was fixed to a stage curtain in the multi-purpose room of both elementary schools. A batting tee was positioned 10 feet (3 meters) from the hitting target and directly perpendicular to the center of the target. To secure the proper position of the batting tee, an outline of the base of the batting tee was taped to the floor with red floor tape. A left and right official size batter's box was marked with red floor tape, positioned the regulation distance of six inches from the edge of the batting tee, and centered front and back in relation to the position of the ball on the tee.

Bats and balls similar to those generally used in physical education classes and tee-ball leagues were used when videotaping students' batting performances. Students
were given the opportunity to select from any one of the following bat compositions: hollow plastic, rubberized, or hard plastic. Students were free to choose either a baseball or softball-sized ball made from solid and whiffle plastic, laminated foam rubber, or uncoated urethane foam rubber. All students were given the opportunity to swing and hit a ball twice. Due to the nature of the swing and angle of the video camera, some students were requested to take another swing. Additional swings resulted when students attempted a swing and missed the ball, and when students attempted a swing and the side view camera was not in correct position after accommodating a right- or left-handed batter. Students were not given any additional instruction or feedback related to their swings from the physical education teacher or researcher prior to, during, or immediately following their performance.

The procedure for videotaping student performances involved the assistance of the physical education teacher and the researcher. During the course of a regularly scheduled striking skills unit, students were assigned to one of five different manipulative activity stations. Four of the stations allowed for maximum participation of all students. The fifth station, the hitting tee, required students to approach the station one at a time. This procedure was used for monitoring and coordinating student participation, allowing for maximum participation of all
students within the limited scheduled class time, and providing a clear and accurate videotape of each batting performance without interference.

The physical education teacher was responsible for the management and organizational procedures as the students arrived at the hitting station. Prior to videotaping and at the start of class, the physical education teacher instructed the students regarding the procedures for the tee-ball hitting station. A brief verbal reminder was repeated as students arrived at the hitting station. The instructions were as follows:

1. Sit in a group 10 feet away from the batting tee and select a bat and two balls to hit.
2. One student at a time will approach the batting tee to hit each ball.
3. Take two swings at the ball on the tee. Be sure to concentrate on making contact with the ball and aim for the target.
4. A successful swing will be counted when you have made contact with the ball on the tee.
5. All students will have the opportunity to swing and hit the ball twice.
6. When I say go, one student will proceed to the batting tee with a bat and two balls. Place one ball on the batting tee and the other one on the ground and take your first swing at the ball.
7. After you hit your first ball, place the second ball on the batting tee and take your second swing at the ball.

8. As soon as you have completed your second successful swing, return to the waiting area.

Critical Element Training Package

The critical element training package using self-instruction was constructed from a seven-day videotaping session of students at two elementary schools performing the batting swing at a ball positioned on a batting tee. Videotapes were edited by the researcher to include correct and incorrect striking skill performances of low, medium, and high-skilled ability students. Representation of correct and incorrect critical elements were included in all sessions of the training package. During intervention, critical elements for each performance were presented to subjects in an audio and visual pattern. Visual aids included a printed title page of the critical element on the colored television monitor followed by a batting performance.

Prior to the introduction of the critical element training package using self-instruction, subjects attended an orientation session. Because of the availability of subjects and differences in individual subject schedules, three separate orientation sessions were conducted. Included in the orientation session was a presentation of
the critical element training package instructional manual, completion of the personal history profile, subject contract form, human subjects consent form, verbal and written descriptions of the three components of the skill analysis process, introduction of the critical elements of batting, review of protocol for the critical element training package using self-instruction, and an opportunity for questions related to training program procedures.

Knowledge of the critical elements was a prerequisite skill for all subjects. All subjects were required to reach 100% criterion prior to implementation of the self-instructional training program (orientation session) and for each day attended. Upon completion of the pretest, subjects individually viewed videotaped batting performances and recorded their responses on the answer sheet (see Appendix G) contained in a personalized self-instructional manual.

The training program included a total of 12 sessions that were completed within a two-week period. Table 3.3 indicates the instructional training program format incorporating the three components in the skill analysis process. Sessions 4, 7, and 10 included intervention of analysis, diagnosis, and feedback, respectively. Session 13 (follow-up maintenance) was scheduled to convene within 7-14 days from the completion of the training program for each subject. Although it was the intent of the researcher for all subjects to complete Session 13 (follow-up maintenance)
Table 3.3: Instructional Training Program Format

within the 7-14 day time limit, subjects three and four were unable to complete the above mentioned session until 17 and 21 days after completion of Session 12. Subjects one and two completed Session 13 within the 14-day limit.

Original scheduling for the training program involved a 2-week time frame as diagrammed in the training program session schedule (Table 3.4). Subjects were required to attend all sessions of the program. Time allotted for each session was approximately 60 to 120 minutes. Due to an underestimation of time in completing the initial two sessions and Sessions 4, 7, and 10, approval was granted by the researcher for subjects to reschedule the remaining sessions. All subjects completed the 12 sessions within the 2-week time frame. At no time did subjects complete
Table 3.4: Training Program Session Schedule

<table>
<thead>
<tr>
<th>Sessions</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>Monday</td>
</tr>
<tr>
<td>3-4</td>
<td>Wednesday</td>
</tr>
<tr>
<td>5-6</td>
<td>Friday</td>
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<tr>
<td>7-8</td>
<td>Monday</td>
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<tr>
<td>9-10</td>
<td>Wednesday</td>
</tr>
<tr>
<td>11-12</td>
<td>Friday</td>
</tr>
<tr>
<td>13</td>
<td>between 7-14 days after completion of Sessions 11-12</td>
</tr>
</tbody>
</table>

sessions in three consecutive days. Since the study was conducted shortly after the completion of the academic school year, changes occurred in scheduling to accommodate subjects who experienced post-academic year commitments, summer class schedules, and last-minute changes in the confirmed schedule.

Construction of the Training Videotape

Training videotapes were compiled from a seven-day videotaping session of second-grade students at two elementary schools in Franklin County. Individual batting performances were videotaped simultaneously with two cameras, one positioned behind the student and one positioned on the side facing the student. Examples of batting performances in each of the 12 sessions included a representative sample of all selected critical elements.
being correct, all elements incorrect, and a combination of correct and incorrect elements. Batting performances in the follow-up maintenance test included 10 performances not previously viewed by the subjects.

To accommodate the nature of the self-paced training package using self-instruction, the master tape was duplicated four times. This duplication procedure allowed for all four subjects to complete sessions simultaneously. In addition, four individual monitors and videotape players were available throughout the course of the study.

Construction of the training videotape involved a set of procedures established by the researcher. The first procedure included reviewing four videotapes of batting performances compiled from the 7-day videotaping sessions. Two videotapes included the side views of batting performances and 2 contained performances from the rear view. Each videotape of batting performances was reviewed and checked by the researcher and 2 independent observers for the presence and/or absence of all selected 13 critical elements. A checklist was developed by the researcher that included vertical columns for each of the 13 critical elements. A vertical column on the left-hand side of the checklist was used to identify each batting performance by the count number on the VCR, sex of the batter, color of the batted ball, and description of the batter's clothing. A circled "L" was included indicating a left-handed batter.
The second procedure was the selection of videotape performances for the training tapes. A total of 345 batting performances of 2nd-grade students were videotaped and reviewed for picture and performance clarity. After viewing all performances, 69 clips were eliminated for the following reasons: a) an unclear side view of 33 performances; b) no rear view of 13 performances; c) 11 students who failed to make contact with the ball on the tee; and d) 12 clips containing interference with other students running in front of the cameras during the swing.

From the remaining 276 clips, the researcher selected 130 performances representative of combined correct and/or incorrect critical elements for the 13 sessions. Of the 130 batting performances, 10 contained all correct critical elements, 23 contained one incorrect critical element, and the remaining 97 performances each contained more than 2 incorrect critical elements. Selection of the batting performances and the presence and/or absence of the critical elements were verified by two independent observers.

The third procedure involved the researcher developing title pages for all video clips. Development of session title pages was computer-generated and recorded on a VHS videotape. Development of training session title pages was computer-generated and copied on software compatible with the professional recording equipment. Design of each title page included white lettering on a blue background screen.
for all references of batting performances and critical elements.

The fourth procedure involved the researcher editing and assembling title pages and batting performance clips of master tapes for Sessions 1 through 13. During editing of all performance sessions, a designated title page was inserted for approximately eight seconds, followed by a batting performance at normal speed. For example, a title page was labeled "Performance #101 - Side View" and then followed by the performance. The next successive title page was labeled "Performance #101 - Rear View" and immediately presented the original performance from the rear view. The same procedure was duplicated for all 10 batting performances in each session. Each performance session tape was approximately 7-10 minutes in viewing length. Each performance was shown one time from a rear and side view with no limitation on repeated viewing time as subjects were allowed to view each performance as often as needed. As a self-paced program using self-instruction, training subjects in the skill analysis process varied as each subject proceeded at their own individual rate.

The fifth procedure included editing and assembling all title pages and video clips for all intervention (training) sessions of the program. Editing and assembling of all intervention sessions were developed by three professional video technicians and the researcher. Title pages were
inserted before each performance for all normal speed and slow-motion clips. Each title page included labels with reference to performance number, view position, correct or incorrect performance, and the critical element featured. Intervention session tapes were developed and ranged from approximately 50 to 75 minutes in viewing length.

Due to an oversight in editing and brought to the attention of the researcher by the first subject completing Session 4, three batting performances in the practice session were eliminated due to partial representation of the video clip from the side view. One performance in the swing phase from each of the three distinct intervention sessions was removed from the total score. Subjects were then required to attain 29 of 35 correct responses to reach 83% criterion to continue with the next section.

The sixth procedure required the researcher, with the assistance of a media technician, to professionally record the audio portion of the training sessions in a sound-proof recording studio. Once title pages and video clips were assembled, the audio portion was inserted. Audio inserts included a verbal prompt highlighting the featured critical element inserted at a freeze frame on all slow-motion batting performances.

Audio inserts, in the form of verbal prompts, were a key element of the training package. In three sections on training for correct performances, each critical element was
stated during the freeze frame in both the side and rear views. For example, Critical Element S-4 included the statement "arms were fully extended with contact of the ball." Verbal statements in the side and rear view differed slightly without sounding redundant but included the key components of the critical element.

As part of the intervention (training) during the preparatory and swing phases, verbal prompts were included for each critical element in both the rear and side views. Batting performances during intervention included incorrect examples of each critical element. At each freeze frame in the slow-motion phase, a verbal statement was included. For analysis, the audio insert verified the incorrectness of each critical element. For example, the verbal prompt for Critical Element S-1 was stated as "Critical Element S-1 requires the batter to take a short step forward and shift the weight forward." For training in diagnosis during the slow-motion phase, the audio insert included the exact description of incorrectness for each critical element. The verbal prompt for Critical Element S-1 was stated as "no step was taken and the weight remained on the back foot." For training in feedback during the slow-motion phase, the audio insert involved a statement that specifically corrected the performance. The verbal prompt for Critical Element S-1 was stated as "step toward the pitcher (target) and shift your weight to the front foot."
Implementation of the Training Videotape

Implementation for each training session of the critical element training program using self-instruction entailed seven sections with an approximate amount of time indicated for each section (Table 3.5). Subjects observed a combination of correct and incorrect batting performances at normal, slow-motion, and again at normal speed, and from a rear and side view. The critical elements were presented with an audio commentary at a freeze frame in the slow-motion phase. Practice sessions for both the preparatory and swing phase were included. Subjects were then required to record their responses for analysis, diagnosis, and feedback on an answer sheet (see Appendix G).

Section I included an example of a correct batting performance. Subjects viewed the correct performance at normal speed from a rear and side view. The same batting performance was presented in slow-motion from a rear and side view. In the slow-motion phase from both views, the critical elements were acknowledged by a brief verbal prompt at a freeze frame at the moment of execution. Subjects repeated viewing the same batting performance at normal speed from a rear and side view.

Section II included the introduction of the six critical elements in the preparatory phase. Subjects viewed six separate batting performances at normal speed, slow-motion, and again at normal speed from a rear and side view,
Table 3.5: Instructional Training Program Format

respectively. All six critical elements in the preparatory phase were introduced individually and designated by a brief verbal prompt at a freeze frame in the slow-motion phase.

Section III involved a practice session that included a combination of six examples of correct and incorrect batting performances at normal speed, slow-motion, and again at normal speed, respectively. Each batting performance was presented from a rear and side view. Batting performances in Section II were included in this section. After viewing each performance, subjects paused the videotape and recorded their responses on the answer sheet for the six critical elements in the preparatory phase. Upon completion of the practice test, subjects self-corrected their responses with those provided on the answer key. Responses were confirmed by the researcher and discussion with the subject followed
relative to all answers. Subjects were required to reach 83% (30 of 36 correct) to proceed to Section IV.

Section IV included an example of a correct batting performance different from the one included in Section I. Presentation of the batting performance represented the same format as in Section I.

Section V included intervention for the seven critical elements in the swing phase. Subjects viewed seven separate batting performances different from those presented in Section II. Presentation of the batting performances were represented in the same format as in Section II.

Section VI involved a practice session identical to the format in Section III but contained six different batting performances. Section VII represented the same format as in Sections I and IV but included batting performances different from those previously demonstrated.

After completing the seven sections included in the intervention, subjects were required to complete a mastery test on their ability to analyze, diagnose, and provide feedback statements for 10 batting performances. Some of the performances in the mastery test were the same as the previous examples used in the practice sessions. Subjects viewed all 10 performances at normal speed from a rear and side view. Upon viewing each performance, subjects recorded their responses for analysis, diagnosis, and feedback on their answer sheet (see Appendix G).
Accuracy Check for Training Videotape

Accuracy for the training videotape was conducted by the researcher and two independent observers with expertise in elementary teaching methods prior to the start of the training program. The first independent observer viewed every batting performance taken during the seven-day videotaping sessions of second-grade students at both local elementary schools. After viewing each batting performance on the side view videotape, the independent observer completed the answer sheet (see Appendix G). The independent observer viewed each batting performance on the rear view videotape and completed an additional set of corresponding answer sheets. A second independent observer was used to confirm any discrepancy in the selected batting performances for the training videotape.

Research Methodology

Independent Variable

The independent variable was the implementation of the critical element training package using self-instruction to primary subjects. The purpose of the critical element training package was to develop subjects' competencies for analysis, diagnosis, and providing appropriate feedback statements for the striking skill of batting. Sequential introduction of the independent variable in the training package occurred in Sessions 4, 7, and 10. Concerns
relative to induction were addressed between the diagnosis and feedback sessions.

Dependent Variable

Three dependent variables, expressed in scores, were considered for the study: analysis, diagnosis, and feedback. Raw scores for the dependent variable in each session were converted to a percentage score and depicted on a multiple baseline graph as a ratio of points for all subjects. The first dependent variable was the subjects' score for accurately analyzing the critical elements for correct and incorrect batting performances. Subjects viewed 10 different batting performances for each session, circling the letter (C) correct or (I) incorrect for each of the critical elements. After completion of the initial step for each batting performance, subjects self-corrected their responses with the answer key included in their manual. Subjects received one point for each appropriate response. Maximum points awarded for each session correlated with the total number (10) of batting performances multiplied by the total number of critical elements (13).

The second dependent variable was the subjects' score for accurately diagnosing each of the 13 critical elements of a batting performance. Based on the subsequent correction of critical elements for each batting performance in the analysis phase, subjects were then required to write a diagnostic statement describing what actually happened
when each critical element was demonstrated. Immediate scoring for the analysis phase reduced the probability for errors of commission and omission for the successive steps of diagnosis and feedback. Previous results from a study conducted by Matanin (1993) suggested that a subject's inaccurate initial response adversely affected subsequent responses. Subjects received one point for each appropriate response, and no points were awarded for a partial or inappropriate response. Maximum points awarded for each session correlated with the total number (10) of batting performances multiplied by the total number of critical elements (13).

The third dependent variable was the subjects' score for providing an appropriate feedback statement for each critical element performed in all batting performances. Subjects addressed both correct and incorrect demonstrations of critical elements with either a specific corrective or a specific reinforcing praise feedback statement for the appropriate critical element. For each feedback statement that characterized the critical element performed, subjects received one point. No points were received for partial or inappropriate responses. Maximum points awarded in each session for feedback statements coincided with the total number (10) of batting performances multiplied by the total number of critical elements (13).
Research Design

Single subject research design used in this study was the multiple baseline across behaviors design. Multiple baseline designs allow for the measurement of various behaviors over time and are significant in determining if a change in behavior has occurred as a result of intervention. Baer, Wolf, and Risley (1968) operationally defined the effect of the multiple baseline design:

In the multiple baseline technique, a number of responses are identified and measured over time to provide baseline against which changes can be evaluated. With these baseline established, the experimenter then applies an experimental variable to one of the behaviors, produces a change in it, and perhaps notes little or no change in the other baseline. If so, rather than reversing the just-produced change, he instead applies the experimental variable to one of the other, as yet unchanged, responses. If it changes at that point, evidence is accruing that the experimental variable is indeed effective, and that the prior change was not simply a matter of coincidence. The variable then may be applied to still another response, and so on. (p. 94)

According to Horner and Baer (1978), answers to the following four questions are appropriate in the application of sequential behaviors: (1) What is the initial level of
performance on each step of the sequence? (2) What happens when sequential opportunities to perform each step in the sequence are provided prior to training on that step? (3) What happens to each step as training is applied? (4) What happens to the performance of untrained steps in the sequence as criterion-level is reached on preceding steps?

Four advantages associated with the multiple baseline design across behaviors are described by Tawney and Gast (1984): (1) a return to baseline is not required to demonstrate experimental control; (2) a reversal condition is not required; (3) it provides a means for evaluating programs designed to teach skills that are irreversible; and (4) it provides a paradigm for continued monitoring in response generalization and maintenance.

In this study, the critical element training package using self-instruction for developing subjects' competencies for analysis, diagnosis, and feedback was introduced sequentially to determine scores for the selected critical elements of batting performances. Training in analysis occurred prior to Session 4, diagnostic training prior to Session 7, and feedback training prior to Session 10.

Data Collection Procedures

Data collection addressed the research questions guiding this study: 1) subjects' ability to analyze correct and incorrect batting performances; 2) subjects' ability to diagnose correct and incorrect batting performances; and 3)
subjects' ability to provide an appropriate feedback statement for correct and incorrect batting performances.

Data collection involved 12 sessions over a two-week period with a follow-up maintenance test in Session 13. Sessions 1 through 3 were used to determine a baseline measure for analysis. Prior to the start of Session 4 of the critical element training package, analysis intervention was introduced. Following Sessions 4 through 6 and before Session 7, diagnosis intervention was introduced. After the completion of Sessions 7 through 9, feedback intervention was introduced prior to Session 10. Subjects then completed Sessions 10 through 12. Session 13 was scheduled to be completed 7-14 days after completion of Sessions 11 and 12.

Session schedules were initially arranged according to Table 3.4. A block of time was scheduled by the researcher based on preliminary schedules and work commitments of all subjects. Any alteration of the schedule would require prior approval by the researcher. As noted previously, summer class schedules and additional commitments required subjects to alter the original schedule. All subjects maintained attendance three days per week and session days were dispersed throughout the week. Since the critical element training package was self-instructional and self-paced, subjects arranged their schedules appropriately in accordance with the length of each session. Sessions 1, 2, 3, 5, 6, 8, 9, 11, 12 and 13 involved analysis, diagnosis,
and feedback for 10 batting performances. The estimated
time for each session listed above was approximately 60 to
120 minutes. Sessions 4, 7, and 10 involved the
intervention package, in addition to the 10 batting
performances. The estimated time for each of the
aforementioned sessions ranged from approximately 120 to 180
minutes. Due to the extensive time required to complete an
intervention session and regular session in one day, one
subject attended four days per week, completing Sessions 4, 7, and 10 separate from the regular sessions.

Procedures for data collection in all sessions required
subjects to view 10 videotaped batting performances at
normal speed, and from a rear and side view. After viewing
each performance, subjects paused the tape and recorded
their responses on the answer sheet (see Appendix G).
Subjects were permitted to view each performance as often as
needed. Prior to and at the completion of each session,
subjects were required to record their start and finish time
on their answer sheets.

The first dependent variable was measured from the
subject's score for analysis when the subject circled the
letter C (correct) or I (incorrect) for each critical
element of each batting performance. Self-correction using
an answer key for the analysis portion of the test was
required prior to initiating the diagnosis section. One
point was awarded for each correct response.
The second dependent variable was measured from the subject's score for diagnosis when the subject provided a written statement describing what actually happened for each critical element performed. One point was awarded for each correct response that addressed each critical element performed. No credit was awarded for a partial or inappropriate response.

The third dependent variable was measured from the subject's score for feedback when the subject provided either a specific corrective or a specific reinforcing praise feedback statement for the appropriate critical element. Based on the overall analysis and diagnosis, one point was awarded when the subject's response was an appropriate and accurate feedback statement. All point scores for analysis, diagnosis, and feedback in each session were converted to percentage scores as a ratio of points awarded and presented visually on a multiple baseline graph.

Data Analysis

Analysis of single subject research data was accomplished primarily through visual analysis, a procedure employed to analyze a functional relationship between the independent and dependent variables. According to Johnston and Pennypacker (1980), statements relative to behavior change "... are known as functional relations and state that a certain behavior (or behavior change) is a function of (is determined by) the operation of specific variables" (p. 16).
Differences within and across subjects for all three behaviors were considered. Cooper et al., (1987) stated the following to further support the significance and systematic examination of data through visual analysis:

Visual analysis of data from an applied behavior analysis study is conducted to answer two questions:
(1) Did a meaningful change in behavior take place?
(2) To what extent can that change in behavior be attributed to experimental manipulation of the independent variable? (p. 130).

Graphic display of data provides a relatively simple and efficient format for organizing, interpreting, and communicating variability, level, and trend results (Cooper et al., 1987). Further evidence (Tawney & Gast, 1984) supported the reliance, efficiency, and effectiveness of graphic display of data for analysis:

Teachers and other practitioners will find graphing economical in terms of the time saved by not having to review daily data forms prior to making program decisions and by not maintaining ineffective instructional programs. (p. 143)

The transfer of data to graphic display provides a description for variability, level, and trend in the data. Variability of data refers to the degree to which behavioral measures within the same environmental conditions vary from one another. Level of data refers to the degree to which
behavioral measures vary within and across conditions. Trend of data describes the overall direction of the data path (Cooper et al., 1987). "Graphic display of behavioral data has proven the most effective means of detecting, analyzing, and communicating these aspects of behavior change (Cooper et al., 1987, p. 108). Data analysis of four inservice physical education teachers and the effects of the critical element training program using self-instruction will be presented in chapter four.

Summary

A critical element training package using self-instruction was used to measure four inservice physical education teachers' ability to analyze, diagnose, and provide feedback for 13 critical elements of the striking skill of batting. Second-grade students from two elementary schools were videotaped to create the mastery tape for the training program. Training videotapes were developed to include normal and slow-motion speed batting performances enhanced by verbal prompts at a freeze-frame. Subjects completed 12 sessions in a 2-week time frame. A follow-up maintenance session (Session 13) was scheduled 7-14 days after completion of Session 12. Single subject research data were analyzed through visual analysis using a multiple baseline across behaviors design. Graphic display of data revealed variability, level, and trend results.
Chapter 4 is divided into three sections. Section one includes the reliability of data collection conducted by the researcher and independent observer. Section two includes a rationale for visual inspection of data in a multiple baseline across behaviors design. Single subject research presents data in graphic form to facilitate interpretation of data, determine significance of behavioral changes, and encourage independent translation (Cooper, Heron, & Heward, 1987). Section three includes subjects' biographical data, prerequisite content knowledge results, and data analysis of subjects by research question.

Reliability of Data Collection

Data collected for this study consist of subjects' responses to students' performance of the skill of batting. Subjects were asked to analyze, diagnose, and provide feedback for each performance trial. Analytic data required subjects to respond and circle either correct or incorrect for each of the 13 critical elements of a batting performance. Based on the self-corrected analysis response,
diagnostic data required subjects to provide a written statement of what actually happened for each critical element in a performance. Based on the analysis and diagnosis responses, feedback data required subjects to provide a specific praise or corrective written response for each critical element of a performance.

Reliability checks of session data were conducted by an independent observer after subjects completed the first and third day of the training program. Data from all four subjects were reviewed. Visual checks of the data by the researcher and independent observer were then conducted upon completion of the study by all four subjects. Interobserver agreement for analytic responses for all four subjects was 100%. Interobserver agreement (IOA) for diagnostic statements for all four subjects was 94.5%, whereas IOA for feedback statements for all four subjects resulted in a score of 96.1%. Where discrepancies existed in the assessment of diagnosis and feedback statements, both assessors reviewed and discussed the data in question and confirmed the answers to ensure 100% reliability.

**Rationale for Visual Inspection of Data**

The significance of single subject research data allows for visual inspection of the data. Cooper et al., (1987) reported the effectiveness of graphic display as an operative tool for detecting, analyzing, and communicating
changes in behavior. Transferring data to graphic display provided a description of variability, level, and trend in the data. Variability refers to "the extent to which measures of behavior under the same environmental conditions differ from one another" (Cooper et al., 1987, p. 131). Level measures the extent of stability within and across conditions depicted on a vertical axis, while trend alludes to the overall direction or slope of a data path (Cooper et al., 1987).

Graphic display expedites interpretation of data and permits consideration in the judgment of a functional relationship between dependent and independent variables. Subject data for analysis, diagnosis, and feedback are displayed on multiple baseline graphs and tables.

Analysis of Subject One

Biographical Data

Subject one was a female, inservice elementary physical education specialist with six years teaching experience for grades K-5. In addition, subject one coached middle school track and field for two years, double-dutch jump rope at a competitive level for grades K-8 for three years, and cheerleading for one year at the high school level. Formative training for developing analytic ability was completed in kinesiology and skill analysis courses at the undergraduate level eight years prior to the study.
Knowledge of content of the 13 critical elements was measured by a prerequisite test prior to the genesis of the training program and at the beginning of each day of data collection. As each subject was required to reach 100% criterion, subject one repeated the tests once during Sessions 1 through 3 and Session 8 before reaching 100% criterion. Tests four through seven were initially completed at 100% criterion.

Research Question #1

What is the impact of the critical element training program on subjects' ability to analyze correct and incorrect batting performances?

Figure 4.1 presents the percentage of correct responses for the 13 critical elements across analysis, diagnosis, and feedback for subject one. Subjects' scores for analytic ability were determined by the percentage of correct responses for each of the 13 critical elements in a performance trial. Each session included 10 different batting performance trials.

Baseline data for analysis of the critical elements were relatively high and stable as indicated in Figure 5. After an initial score of 78%, a 05% increase occurred in Session 2, followed by a 04% decrease in Session 3. During baseline, the mean score was 80% with a range from 78% to 83%. Data points for subject one during baseline were
Figure 4.1: Multiple baseline across behaviors design showing percentage of correct responses as a ratio of points awarded for analysis, diagnosis, and feedback for subject one.
maintained at a high and stable level and demonstrated a flat trend with little variability.

Immediately following baseline, training occurred for analysis and subject one showed a slight decrease of 04% in analytic ability in Session 4 with a score of 75% (see Figure 4.1). For all 9 sessions after training, the mean score for subject one was 82% with a range of 75% to 90%. Subject one maintained analytic ability after training for 9 sessions at a high and stable level with a 02% increase above the baseline mean score.

Data points after training demonstrated a slight increase in trend. The highest percentage score for accurately analyzing critical elements per session occurred after training as subject one achieved their highest percentage score at 90% in Session 8.

Data results of analysis for subject one are suggestive of a weak functional relationship. Data for analysis of subject one during baseline and after training conditions showed very little variability. The balance between the highest and lowest data points remained at approximately the same range scoring within 11%. Although variability was minimal for analysis scores, a 10% increase occurred after training between Sessions 7 and 8. Additionally, the highest decrease in percentage of correct responses occurred after training between Session 9 and 10, accounting for a 05% reduction in percentage score.
In the follow-up maintenance phase completed 14 days after Session 12, subject one demonstrated a decline in analytic ability, depicting a score of 75%. This score represented a decrease of 08% from the last session after training and a decrease of 06% from the overall mean score of 81% for analytic ability. Subject one's score in follow-up maintenance was the lowest score recorded for percentage of correct responses in analytic ability.

Table 4.1 presents a complete and itemized number of correct responses for analysis of the 13 critical elements for each session recorded by subject one. The highest number of correct responses for analysis occurred with Critical Elements P-1 and P-2, as subject one recorded 120/130 (x=9.2) and 116/130 (x=8.9), respectively. The lowest number of correct responses for analysis occurred with Critical Element P-3 and S-5, as subject one recorded 96/130 (x=7.4) for both. The number of correct responses for the remaining critical elements in both phases ranged from 101/130 (x=7.8) for Critical Element S-1 to 113/130 (x=8.7) for Critical Element P-5. Subject one recorded a higher number of correct responses for critical elements in the preparatory phase totaling 653/780 (x=8.4) than in the swing phase at 722/910 (x=7.9).

The ability of subject one to analyze the 13 critical elements for correct and incorrect batting performances improved slightly after training and was maintained at a
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Table 4.1: Correct responses for analysis of 13 critical elements by session for subject one.

high and stable level. Overall analytic ability of subject one remained high and stable but showed a slight decrease in follow-up maintenance.

Research Question #2

What is the impact of the critical element training program on subjects' ability to diagnose correct and incorrect batting performances?

Figure 4.1 shows the percentage of correct responses as a ratio of points awarded for the 13 critical elements.
across analysis, diagnosis, and feedback for subject one. Subjects' scores for diagnostic ability were based on the corrected analysis response and determined by the percentage of correct responses for each of the 13 critical elements in a performance trial. Each session included 10 different batting performance trials.

Baseline scores for subject one in the diagnostic phase were moderate as indicated in Figure 4.1. Session 4 in baseline can be described as an outlier in respect to the remaining data points that are stable and suggest inconsiderable variability. Diagnostic ability throughout baseline for subject one depicted scores ranging from 34% to 55%, with a mean score of 46%. Data points during baseline demonstrate a slight increase in trend.

Immediately following baseline, training occurred and subject one showed a significant increase in level of performance. Diagnostic ability of subject one improved significantly to 73% in Session 7, a pivotal increase of 18% over the previous session score of 55%. The diagnostic score in Session 7 also represented a significant increase over the mean baseline score of 46%.

Subject one's diagnostic ability continued at a high and stable level for the remaining six sessions showing a mean score of 73% and scores ranging from 68% to 77%. The mean score of 73% for diagnosis after training showed a significant increase in trend, 27% above the baseline mean.
Subject one recorded their overall highest diagnostic score in Session 8 after training, achieving a score of 77%. Data for the six sessions after training showed consistency and were demonstrated at a relatively flat trend with little to no variability.

Variability in diagnosing correct and incorrect critical elements was insignificant during baseline and after training. Aside from a decrease of 16% prior to and an increase of 21% after Session 4, all data points remained within a range of 11% during baseline and within a range of 09% after training.

Data for subject one in the follow-up maintenance session disclosed a score of 76%, representing a 02% increase from Session 12 and a significant increase of 17% from the overall mean score of 59%. Subject one's score in follow-up maintenance was the second highest score recorded for diagnosis, 01% below the 77% recorded in Session 8.

Table 4.2 scores indicate the tabulated number of correct responses for diagnosis of the 13 critical elements for each session recorded by subject one. Subject one recorded the highest number of correct responses for diagnosis in the swing phase, scoring 119/130 (x=9.1) for S-2, 107/130 (x=8.2) for S-3, and 106/130 (x=8.1) for S-7. The lowest number of correct responses occurred with Critical Element as subject one scored 16/130 (x=1.2) for P-5. Mean scores for the number of correct responses for the
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Table 4.2: Correct responses for diagnosis of 13 critical elements by session for subject one.

remaining critical elements in both phases ranged from 3.4 to 7.8. The number of correct response scores for subject one when diagnosing the 13 critical elements was 425/780 (x=6.6) in the swing phase and 601/910 (x=5.4) in the preparatory phase. These results are contradictory to scores recorded by subject one in the analysis phase.

Subject one's ability to diagnose the 13 critical elements of batting performances across 13 sessions improved significantly. The greatest percentage of increase in
correct responses occurred after training and remained high and stable throughout the training program.

Noticeable changes in the number of correct responses occurred in three of the critical elements before Session 7 and after training. Critical Element P-3 increased from a baseline mean of 1.8 to 7.7. In the first three sessions, subject recorded a score of 4/30. With no correct answers in Session 4, subject one improved diagnostic ability and recorded 7/20 correct responses. Critical Element P-4 increased from a baseline mean of .5 to 5.2 after training. After recording 8/60 correct responses for Sessions 1 through 6, subject one improved to 53/60 correct responses for Sessions 7 through 12. Subject one also showed a dramatic increase in diagnostic ability for Critical Element S-5, recording a score of 3/60 correct responding before training and 31/60 after training in Sessions 7 through 12.

Research Question #3

What is the impact of the critical element training program on subjects' ability to provide appropriate feedback specific to correct and incorrect batting performances?

Figure 4.1 shows the percentage of correct responses for the 13 critical elements across analysis, diagnosis, and feedback for subject one. Feedback scores were determined by the percentage of correct responses for each of the 13 critical elements in a performance trial. Ten different performance trials were included in each session.
Baseline scores of subject one (see Figure 4.1) for feedback were demonstrated at a moderate level of performance and showed a slight increase in trend. The mean score for specific praise and/or specific corrective feedback statements was established at 48% during baseline with scores ranging from 31% to 61%. The highest score during baseline occurred in Sessions 8 and 9 at 61%. Variability during baseline was insignificant, with scores fluctuating from 03% to 14%.

After training, a significant increase of 18% in score occurred in Session 10. The mean score of 78% after training was 30% above the baseline mean score of 48%. Feedback scores for Sessions 10, 11, and 12 remained virtually consistent at a high and stable level. Variability for feedback was nonexistent after training.

Data for subject one in the follow-up maintenance session (Figure 4.1) produced a score of 75%. This score represented a 03% decrease from the mean score after training but a significant increase of 19% from the overall mean score of 56%. Mean scores for feedback in baseline, after training, and in follow-up maintenance were similar to those in diagnosis, with a difference no greater than 05%.

Table 4.3 scores indicate the number of correct responses for feedback statements of the 13 critical elements for each session recorded by subject one. Subject one scored the highest number of correct responses when
Table 4.3: Correct responses for feedback of 13 critical elements by session for subject one.

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providing feedback statements for Critical Elements S-2 with a score of 125/130 (x=9.6). The lowest number of correct responses involved Critical Element P-5 with a score of 19/130 (x=1.5). Remaining mean numbers for subject one when providing feedback for all critical elements ranged from 3.1 to 9.0. Subject one also recorded her lowest accuracy rate in diagnosis for Critical Element P-5.

The ability of subject one to provide specific praise and/or corrective feedback statements for the 13 critical
elements of a batting performances improved steadily throughout baseline. Subject one demonstrated a significant improvement after training and maintained the ability to provide feedback at a high and extremely stable level. Data in the follow-up maintenance phase occurring 14 days after training suggested subject one was able to preserve the ability to provide feedback.

Significant to the follow-up maintenance session was the increase in score for Critical Element P-5. Subject one scored the maximum number of correct responses (10), well above the mean score of .75 in the previous 12 sessions. Training in feedback seemed to have the biggest impact on Critical Element P-5 as the baseline mean of 1.3 improved to a mean of 8.8. Noticeable change also occurred with Critical Element P-4 as subject one improved from a mean score of 2.0 to a mean of 7.0 after training.

Scores for feedback after training in diagnosis during Sessions 8 and 9 suggests possible induction for three critical elements in the preparatory phase and one in the swing phase. Critical Element P-1 showed an immediate change from a baseline mean of .5 to a mean score of 8.3, reporting 20/20 correct responses. Critical Element P-2 increased from a baseline mean of 2.8 to a mean score of 8.7 and correct responses were scored at 20/20. Critical Element P-3 increased to a mean score of 5.3 following a .5
baseline mean. During Sessions 7 through 9, subject one recorded 16/30 correct responses.

Analysis of Subject Two Data

Subject two was a female, inservice physical education specialist with 13 years teaching experience that included pre-kindergarten through grade 3, as well as seventh and eighth-grade middle school students. In addition to teaching, subject two coached six different sports at the elementary and middle school levels (see Table 3.1). More recent and specific to this study in relationship to the striking skill of batting, subject two has coached middle school softball for the past 10 years. Formative training for developing analytic ability was completed in kinesiology and three methods courses at the undergraduate level 16 years prior to the study.

Content Knowledge

Knowledge of content of the 13 critical elements was measured by a prerequisite test prior to the start of the training program and each day of data collection. All subjects were required to reach 100% criterion on all prerequisite tests. Before the start of the first day of data collection, subject two provided only a partial answer for Critical Element S-6 in the pretest. As a result, the researcher and subject discussed the importance of stating all components of the critical elements and as corrections
were made, subject two commenced with the initial session. Subject two completed the remaining pre-tests at 100% criterion for the remaining seven days of data collection.

Research Question #1

What is the impact of the critical element training program on subjects' ability to analyze correct and incorrect batting performances?

Figure 4.2 represents the percentage of correct responses for the 13 critical elements across analysis, diagnosis, and feedback for subject two. Analysis scores were determined by the percentage of correct responses for all 13 critical elements of a batting performance. Ten performance trials were included in each of the 13 sessions of the training program.

Baseline data for analysis was relatively high and stable as indicated in Figure 4.2. After an initial score of 81%, a 3% increase occurred in Session 2, followed by a 3% decrease in Session 3. The mean score for analysis in baseline was 82%. Baseline data showed no variability and represented a level trend.

Immediately following analysis training, analytic ability of subject two decreased 12% in Session 4 with a score of 69% (see Figure 4.2). After recording the lowest score for analysis in Session 4, subject two maintained analytic ability for the 9 sessions at a high and stable level. The mean score for analysis after training was 78%,
Figure 4.2: Multiple baseline across behaviors design showing percentage of correct responses as a ratio of points awarded for analysis, diagnosis, and feedback for subject two.
a 04% decrease from the baseline mean of 82%. The highest percentage of correct responses for analyzing critical elements per session occurred after training in Session 8, as subject two achieved a score of 85%.

Data points after training represented a small increase in trend after Session 4 and little variability in the remaining sessions. Although subtle, changes in percentage of correct responses occurred between Sessions 4 and 5, 5 and 6, and 7 and 8, showing an increase of 06%. The highest decrease in percentage of correct responses occurred after training and prior to Session 4, accounting for a 12% reduction in score. The effects of training may have afforded subject two with greater discrimination practices when analyzing certain critical elements. A measurable decrease (5) in the number of correct responses involved Critical Elements P-3 and S-6.

Subject two completed the follow-up maintenance session 16 days after completion of Sessions 11 and 12. A decline in analytic ability occurred as subject two recorded a score of 78%. This score replicated the mean score of 78% for analysis after training. The overall mean score of 79% for subject two decreased 03% from the baseline mean of 82%. The follow-up maintenance score remained consistent at a high level and showed no variability from previous session scores.
Table 4.4: Correct responses for analysis of 13 critical elements by session for subject two.

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Total 120 109 83 105 102 102 93 103 102 115 107 95 108 1329
Mean 9.2 8.4 6.4 8.1 7.8 7.8 7.2 7.9 7.8 8.8 8.2 7.3 8.3 102.2

Table 4.4 indicates the number of correct responses for analysis of the 13 critical elements by subject two for each session completed. The number of correct responses of critical elements by session scored highest by subject two included 120/130 (x=9.2) for Critical Element P-1 and 115/130 (x=8.8) for Critical Element S-4. Subject two recorded the lowest number of correct responses by session when analyzing Critical Element P-3 with a score of 83/130 (x=6.4). Mean scores for the remaining critical elements in
the preparatory and swing phases ranged from 7.1 to 8.4. Overall, subject two was consistent in achieving the number of correct responses for critical elements for all sessions in both the preparatory phase (621/780, x=7.96) and the swing phase (723/910, x=7.94).

The ability of subject two to analyze the critical elements for correct and incorrect batting performances decreased slightly from baseline but was maintained at a high and stable level throughout the training program. Data points showed little variability throughout all sessions. The number of correct responses remained consistent with the exception of Critical Element P-3, as subject two decreased from a baseline mean score of 8.3 (25/30 correct responses) to 5.8 (58/100 correct responses) after training and follow-up maintenance.

**Research Question #2**

What is the impact of the critical element training program on the subjects' ability to diagnose correct and incorrect batting performances?

Figure 4.2 represents the percentage of correct responses as a ratio of points awarded by subject two for the 13 critical elements across analysis, diagnosis, and feedback. Scores for diagnosis were derived from the corrected analysis response of all critical elements of a batting performance trial. Ten different batting performances were included in each session.
Baseline data for subject two in the diagnostic phase were relatively high and stable (see Figure 4.2) with little variability and indicating an increase in trend. The mean score for diagnostic ability of subject two throughout baseline was 73%, with a range of 68% to 78%.

Immediately after training, subject two improved to 88% in diagnostic ability which represented a significant increase of 15% over the baseline mean. Diagnostic ability continued at a high and stable level for the remaining six sessions with scores ranging from 82% to 94%. The mean score of 89% for diagnosis following training demonstrated a 16% increase over the baseline mean. Subject two recorded their overall highest session score following training for diagnosis, achieving a score of 94% in Sessions 11 and 12.

Variability for sessions after training was extremely stable within a narrow range of 08%, represented by an increase in score between Sessions 9 and 10. The lowest data point after training remained higher than the highest data point during baseline. The percentage of correct responses was relatively consistent after training, represented by a level trend in data points and showing little variability.

In the follow-up maintenance session, subject two achieved a score of 91%, representative of an 18% increase over the baseline mean of 73% and a 02% increase over the mean score of 89% after training. The score of 91% was the
Table 4.5: Correct responses for diagnosis of 13 critical elements by session for subject two.

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<th>Sess.</th>
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</table>

Total 116 121 119 128 95 114 106 126 123 44 95 75 119 1382
Mean 8.9 9.3 9.2 9.8 7.3 8.8 8.2 9.7 9.5 3.4 7.3 5.8 9.2 106.3

Table 4.5: Correct responses for diagnosis of 13 critical elements by session for subject two.

Second highest score recorded by subject two for diagnosis. Subject two was able to maintain diagnostic ability at a high and stable level and extremely minimal variability.

Table 4.5 scores indicate the itemized number of correct responses for diagnosis of the 13 critical elements for each session recorded by subject two. Subject two recorded the highest number of correct responses when diagnosing Critical Elements P-4 (128/130, x=9.8) and S-2 (126/130, x=9.7). The lowest number of responses for
diagnosis by subject two included Critical Element S-4, with a score of 44/130 (x=3.4). Accuracy rates for the remaining critical elements in both phases ranged from 58% to 91%. Mean scores for the remaining critical elements ranged from 5.8 to 9.3.

Subject two's ability to accurately diagnose the 13 critical elements of batting performances was maintained throughout the training program. A significant increase in diagnostic ability occurred after training and remained at a stable level. No overlapping of data points occurred across baseline and after training conditions, indicating a continual ascending trend.

Diagnostic training appeared to have the most impact on Critical Element S-6. After a baseline mean of 2.8 (17/60 correct responses), subject two increased the mean score to 8.4 (59/70 correct responses) after training and follow-up maintenance. Scores for Critical Element S-4 immediately after training showed no change and remained stable with a mean score of 1.7 (5/30 correct responses). Once feedback training occurred, the mean score for Critical Element S-4 during Sessions 10 through 13 increased to 7.3 as subject two recorded 29/40 correct responses.

Research Question #3

What is the impact of the critical element training program on subjects' ability to provide appropriate feedback specific to correct and incorrect batting performances?
Figure 4.2 represents the percentage of correct responses as a ratio of points awarded to subject two for the 13 critical elements of batting performances across analysis, diagnosis, and feedback. Feedback scores were determined by the percentage of correct responses for each critical element in a performance trial. Each session included 10 batting trials.

Baseline scores for feedback (Figure 4.2) were consistently low and showed a decrease in trend. The mean score for praise and corrective feedback statements for subject two during baseline was 42%, with scores ranging from 37% to 50%. The highest score (50%) recorded by subject two in baseline occurred in Session 1. Data points in baseline showed minimal variability and fell within a range of 13%.

After training, subject two improved feedback ability significantly by a margin of 24% in Session 10 (see Figure 4.2). The mean score for feedback after training was 71%, with an range of 66% to 75%. Feedback data after training showed a slight increase in trend with minimal variability. The effects of training were substantial as subject two increased feedback 29% over the baseline mean of 42%.

Feedback data in the follow-up maintenance session significantly increased 17% after an absence of 16 days from completing Session 12. The follow-up maintenance score of 88% was the highest score recorded by subject two for all 13
Sess.  P-1 P-2 P-3 P-4 P-5 P-6 S-1 S-2 S-3 S-4 S-5 S-6 S-7  Total  
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12 1 1 2 5 6 9 9 10 10 10 10 10 10 93 
13 7 7 9 6 9 10 10 10 9 10 9 9 115 
Total 14 36 35 23 62 105 76 124 122 65 53 57 115 887 
Mean  1.1 2.8 2.7 1.8 4.8 8.1 5.8 9.5 9.4 5 4.1 4.4 8.8 68.2 

Table 4.6: Correct responses for feedback of 13 critical elements by session for subject two.

sessions of feedback. This score represented a 46% increase over the baseline mean, 17% above the after-training mean score, and a 36% increase above the overall mean score of 52% for subject two.

Table 4.6 shows the specific number of correct responses for feedback statements of the 13 critical elements for each session recorded by subject two. Subject two produced the highest number of correct responses when addressing Critical Elements S-2 and S-3, recording scores.
of 124/130 (x=9.5) and 122/130 (x=9.4), respectively. Scores representing the lowest number of correct responses involved Critical Elements P-1 (14/130, x=1.1) and Critical Element P-4 (23/130, x=1.8). Mean scores for remaining critical elements in the preparatory and swing phases ranged from 2.7 to 8.8. High scores (612/910, x=6.7) for subject two were consistent in the swing phase as were low scores (275/780, x=.35) in the preparatory phase for feedback statements.

Subject two was able to significantly improve in the ability to provide feedback after training occurred. It is suggested that training had a positive effect, as data points disclosed no overlap across all three conditions. An increase in trend was evident across all 13 sessions.

Training in providing feedback seemed to have a prominent influence on three critical elements in the swing phase and one in the preparatory phase. The greatest impact involved Critical Elements S-5 and S-6 as subject two improved from a baseline mean of 1.8 (16/90 correct responses) to 9.3 (37/40 correct responses) for S-5, and 2.0 (18/90 correct responses) to 9.8 (39/40 correct responses) for S-6. Critical Element S-4 also increased from a baseline mean of 3.3 (30/90 correct responses) to a mean score of 8.8 (35/40 correct responses) after training. In the preparatory phase, Critical Element P-4 improved from a baseline mean of .44 (4/90 correct responses) to 4.8 (19/40
correct responses) after training. While notable changes occurred in the aforementioned critical elements, subject two seemed to provide moderate to high consistency for specific feedback statements for Critical Elements P-6, S-2, S-3 and S-7 before and after training. Differences in mean scores during baseline and after training for the above mentioned critical elements ranged from .6 to 1.4.

Analysis of Subject Three

Subject three was a female physical education specialist with 14 years teaching experience for grades K-6. In addition to classroom teaching, subject three coached a girls' high school junior varsity basketball team for three years from 1982-1985. Formative training for developing analytic ability was completed in a kinesiology course 18 years prior to the study and a skill analysis course at the graduate level 9 years prior to the study.

Content Knowledge

All subjects were required to complete a prerequisite test to measure knowledge of content prior to the start of the training program and each day of data collection. Eight pretests were completed by subject three, of which partial answers to critical elements were recorded in the first, third, fourth, fifth, and seventh pretests. Of the eight partial answers, seven occurred in the swing phase and five of them relating to Critical Element S-6. Subject three
failed to include the component of the weight transfer forward with continued hip and shoulder rotation. Following discussion of the answer sheet with the subject and prompts by the researcher, subject three completed all prerequisite tests at 100% criterion.

**Research Question #1**

What is the impact of the critical element training program on subjects' ability to analyze correct and incorrect batting performances?

Figure 4.3 represents the percentage of correct responses for the 13 critical elements across analysis, diagnosis, and feedback for subject three. Analytic ability for subjects was determined by the total number of correct responses for all 13 critical elements of a performance trial and then converted to percentage scores. Subjects viewed 10 different batting performances in each of the 13 sessions of the training program.

Baseline data for visual discrimination was relatively high and stable as shown in Figure 7. After an initial score of 72%, an 06% increase occurred in Session 2 and scores remained stable at 78% in Session 3. Subject three's mean score for analysis during baseline was 76%, with a range from 72% to 78%. Data points during baseline showed a slight increase in trend with insignificant variability.

Subject three demonstrated a modest gain in analytic ability after training in Session 4. Mean performance for
Figure 4.3: Multiple baseline across behaviors design showing percentage of correct responses as a ratio of points awarded for analysis, diagnosis, and feedback for subject three.
subject three after training was 82%, increasing 03% from the baseline mean. After-training session scores ranged from 75% to 88% with the highest percentage score occurring in Session 8. Subject three maintained analytic ability after training at a high and stable level. Analysis scores showed minimal variability and a slight increase in trend.

In the follow-up maintenance session completed 10 days after Session 12, subject three demonstrated a decline in analytic ability, depicting a score of 74%. This score represented a decrease across all conditions of the training program, including 11% from Session 12, 02% from the baseline score, 08% after training, and 06% below the overall mean score of 80%.

Table 4.7 indicates the number of correct responses for analysis of the 13 critical elements for each session recorded by subject three. The highest number of correct responses recorded by subject three included 119/130 (x=9.2) for Critical Element P-1 and 114/130 (x=8.8) for Critical Element S-7. The lowest number of correct responses recorded by subject three was 84/130 (x=6.5) for Critical Element S-6. Results of the lowest score reflect data from prerequisite tests when subject three was requested to completely define the critical element of hip and shoulder rotation with weight transfer forward.

The number of correct responses for the remaining critical elements in both phases ranged from 99/130 (x=7.6)
### Table 4.7: Correct responses for analysis of 13 critical elements by session for subject three.

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Total: 119 99 100 110 112 102 99 102 102 105 102 84 114 1350

Mean: 9.2 7.6 7.7 8.5 8.6 7.8 7.6 7.8 7.8 8.1 7.8 6.5 8.8 103.8

Subject three recorded a higher mean number of correct responses for critical elements in the preparatory phase (642/780, x=8.2) than in the swing phase (708/910, x=7.8).

The ability of subject three in analyzing the critical elements for correct and incorrect batting performances increased slightly from baseline and was maintained at a high and stable level throughout the training program. Data showed minimal variability and a slight increase in trend.
Research Question #2

What is the impact of the critical element training program on subjects' ability to diagnose correct and incorrect batting performances?

Figure 4.3 represents the percentage of correct responses for the 13 critical elements across analysis, diagnosis, and feedback for subject three. Based on the corrected analysis response, subjects were required to write a diagnostic statement of the performance trial. Scores for diagnosis were tallied and converted to percentage scores for each of the 13 critical elements. Ten batting performances were included in each of the 13 sessions.

Baseline data for diagnostic ability of subject three resulted in a mean score of 55%, with scores ranging from 43% to 65% (see Figure 4.3). During baseline, scores revealed a significant increase in trend at a level approximately 20% below the baseline scores for analysis. Variability of data points during baseline was minimal as scores fell within a range of 08% of the ascending trend line.

After training, diagnostic performance of subject three produced a mean score of 74%, a significant increase of 19% over the baseline mean. Data points for diagnostic ability of subject three continued on an ascending trend with scores ranging from 69% to 79%. The highest percentage (79%) of correct responses for diagnosis by subject three was
recorded in Session 9. Scores after training were relatively high and stable.

Variability for sessions after training was extremely steady with a narrow range of 09%. The lowest data point (70%) in Session 10 was higher than the highest data point (65%) in Session 6 during baseline.

Diagnostic ability of subject three in the follow-up maintenance session decreased 09% after an absence of 10 days. This result is analogous to the 11% decrease revealed in the follow-up session of subject three for analysis. Follow-up maintenance represented a decrease of 10% from the mean score after training but an increase of 10% from the baseline mean. The follow-up maintenance score was identical to the overall diagnostic ability of 65% for subject three, thus maintaining diagnostic ability at a consistent rate.

Table 4.8 indicates the itemized number of tallies and mean scores for correct responses for diagnosis of the 13 critical elements for each session recorded by subject three. The highest number of correct responses for subject three in diagnosing all critical elements included a score of 121/130 (x=9.3) for Critical Element S-2. The lowest number of correct responses scored by subject three again represented Critical Element S-6, scoring 3/120 (x=.23). Failure to include all components of the critical element (i.e. hip and shoulder rotation continues with weight
Sess.  P-1 P-2 P-3 P-4 P-5 P-6  S-1 S-2 S-3 S-4 S-5 S-6 S-7 Total
1   0  6  2  1  2  6  1  8  7  5  8  0 10  56
2   10  9  0  0  6  5  0  9  8  5  8  0  6  66
3   10  7  4  0  3  7  1  9 10  1  8  0 10  70
4   10  8  3  0  4  6  0  8  9  7  9  1 10  75
5   7  8  9  0  5  5  6  9  9  7  5  0  5  75
6   9  9  8  1  6  7  6 10  6  8  6  0  9  85
7   10 10  8  0  8  9  4 10  8  7  7  0  9  90
8   10 10  9  0  9  9  7 10  8 10  9  0 10 101
9   10 10  9  7  8  8 10  9 10  6  7  0  9 103
10  10  8  9  1  5  9  7  9  7  9  8  0  9  91
11  10  8  9  5  7 10  7 10  9  8  8  0  9 100
12  9  10  9  3  3  9  9 10  8  9  6  1 10  96
13  8  5  8  1  6  8  6 10  8  7  8  1  9  85
Total 113 108 87 19 72 98 64 121 107 89 97 3 115 1093
Mean  8.7  8.3  6.7  1.5  5.5  7.5  4.9  9.3  8.2  6.8  7.5  .23  8.8  84.1

Table 4.8: Correct responses for diagnosis of 13 critical elements by session for subject three.

transfer to the forward foot on follow-through) in the diagnostic statement accounted for an extremely low score.

Scores for remaining critical elements in both the preparatory and swing phases ranged from 1.5 to 8.8.

Subject three reported similar mean scores for all critical elements in the preparatory phase (497/780, x=6.4) and in the swing phase (596/910, x=6.5). Mean scores for subject three in diagnosis ranged from 1.3 to 1.8 lower than scores in analysis.
Subject three was able to maintain diagnostic ability after training at a level higher than baseline but lower than analysis after training. Although the score for follow-up maintenance was below the mean score after training, performance was consistent for the overall diagnostic ability of subject three.

Scores for the number of correct responses for Critical Elements P-3, S-1, and S-4 increased dramatically after training in analysis (Table 4.8) suggesting that induction may have occurred as a result of training in Session 4. Critical Element P-3 increased 4.7 in mean score during Sessions 4 through 6 (20/30 correct responses), after analysis training and prior to diagnosis training. After training in Session 7, Critical Element P-3 continued to increase and showed a mean score of 8.7 (61/70 correct responses). Critical Element S-4 increased 3.6 (22/30 correct responses) in mean score in the three sessions after analytic training. After diagnosis training in Session 7, subject three continued to show improvement in diagnostic ability with a moderate increase of .7 and a mean score of 8.0 (56/70 correct responses). Similar but less dramatic results occurred with Critical Element S-1 as subject three recorded 2/30 correct responses during Sessions 1 through 3 and 12/30 correct responses during Sessions 4 through 6.

Overall low scores for Critical Elements P-4 (19/130 correct responses) and S-6 (3/130 correct responses) were a
result of incomplete diagnostic statements by subject three. For example, subject three's response to an incorrect performance of Critical Element P-4 included "hands were not together." Although this answer was partially accurate, specificity of the statement should have been stated as "hands were separated but left hand was on top of the right hand" (for a left-handed batter). The original diagnostic statement merely negated part of the critical element. Points were awarded based on the statement indicating what actually happened during the batting performance. Therefore, no credit was awarded for a partial and/or negated answer.

Subject three produced similar responses when addressing Critical Element S-6. A complete description of the critical element should have read "hip and shoulder rotation continuing with weight transfer to the forward foot on follow through." A high percentage of responses failed to include all three components of the critical element: hips, shoulders, and weight transfer to the forward foot. As mentioned previously, no credit was awarded for an incomplete answer for either a correct or incorrect performance.

Research Question #3

What is the impact of the critical element training program on subjects' ability to provide appropriate feedback specific to correct and incorrect batting performances?
Figure 4.3 shows the percentage of correct responses as a ratio of points awarded for the 13 critical elements across analysis, diagnosis, and feedback for subject three. Feedback scores were calculated by adding the sum total of correct responses and converting to a percentage score. Scores were derived from all 13 critical elements of 10 batting performances per session.

Baseline scores for feedback (Figure 4.3) by subject three demonstrated a low to moderate level of performance but illustrated an increase in trend with some variability. Baseline mean score for feedback statements by subject three was 36%, with a range of 18% to 48%. After recording the lowest (18%) of all scores recorded for feedback in Session 1, subject three steadily improved in providing specific feedback statement throughout baseline. The increase in trend during feedback baseline condition is similar to that of analysis and diagnosis.

After training, a robust increase in trend occurred in Session 10 as subject three demonstrated feedback proficiency at 71%, an increase of 29% from the previous session and 35% improvement above the baseline mean. Feedback scores for Sessions 10 through 12 remained at a high and stable level. The mean score of 77% was 41% above the baseline mean and included a range from 71% to 81%. The lowest data points after training showed no overlap and were clearly visible above the highest data points during
baseline, accounting for minimal variability within and across conditions.

Subject three concluded the follow-up maintenance session 10 days after completing combined Sessions 11 and 12. Subject three recorded a score of 75%, 39% above the baseline mean and slightly below after-training condition scores (see Figure 4.3). Follow-up maintenance remained at a high and stable level as subject three sustained the ability to provide feedback for correct and incorrect critical elements of a batting performance.

Table 4.9 scores indicate the number of correct responses for feedback statements of the 13 critical elements for each session recorded by subject three. The highest number of correct feedback statements accumulated by subject three was 115/130 (x=8.8) for Critical Element S-3. The lowest number of correct feedback statements involved Critical Element S-6, recorded at 8/130 (x=.62). As in diagnosis, subject three did not respond with a complete statement of the critical element. Mean numbers for remaining critical elements ranged from 1.8 to 7.8. Higher scores by subject three were evident in the preparatory phase (402/780, x=5.2) than in the swing phase (413/910, x=4.5). Similar results in scores were also found throughout the analysis phase for subject three.

The ability of subject three to provide specific praise and corrective feedback statements improved drastically as a
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Mean 7.8 3.5 4.5 3.5 4.1 7.5 2.8 5.2 8.8 6.2 1.8 .6 6.3 62.7

Table 4.9: Correct responses for feedback of 13 critical elements by session for subject three.

The result of training. The gradual increase in trend for data points across all conditions was more evident in feedback than in analysis and diagnosis. The largest increase in percentage of correct responding and highest maintenance level for all three behaviors occurred with feedback.

Critical element training in feedback seemed to have the greatest impact on Critical Elements P-2 and S-2. Subject three increased from a mean baseline score of 1.2 (11/90 correct responses) to a mean score 8.8 (35/40 correct responses).
responses) after training for P-2. Results for Critical Element S-2 improved from a baseline mean of 3.0 (27/90 correct responses) to a perfect mean score of 10 (40/40 correct responses) after training.

Scores for the number of correct responses for Critical Elements P-4 and S-1 increased immediately after diagnosis training, suggesting that induction occurred prior to feedback training between Sessions 7 and 9. During Sessions 1 through 6, correct responses totaled 1/60. During Sessions 7 though 9 and before feedback training, correct responses totaled 19/30. Subject three increased the baseline mean score of Critical Element P-4 from .17 to 6.3, and then remained consistent (x=6.5) after training. Critical Element S-1 showed a less dramatic increase from .33 to 2.7 in mean scores. Correct responses for Sessions 1 through 6 were reported at 2/60, while during Sessions 7 through 9, 8/30 accounted for the number of correct responses. After feedback training in Session 10, the mean score increased to 6.8 (27/40 correct responses).

Scores for number of correct responses for Critical Element S-6 showed a slight increase in mean score after training. This insignificant improvement parallels the scores recorded by subject three for diagnosis. As mentioned previously, subject three failed to address the entire critical element in the response statement, and therefore did not receive credit for the answer. An
improved performance occurred with Critical Element P-4 in comparison to the results for diagnostic ability.

Analysis of Subject Four

Biographical Data

Subject four was a female elementary physical education specialist with 10 years teaching experience for grades K-5, including instruction for students with disabilities. Additional instructional opportunities included coaching track and field in Special Olympics for five years. Formative training for developing analytic ability was completed 12 years prior to the study in undergraduate kinesiology and skill analysis courses.

Content Knowledge

Subjects' knowledge of content of the 13 critical elements was measured by prerequisite tests completed prior to the start of the training program and each day of data collection. Subject four completed 9 prerequisite tests at 100% criterion. Each test by subject included a precise and accurate description of the critical elements.

Research Question #1

What is the impact of the critical element training program on subjects' ability to analyze correct and incorrect batting performances?

Figure 4.4 provides the percentage of correct responses as a ratio of points achieved by subject four for the 13
critical elements across analysis, diagnosis, and feedback behaviors. Analytic ability was determined by the total number of correct responses in each session and converted to a percentage score. Each session included 10 batting performances.

Baseline data for visual discrimination demonstrated a ceiling effect and showed a very high and stable level as indicated in Figure 4.4. After an initial score of 89%, a slight ascending trend in the scores was evident. Insignificant variability was noted as scores fell within a range of 03%. Baseline mean for subject four was 91%.

Immediately following baseline, training occurred and subject four showed a slight increase of 02% in Session 4 with a score of 95% (Figure 4.4). Subject four maintained analytic ability for the remaining 9 sessions at a higher and stable level than baseline. After training, subject four recorded a mean score of 95%, a 04% increase from the mean baseline score. The highest score recorded by subject four for accurately analyzing critical elements per session occurred after training in Session 8, as subject four achieved a score of 128/130 (98%). Data after training represented a level trend.

Variability for analysis scores was extremely stable. With the exception of the data point (92%) in Session 12, all data points after training remained higher than the data
Figure 4.4: Multiple baseline across behaviors design showing percentage of correct responses as a ratio of points awarded for analysis, diagnosis, and feedback for subject four.
points during baseline. Percentage of correct responding was relatively consistent after training for subject four.

The follow-up maintenance session for subject four was completed 21 days after the completion of Session 12 due to an out-of-town commitment. Nevertheless, subject four showed a 05% improvement in analytic ability from the previous session, recording a score of 97% in Session 13.

Table 4.10 shows the number of correct responses attained by subject four when analyzing the 13 critical elements for 10 batting performance trials in each session. Subject four scored a perfect 130/130 (x=10) when analyzing Critical Element P-1. The lowest mean score for analysis by subject four included Critical Element S-6, scoring 116/130 (x=8.9). Mean scores for the remaining critical elements in both phases ranged from 9.1 to 9.8. Subject four scored somewhat higher for analysis of critical elements in the preparatory phase (746/780, x=9.6) than for critical elements in the swing phase (852/910, x=9.4).

The ability of subject four to analyze the critical elements for correct and incorrect batting performances was maintained at a high and stable level throughout the training program. After showing a slight increase in trend during baseline, analytic scores increased slightly and remained at a flat trend. Variability for all data points was insignificant. Subject four's data for analysis produced a ceiling effect for percentage of correct
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Table 4.10: Correct responses for analysis of 13 critical elements by session for subject four.

responses and the number of correct critical elements for all sessions.

**Research Question #2**

What is the impact of the critical element training program on subjects' ability to diagnose correct and incorrect batting performances?

Figure 4.4 reveals the results of percentage of correct responses for the 13 critical elements across analysis,
diagnosis, and feedback. Subjects' scores for diagnosis were based on the corrected analysis response and determined by the percentage of correct responses for each of the 13 critical elements of a batting performance. All sessions included 10 different batting performances.

Baseline data for diagnosing the 13 critical elements of batting performances for subject four demonstrated a very high and stable level and represented a very slight increase in trend (Figure 4.4). All six sessions showed very little variability and were scored in the 90th percentile, ranging from 91% to 95%. Subject four accrued a mean baseline score of 93% for diagnosis.

Subject four maintained a high and stable level for diagnosing critical elements after training. Scores in the remaining 6 sessions were maintained at the 90th percentile with a range identical to scores achieved during baseline. The mean score of 93% following intervention matched the mean baseline score of 93%. As previously reported during baseline, variability was insignificant after training.

Data for subject four in follow-up maintenance was maintained at a high and stable level just 02% below previous mean scores during baseline and after training. Overall diagnostic ability of subject four was 93%, demonstrating little to no variability throughout all 13 sessions of the training program.
Table 4.11 represents the itemized number of correct responses for diagnosis for each critical element in all 13 sessions. The highest number for correct responses was 129/130 ($x=9.9$) for Critical Element P-4. The lowest number of correct responses was 99/130 ($x=7.6$) for Critical Element S-6. Remaining scores for all critical elements ranged from 107/130 ($x=8.2$) to 128/130 ($x=9.8$).
Subject four was able to maintain consistency in diagnosing all 13 critical elements in both the preparatory and swing phases during all conditions. Data remained at an extremely high and stable level, revealing very little variability and change in trend. Mean scores for diagnostic ability of subject four were consistent at 93% and similar to mean scores for analysis during all conditions. Only a few insignificant changes occurred in the number of correct responses involving Critical Element S-6. Subject four's score decreased slightly by a mean of 1.8 in the 3 sessions following diagnosis training. The mean score for diagnosis then increased, showing a mean of 8.5 after feedback training occurred in Session 10. Aside from this one variation in number of correct responses, all diagnostic statements were an exact replication of prerequisite tests.

Research Question #3

What is the impact of the critical element training program on subjects' ability to provide appropriate feedback specific to correct and incorrect batting performances?

Figure 4.4 shows the percentage of correct responses as a ratio of points awarded for subject four when providing feedback for the 13 critical elements of batting performances. Based on the diagnostic response, a praise or corrective feedback statement was required for each critical element of a batting performance. Ten batting performances were included in each session.
Baseline scores for feedback of subject four greatly improved and were maintained at a high and stable level after the initial three sessions (Figure 4.4). Baseline mean score for feedback by subject four was 88%, with a range of 67% to 95%. Following the lowest score for providing feedback recorded by subject four in Session 1 at 67%, a significant increase of 15% occurred in Session 2. Baseline data for feedback demonstrated an increase in trend of 21%.

After training in Session 10, subject four attained the highest percentage of 99% for all sessions of the training program, accumulating 129/130 correct answers. Feedback scores for Sessions 10 through 12 improved over baseline and remained extremely high and stable with the mean score of 97%, 09% above the baseline mean. Variability for scores after training was insignificant.

Table 17 indicates the number of correct responses for feedback statements of the 13 critical elements for each session recorded by subject four. Subject four recorded the highest score of 130/130 (x=10) for Critical Element S-3 and the lowest score of 96/130 (x=7.4) for Critical Element S-6. Mean scores for the remaining critical elements in both the preparatory and swing phases ranged from 8.1 to 9.9.

Subject four's ability to provide specific praise and/or corrective feedback statements improved during baseline. After training, subject four increased the
Table 4.12: Correct responses for feedback of 13 critical elements by session for subject four.

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percentage of correct responses, maintaining a very high and stable level. Mean scores for feedback responses parallel previous mean scores for analysis and diagnosis. Data across all conditions for all three behaviors increased. Feedback statements were considerably identical to the original list of critical elements (see Table 3.2). Similar results occurred in the diagnostic phase of the program.
Summary

Results of the critical element training program were analyzed by the research questions addressing analysis, diagnosis, and feedback. A summary of the results for each question follows.

Results indicated that all subjects improved and maintained the ability to analyze all 13 critical elements of batting performances at a high and stable level. Subjects one, two, and three were consistent with overall mean scores ranging from 79% to 81%. Subject four recorded an overall mean score of 95% for analysis. All subjects recorded their highest scores analyzing Critical Element P-1 with correct responses totaling 489/520. Subjects one (96/130) and two (83/130) scored lowest for Critical Element P-3, while subjects three (84/130) and four (116/130) scored lowest for Critical Element S-6. When considering the three lowest scores recorded by each subject for all sessions, Critical Elements S-5 and S-6 were included.

All subjects were able to improve and maintain diagnostic ability for the 13 critical elements of batting performances. Overall percentage of correct responses for the 13 critical elements in the diagnostic phase demonstrated a wider range of results. Subjects one and three reported overall mean scores of 61% and 65%, respectively. Subject two scored higher at 82%, and subject four scored the highest at 93%. Critical Element S-2
received the most correct responses (494/520), recorded as the highest score for subjects one and three (240/260), and second highest for subjects two and four (254/260). Subjects two and four scored highest on Critical Element P-4 (257/260). The lowest number of correct responses (223/520) for subjects involved Critical Element S-6, recorded by subjects three (3/130) and four (99/130) as their lowest, subject two (75/130) the second lowest, and subject one (46/130) the third lowest.

As in analysis and diagnosis, all subjects improved in feedback and maintained stable levels of performance after training. Results in feedback were similar to scores reported in diagnosis for all subjects with the exception of subject three. Subject one and two reported overall mean scores of 57% and 52%, respectively. Subject three reported the lowest overall mean score for feedback at 48%. Subject four remained consistent at a very high and stable level with an overall mean of 91%. Critical Elements S-2 and S-3 ranked either one or two as the highest score recorded by subjects one (250/260), two 246/260), and four (259/260). As Critical Element S-3 was highest for subject three (115/130), Critical Element P-1 ranked second highest with a score of 101/130.

Effects of the critical element training package using self-instruction on the ability of inservice physical educators demonstrated effectiveness. All subjects were
able to improve and maintain existing behaviors for analyzing, diagnosing, and providing feedback for the 13 critical elements of the striking skill of batting.
CHAPTER 5
DISCUSSION, IMPLICATIONS, AND RECOMMENDATIONS

Discussion

The purpose of this study was to examine the effectiveness of a critical element training package using self-instruction on the ability of elementary inservice physical educators to analyze, diagnose, and provide appropriate feedback for the striking skill of batting. Four inservice teachers agreed to participate in the study. A single subject, multiple baseline across behaviors design was used for assessing analysis, diagnosis, and feedback behaviors for the striking skill of batting. Raw scores were converted to percentage scores as a ratio of points awarded. All subjects completed 13 sessions on a variable time schedule.

Three research questions guiding this study are stated in the discussion. Question one addressed results of subjects' ability to analyze critical elements of batting performances. Question two addressed results of subjects' diagnostic ability for critical elements of performances. Question three addressed subjects' ability to provide feedback for critical elements of batting performances.
Research Question #1

What is the impact of the critical element training package using self-instruction on subjects' ability to analyze correct and incorrect batting performances?

Subjects' scores for analysis were determined by the percentage of correct responses of the 13 critical elements for a batting performance trial. Ten different batting performances were included in each of the 13 sessions. Procedures for analysis required subjects to circle the letter C (correct) or I (incorrect) for each critical element of the 10 batting performances in a session. All subjects completed the requirements for analyzing the critical elements.

Baseline scores for subjects when analyzing the 13 critical elements in videotaped batting performances were demonstrated at a high and level trend, representative of a high percentage of correct responding. Mean scores for subjects one, two, and three fell within a range of 76% to 82% and showed little variability. Subject four recorded a baseline mean score of 91%. These findings were contradictory to studies involving preservice teachers that reported subjects were unable to verbally and/or visually identify critical elements prior to intervention (Halverson, 1987; Johnson, 1990; Kniffin, 1985; Morton, 1989; Rush, 1990; and Wilkinson, 1986). Prior teaching experiences provide valuable information when analyzing sport skills.
Previous to training, subjects' percentage scores reflected the ability to analyze the majority of critical elements in batting performances. Subjects with knowledge and familiarity of the sport had less difficulty identifying critical elements and showed higher scores than subjects with minimal and no experience (Harari, 1986; Imwold & Hoffman, 1983, 1986; Petrakis, 1987). The highest percentages of correct responding for all subjects varied across sessions. While subjects three and four increased successively in percentage of correct responding, subjects one and two scored highest in Session 2 and then declined 04% and 03% respectively.

Subjects' mean scores for analysis of all critical elements during baseline was 82%. Subject four was the only subject to score above the mean at 91%. Subject two matched the mean score of 82%, while subjects one and three scored below the mean at 80% and 76% respectively.

The highest number of correct responses by all subjects pertained to Critical Element P-1, indicating a mean number of 9.7 and a range from 9.3 to 10. Analyzing Critical Element P-1, stated as "stand at the side of the plate with side of the body facing the pitcher", may have been the easiest to observe and respond. During orientation, the ready position of the batter was presented by the researcher as a position facing the batting tee and perpendicular to the target, thus defining the range of correctness.
Knowledge of the range of correctness of a critical element allows observers to evaluate and diagnose performances with less difficulty (Knudson & Morrison, 1997).

The lowest number of correct responses by all subjects involved Critical Element P-4, indicated as "bat is gripped with hands touching, rear hand over the front hand." The mean number reported was 7.6, with a range from 7.0 to 8.7. Feedback from the subjects indicated difficulty in seeing the batter's hands in a stationary position. Even though Critical Element P-4 occurs in a static state, many batting performances produced continuous movement of the hands throughout the batting swing. Consequently, subjects may have experienced difficulty in observing this specific element in a stationary position.

After training, all subjects increased their ability to analyze the 13 critical elements of batting performances. Analytic ability levels showed a moderate increase across all subjects following training. Subjects' ability to maintain and improve competence for analyzing various critical elements was reported in similar studies (Halverson, 1987; Kniffin, 1985; Morton, 1989; Rush, 1990; Wilkinson, 1986).

As in baseline, subjects experienced the highest number of correct responses after training for analyzing Critical Element P-1 and the lowest accuracy rate analyzing Critical Element P-4. Selected performances of Critical Element P-1
(stand at the side of the plate with side of the body facing the pitcher) were demonstrated at opposite ends of the continuum making it relatively obvious to discriminate between a correct and incorrect demonstration (Williams, 1995). As mentioned previously, difficulty in analyzing Critical Element P-4 (grip/hand position) may have been a result of some performers' hands moving throughout the swing, thus making it difficult for subjects to observe hand position in the preparatory phase as well as position through the swing and at contact of the ball.

Overall, all subjects demonstrated a very slight level of improvement as a result of analysis training. In the follow-up maintenance session, all subjects were able to accurately analyze the critical elements of videotaped performances above 74%. Subjects one and three reported a slight decrease in trend in follow-up maintenance while subject two maintained a stable performance and subject four increased in performance. Unlike baseline and after-training scores, subjects' overall scores for the highest number of correct responses involved Critical Element P-4 and P-5 (bat is back to a position over the shoulder, pointing up and back). The overall lowest number of correct responses by all subjects involved Critical Element P-2 (feet are spread about shoulder-width apart).

Critical element training in analysis demonstrated no functional relationship but produced slight increases in
subjects' ability to maintain and improve analytic ability. As a result of training, subjects improved initial abilities for all 13 critical elements of the batting swing. Even though results were not significant, more dramatic results were found in studies that included preservice teachers observing combinations of correct and incorrect examples of throwing, catching, and striking skills (Beveridge & Gangstead, 1988; Gangstead, 1984; Gangstead & Beveridge, 1984; Morrison & Reeve, 1986, 1988, 1989).

Research Question #2

What is the impact of the critical element training package using self-instruction on subjects' ability to diagnose correct and incorrect batting performances?

After observing videotaped batting performances and analyzing critical elements as correct or incorrect, subjects were required to write a diagnostic statement addressing each critical element in the batting performance and specify the cause of each critical element. Diagnostic statements were written after subjects corrected the analysis response.

Baseline scores for diagnosis of the 13 critical elements in videotaped batting performances were demonstrated at a moderate to high rate for subjects prior to training. Subjects' diagnostic scores reflected their initial ability to diagnose errors in batting performances. Subjects' mean scores during baseline were represented at
rates ranging from 46% to 93%, with an overall mean score of 67%. All subjects demonstrated a modest increase in trend. Findings from similar studies with preservice teachers produced low results prior to diagnostic training for critical elements and performance principles of various sport skills (Johnson, 1990; Matanin, 1993; Rush, 1990; Williams, 1995).

Based on the corrected analytic response, all subjects increased their ability to diagnose Critical Element P-4 (bat gripped with hands touching each other). Overall, the highest percentage of correct responses involved Critical Element S-2 (hips rotate toward the pitcher) at 91%. The lowest percentage of correct responses involved Critical Element S-6 (hip and shoulder rotation continues with weight transfer to forward foot on follow through) at 32%. Although subjects were able to analyze these two critical elements at a high rate, low scores were attributed to incomplete and inaccurate diagnostic statements involving incorrect performances.

Following training, subjects one, two, and three demonstrated an increase in their ability to diagnose the 13 critical elements, represented by a rate of increase in mean score ranging from 16% to 27%. Results of diagnostic ability for subject four remained consistently high and stable at 93%. Unlike baseline scores, the highest accuracy rates for all subjects after training involved Critical
Element S-2 (hips rotate toward the pitcher). Low numbers of correct responses for Critical Element P-4 (bat is gripped with hands touching) (16/130, x=1.5) and S-6 (hip and shoulder rotation continues with weight transfer to forward foot on follow through) (1/130, x=.01) were reported by subject three. Subject two recorded the lowest number of correct responses (26/130, x=3.4) for Critical Element S-4 (arms are fully extended with contact of the ball). Subject one scored lowest (6/130, x=.46) for Critical Element P-5 (bat is back to a position over the shoulder, pointing up and back).

Overall, examination of data indicated training in diagnosis was representative of a weak to moderate functional relationship, with scores depicting an increase in diagnostic skills for subjects one, two, and three. Scores for subject four demonstrated a ceiling effect as scores remained consistent within a range of 90% to 95%, indicative of no functional relationship between training and diagnostic ability. Although diagnostic ability scores were demonstrated below analytic ability, subjects' scores were all above 61%. Previous research presented concerns relating to analysis and diagnosis as one entity (Johnson, 1990; Matanin, 1993; McPherson, 1990). Despite the outcome of subjects' moderate to high overall scores, these findings relate to past research indicating that analysis and diagnosis should be addressed as separate instructional
components when training subjects (Matanin, 1993; Rush, 1990; Williams, 1995).

Subjects' ability to maintain diagnostic ability for the 13 critical elements of batting performances was evident in follow-up maintenance. All subjects were able to accurately diagnose the critical elements above 65%. Subjects one and two reported a moderate increase in trend, while subjects three and four showed a slight decrease.

Research Question #3

What is the impact of the critical element training package using self-instruction on subjects' ability to provide appropriate feedback specific to correct and incorrect batting performances?

Based on the analysis and diagnosis of each critical element in the videotaped batting performances, subjects were required to write a specific corrective or specific praise feedback statement addressing each critical element of a performance. Feedback statements were transcribed according to the corrected analysis response and subsequent diagnostic statement for each critical element.

Baseline scores for subjects when providing specific corrective or specific praise feedback statements demonstrated the most variability of the three skill analysis behaviors. Subject baseline scores ranged from 36% to 88%, with a mean score of 54%. These findings reflect and support previous models for conceptualizing a
performance (Barrett, 1983; Neilson & Beauchamp, 1992) and focusing on discrepancies between the observed and desired performance when developing feedback patterns (Neilson & Beauchamp, 1992).

During baseline, all subjects scored their highest number of correct responses for Critical Element S-3 (bat is brought around parallel to the ground in line with the ball), with a mean score of 9.3 and a range from 8.8 to 10. While all subjects recorded their highest scores for Critical Element S-2 (hips rotate toward the pitcher) in diagnosis, three of the four subjects reported their second highest scores with the same critical element when providing feedback. Induction from training in diagnosis might account for the direct correlation of content knowledge for Critical Elements P-1, P-2, P-3, P-4, and S-1 prior to and after feedback training.

Low and variable scores during baseline were a result of incomplete and inaccurate feedback statements. For example, where subject four indicated "rotate hips and shoulders while shifting weight to your front foot," subject two commented "allow your body to move around with the swing." The significance of providing specific feedback to low and high-skilled students is warranted. Results of previous studies indicated immediate improvement, higher success rates, and consistency in performance when teachers provide specific and corrective feedback (Pellett &

Following training, subjects one, two, and three demonstrated an increase in trend, represented by a mean percentage score ranging from 29% to 41%. Subject four increased in mean score by 09%. As a result of training, subjects provided feedback statements that were specifically related to the critical elements in both corrective and praise form.

A moderate to high functional relationship existed for subjects one, two, and three relative to training and the ability to provide feedback. Subject four results demonstrated a ceiling effect throughout all sessions and may have reflected a level of achievement and previous content knowledge of the critical elements of the batting swing. Responses provided by subject four were extremely precise and descriptive. Similar results pertaining to high achievement individuals (i.e. experienced teachers) upon entering training programs indicated superior preparation, more appropriate feedback, efficient feedback patterns, and higher grades (Neilson & Beauchamp, 1992; Smith, Kerr, & Meek, 1993).

Implications for Teacher Education

Data suggest that videotape training using self-instruction was effective in improving subjects' analytic
ability. Similar findings have been reported in previous studies (Beveridge & Gangstead, 1988; Gangstead, 1984; Gangstead & Beveridge, 1984; Morrison & Reeve, 1986, 1988, 1989). Considering the overwhelming amount of course content covered by physical education teacher education (PETE) programs in preparation of preservice teachers, results of this study suggest that self-instructional training packages should be considered in skill analysis courses.

Training packages using self-instruction originating from videotape, video disc, and computer-generated sources provide supplementary instruction for teachers in the field as well. As this study involved training in a laboratory setting using videotape of a closed skill, further research is needed to examine maintenance of analytic ability in live settings where sport skill performances could be masked by continuous environmental interference. Although evaluative skills transferred from training to the live setting (Kniffin, 1985), others have found that video training did not improve live observational skills (Eckrich, Widule, Shrader, & Maver, 1994). Physical education teacher education programs must move beyond the scope of observational training and require experiences in the live setting.

Training in skill analysis is normally covered in one or two undergraduate methods courses. Physical Education
Teacher Education (PETE) programs should consider providing preservice teachers with multiple opportunities for skill analysis in all sport skill-related classes. Analytic opportunities could include peer observation and evaluations, videotaped self-evaluations, and small group feedback sessions. Wilkinson (1991) indicated that self-instructional training should not only be considered as an appropriate and feasible method for training preservice teachers, but that it may be an absolute necessity.

Research has indicated that preservice and inservice teachers can be trained to improve and maintain initial levels of analytic ability (Eckrich, Widule, Shrader, & Maver, 1994; Wilkinson, 1991, 1996). As critical element and performance principle approaches to skill analysis have demonstrated time effectiveness, there still remains the need to examine a more efficient process for encompassing the vast amount of sport skills that teachers will encounter in the teaching environment.

Significant to the present study was the critical question of time. In response to an exit questionnaire regarding the least congenial facet of the training package, all four subjects mentioned time. Statements such as "the amount of time," "sessions were too long for my attention span," and "extremely long time commitment" were indicative of concerns in fulfilling the obligatory 13 sessions allocated to develop analytic ability for the striking skill
of batting. Given the lengthy time needed to complete just one regular session (approximately 90 to 180 minutes) and one training session (approximately 120 to 180 minutes), it may be feasible to include sport skills that share similar critical elements for sidearm striking (i.e. badminton, tennis, racquetball).

Data suggest use of a critical element training package demonstrated positive effects and improved subjects' overall analytic ability. Wilkinson (1991) suggested skill analysis training might be taught more efficiently by incorporating shared common performance features, where subjects would experience transfer of learning.

From a theoretical standpoint, skill analysis is more than the process of observing sport skills and concluding with possible suggestions for changing student behavior. The importance of knowing what critical elements to observe, whether each critical element is correct or incorrect, determining the cause of an incorrect performance, and providing praise and/or corrective feedback relative to performance are crucial steps when preparing preservice teachers for careers in teaching and coaching. The need for PETE programs to include all steps of the skill analysis process in undergraduate experiences is both vital and warranted.

Recognizing that PETE programs attempt to provide preservice teachers with tools necessary for teaching in the
physical education environment, this study was an attempt to examine analytic ability of inservice physical education specialists. Data results for each subject would suggest that past and present teaching and coaching experiences had an effect on initial analytic abilities. Overall, the lowest scores were reported by subjects one and three, whose teaching experiences totaled 5 and 14 years, respectively. Additionally, subject one had coaching experience in track and field, double dutch jump rope, and cheerleading, areas unrelated to the striking skill of batting. Demonstrating slightly higher scores than subject one, subject three had three years coaching experience in basketball and presently participated in recreational softball.

Scores reported by subject two were slightly higher than scores of subjects one and three, with subject two scoring measurably higher (17% to 20%, respectively) in diagnosis. Although subject two maintained analytic and diagnostic ability at a high level, feedback scores were initially low but improved after training to 52%. What is worth noting is that subject two reported 10 years experience coaching softball and had the second highest number of years (13) teaching experience.

The highest scores reported by all subjects for all behaviors involved subject four. Subject four described coaching experiences unrelated to striking skills (i.e. track and field). In addition to having the second fewest
number of years (10) teaching, subject four indicated current experience related to observations and discussions involving recreational tee-ball. When asked to comment on the most-liked aspect of the training package, subject four remarked "I actually learned a lot more about striking critical elements than previously known."

Similar results for improving analytic behaviors of experienced teachers have been reported by Behets (1996) and suggest the need for increased efforts in promoting and enhancing teacher observational training for both preservice and inservice teachers. Aside from the traditional undergraduate educational experience and occasional enrollment in graduate courses, PETE programs, in accordance with local schools, could develop partnerships and work collaboratively with inservice teachers. Consequently, the development of such collaborative efforts increase the probability that effective teaching will begin to emerge, thus enhancing student learning.

**Recommendations for Future Research**

The following recommendations are based on the results of this study and should be considered in future research:

1. This study should be replicated with consideration to limiting subjects to viewing each batting performance once per session. Realistically, teachers in the classroom have but one chance to observe a student's single sport skill
performance. Based on a realistic singular observation occurring in the physical education environment, effective teaching necessitates the ability to analyze, diagnose, and provide appropriate feedback to the student.

2. This study should be replicated by selecting fewer critical elements within the two phases of the batting swing. Skill analysis may be more operational when a performance is evaluated with a modest list of critical elements (Knudson & Morrison, 1997; McPherson, 1990).

3. Replication of the study should consider using videotaped batting performances that include students from all grades at the elementary level.

4. Consideration should be given to addressing an increase in the number of examples of correct and incorrect performances when training subjects to diagnose numerous (13) critical elements.

5. Replication of the study should consider a comparison between inservice physical education teachers and inservice classroom teachers who teach physical education.

6. Subjects in this study had a minimum of six years teaching experience at the elementary level. Future research may wish to consider examining analytic ability of first-year physical educators.

7. This study should be replicated with a generalization phase to include performances of various sidearm striking skills common in elementary curricula.
8. This study should be replicated to include a periodical completion of the prerequisite test once every three sessions just prior to training. This procedure may be used to examine whether content knowledge is maintained by subjects, as well as the effects of subsequent analysis, diagnosis, and feedback responses.

Summary

In summary, results of the data indicate that a critical element training package using self-instruction was effective in producing increased scores for all subjects. Inservice teachers were able to improve and maintain high ability levels in analysis, diagnosis, and feedback for the striking skill of batting. These results concur with previous findings that indicated subjects with teaching experience and competitive coaching backgrounds scored higher than preservice teachers and subjects with general teaching experience (Harari, 1986; Imwold & Hoffman, 1983, 1986; Petrakis, 1987). Although subjects reported moderate to high baseline scores for analysis, diagnosis, and feedback, all subjects demonstrated an increase in initial performance as a result of critical element training.
LIST OF REFERENCES


APPENDIX A

HUMAN SUBJECT CONSENT FORM
CONSENT FOR PARTICIPATION IN
SOCIAL AND BEHAVIORAL RESEARCH

I consent to participating in (or my child's participation in) research entitled:

Effects of a Critical Element Training Program Using Self-Instruction on Sport Skill Analytic Ability of Inservice Physical Education Teachers.

_________________________ or his/her authorized
(Principal Investigator)

representative has explained the purpose of the study, the procedures to be followed, and the expected duration of my (my child's) participation. Possible benefits of the study have been described as have alternative procedures, if such procedures are applicable and available.

I acknowledge that I have had the opportunity to obtain additional information regarding the study and that any questions I have raised have been answered to my full satisfaction. Further, I understand that I am (my child is) free to withdraw consent at any time and to discontinue participation in the study without prejudice to me (my child).

Finally, I acknowledge that I have read and fully understand the consent form. I sign it freely and voluntarily. A copy has been given to me.

Date: _________________________ Signed: _________________________
(Participant)

Signed: _________________________ Signed: _________________________
(Principal Investigator or his/her Authorized Representative)

(Person Authorized to Consent for Participant - If required)

Witness: _________________________

HS-027 (Rev. 3/87) -- To be used only in connection with social and behavioral research.
TEACHER SUBJECT CONSENT FORM

1. Participants will attend an orientation meeting.

2. Participants will attend and complete all required sessions of the training program to receive credit (S). Failure to complete all sessions will result in a grade of (U).

3. Participants must make prior arrangements for any change or delay in the study.

4. Participants will not discuss instructional and videotaped information with other participants throughout the study.

5. At the completion of the study, results will be shared with participants upon request.

I HAVE READ THE ABOVE TERMS OF THE SUBJECT CONSENT FORM. I UNDERSTAND THAT MY PARTICIPATION IS VOLUNTARY. I ACKNOWLEDGE THAT INDEPENDENT STUDY CREDIT WILL BE CREDITED UPON COMPLETION OF THE STUDY.

______________________________  _________________________
Name                                      Date

RESEARCHER CONTRACT TERMS

1. The researcher will comply with designated meetings and times for all instructional sessions.

2. The researcher will award subjects who complete the research project three credit hours of Independent Study (PAES 893) the quarter of completion of the project.

3. The researcher will agree to complete confidentiality of subject identity and study procedures and information.

4. The researcher will share the results of study upon request.

______________________________  _________________________
Researcher                       Date
TEACHER SUBJECT PERSONAL HISTORY PROFILE

TO BE COMPLETED BY SUBJECTS (INSERVICE PHYSICAL EDUCATION TEACHERS) PRIOR TO THE VIDEOTAPE TRAINING PROGRAM. THE INFORMATION WILL BE USED FOR THE PURPOSE OF EXAMINING RELATIONSHIPS TO DEMOGRAPHIC DATA.

NAME ___________________________ AGE _____ SEX _____

MAJOR FIELD OF STUDY ___________________________

MINOR FIELD OF STUDY ___________________________

COURSES TAKEN IN SKILL ANALYSIS, KINESIOLOGY, OR BIOMECHANICS

________________________________________________

________________________________________________

________________________________________________

TEACHING EXPERIENCE (YEARS AND SUBJECT)

________________________________________________

________________________________________________

________________________________________________

COACHING EXPERIENCE (YEARS AND SPORT)

________________________________________________

________________________________________________

________________________________________________
APPENDIX D

SCHOOL PRINCIPAL LETTER
As a current doctoral student at The Ohio State University, I am in the process of collecting videotaped performances of elementary students utilizing striking skills. I am interested in student performance of a batting swing using a batting tee. The purpose of my study is to determine the effects of a critical element training program and the ability of primary subjects (in-service physical education teachers) to analyze, diagnose, and provide appropriate feedback on striking skill performances of elementary students.

So that I am able to obtain a significant sample of batting skill performances in a natural environment, I am requesting permission to videotape second-grade students at your elementary school. Videotaping the striking activity will occur during the regular physical education class as part of a manipulative skills unit. No change in the regular physical education curriculum will occur. The entire procedure will be conducted within a week. Videotapes will only be used for training teachers, will remain with the investigator throughout the study, and destroyed upon completion of the study.

Your assistance in this matter is greatly appreciated. I look forward to a favorable response and thank you for your thoughtful consideration. Should you have any further questions concerning this videotape procedure, I can be reached at the number listed below.

Best regards,

Jeanne Raudensky
Graduate Student

Dr. Sandra Stroot,
Associate Professor
Sport and Exercise
Education
Academic Advisor
APPENDIX E

ELEMENTARY SCHOOL STUDENT CONSENT FORM
Dear Parent or Guardian:

I, Jeanne Raudensky, a current doctoral student at The Ohio State University, am in the process of collecting videotaped performances of elementary students utilizing striking skills. In order to develop a training tape, I am interested in videotaping students performing a batting swing at a ball positioned on a batting tee. The purpose of my study is to determine the effects of a critical element training program for current physical education teachers in their ability to analyze a batting swing and provide the necessary feedback to improve the performance.

So that I am able to obtain a sample of elementary students performing in a natural environment, I am requesting permission for your child to participate. Videotaping of the striking activity will occur during their regular physical education class as part of their manipulative skills unit. No change in their regular physical education curriculum will occur. The entire videotape procedure for each student will involve 30-60 seconds. Student participation is voluntary and they may withdraw at any time without penalty. The videotape will only be used for training purposes, remain with the investigator throughout the study, and destroyed upon completion of the study.

Your assistance in this matter is greatly appreciated. I look forward to your positive and favorable response and thank you for your thoughtful consideration. Feel free to call should you have any questions.

Please complete the attached consent form if you would like your child to participate in the study. Your immediate attention is appreciated.

Best regards,

Jeanne Raudensky
Graduate Student

Dr. Sandra Stroot
Associate Professor
Sport and Exercise Education
Academic Advisor

Enclosures (2)
APPENDIX F

CRITICAL ELEMENT PRETEST

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PRETEST FOR CRITICAL ELEMENTS

SUBJECTS:

PLEASE COMPLETE THE FOLLOWING TWO QUESTIONS ON THE STRIKING SKILL OF BATTING. THE PREPARATORY PHASE IS DEFINED AS THE PHASE IN PREPARATION PRIOR TO A SWING. THE SWING PHASE IS DEFINED AS THE ACTUAL EXECUTION OF THE SWING.

LIST THE SIX CRITICAL ELEMENTS IN THE PREPARATORY PHASE FOR THE STRIKING SKILL OF BATTING.

P-1

P-2

P-3

P-4

P-5

P-6

LIST THE SEVEN CRITICAL ELEMENTS IN THE SWING PHASE FOR THE STRIKING SKILL OF BATTING.

S-1

S-2

S-3

S-4

S-5

S-6

S-7
APPENDIX G
SESSION ANSWER SHEET
SESSION 1 - ANSWER SHEET

ANALYSIS: INDICATE BY CIRCLING C (CORRECT) OR I (INCORRECT) FOR EACH CRITICAL ELEMENT DEMONSTRATED IN EACH PERFORMANCE. WHEN FINISHED WITH THIS STEP, TURN TO THE ANSWER KEY ON THE NEXT PAGE TO CORRECT YOUR ANSWERS.

DIAGNOSIS: BASED ON THE CORRECTED (X) RESPONSE FOR ANALYSIS, WRITE A DIAGNOSTIC STATEMENT THAT DESCRIBES WHAT ACTUALLY HAPPENED FOR EACH CRITICAL ELEMENT.

FEEDBACK: BASED ON THE DIAGNOSIS, WRITE A FEEDBACK STATEMENT THAT ADDRESSES EACH CRITICAL ELEMENT PERFORMED.

PERFORMANCE # 101

C.E. A:

P-1 C I
  D: ____________________________
  F: ____________________________

P-2 C I
  D: ____________________________
  F: ____________________________

P-3 C I
  D: ____________________________
  F: ____________________________

P-4 C I
  D: ____________________________
  F: ____________________________

P-5 C I
  D: ____________________________
  F: ____________________________

P-6 C I
  D: ____________________________
  F: ____________________________

S-1 C I
  D: ____________________________
  F: ____________________________

S-2 C I
  D: ____________________________
  F: ____________________________

S-3 C I
  D: ____________________________
  F: ____________________________

S-4 C I
  D: ____________________________
  F: ____________________________

S-5 C I
  D: ____________________________
  F: ____________________________

S-6 C I
  D: ____________________________
  F: ____________________________

S-7 C I
  D: ____________________________
  F: ____________________________

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