

1991

Student Thought Processes and Quality of Practice During Motor Skill Instruction.

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**Student thought processes and quality of practice during motor
skill instruction**

Solmon, Melinda Ann, Ph.D.

The Louisiana State University and Agricultural and Mechanical Col., 1991

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Ann Arbor, MI 48106

Student Thought Processes and Quality of Practice
During Motor Skill Instruction

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Kinesiology

by

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August, 1991

ACKNOWLEDGEMENTS

There are many people without whom this project could not have been completed. First I must express my sincere gratitude to Fran Ralston, assistant volleyball coach for the LSU women's volleyball team who served as the teacher for the instructional unit. Fran gave freely of her time, expertise, knowledge and patience, and I will be forever in her debt for her role in this study. My fellow graduate students also played essential roles in the data collection process, and I could not have done it without their help. Thanks to Nyit Chin Keh, and Jerry Hand who faithfully and reliably filmed and interviewed on schedule without a hitch. Special thanks to Pam Duncan who not only assisted with data collection but also served as a coder to establish reliability coefficients.

I would also like to thank the members of my committee (Drs. Landin, Magill, Mathews, and Worthy) for their time and valuable input over the course of both my general exams and dissertation. Thank you Jo Carter, for serving on my committee in Dr. Worthy's stead for the final defense, as well as your help in collecting data and moral support throughout this process.

Special thanks to Dr. Amelia Lee, my major professor and mentor, for all of her patience, help and support as I progressed toward my degree. There are no words to express how grateful I am for all that she has taught me.

My friends who put up with me while I was in school also deserve recognition. My friends and co-workers in the East Baton Rouge Parish School Board Special Education Department have been very helpful and supportive as I returned to school. Thanks especially to Melinda Shelton for being always being there.

Though I have always been blessed with many friends, lots of help, and lots of good luck, my family has been the cornerstone of all that I have been able to accomplish. I would like to thank my sister Pam and her husband Keith for their constant encouragement and support. But most of all, I must thank my parents, Dale and Virginia Solmon, for all that they have done for me throughout my life. No human being could have asked for anymore. So I dedicate this to my parents--in memory of my Dad, who believed in me no matter what, and in honor of my Mother, who taught me to believe in myself.

FOREWORD

This manuscript is written in the format of the American Psychological Association. The body of the manuscript is presented in the format of submission for publication to scholarly journals. The remaining sections comprise the appendix and consist of the extended review of the related literature, pilot data, detailed descriptions of instruments employed, and sample interview transcripts.

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ABSTRACT

The focus of this study was the examination of relationships between initial skill level, observer estimates of attention, student thoughts, quality of practice, and achievement during motor skill instruction. Specifically, the following questions were addressed: 1) What is the relationship between observed student behavior to quality of practice and achievement? 2) What is the relationship between student reports of their cognitive processes to quality of practice and achievement? 3) Does written self-report data produce the same information as data collected during stimulated recall interviews? and 4) Are student self-report data about attention consistent with observer estimates of overt student behavior?

Fifty-six sixth grade students participated in a 4-day instructional unit on the forearm pass in volleyball. Prior to instruction, they completed a skill pretest and Harter's perceived competence scale. Subjects completed forms daily about the errors they made during practice. All classes were video-taped so that student behavior and quality of practice could be coded. Selected students also participated in stimulated recall interviews. At the end of the unit, all students were posttested and completed a Cognitive Processes Questionnaire (CPQ) about their attention, use of strategies, and motivation during the unit. Residual gain scores were used as the indicant of

achievement. Correlation coefficients were used to assess relationships between variables of interest.

Correlates of achievement were identified as the number of practice trials, the number of correct practice trials, engaged practice time, motivation as measured by the CPQ, and the ability to verbalize detection and correction of errors during practice. The results suggest that perceived competence and skill level are important factors in how students spend their time in physical education classes. It appears that motivation and attention to detection and correction of errors are closely related variables which impact the quality of practice. The interview data supported the use of the perceived competence scale, the error sampling technique, and the CPQ as methods to gather information about student thought process during instruction. In contrast to previous results, student estimates of attention were not more accurate predictors of student achievement than observer estimates of overt behavior.

Introduction

The investigation of the thought processes of students as they learn is increasingly being recognized as an important consideration in the study of teaching (Peterson, 1988). Investigations conducted on student thought processes are grounded in the belief that learning from teaching does not occur automatically (Wittrock, 1986). Rather, it requires active, effortful information processing or manipulation on the part of the student (Peterson & Swing, 1982). It has been demonstrated that students do mediate instructional events with their cognitive processing to the extent that Winnie and Marx (1982) referred to the cognitive mediational paradigm as a heuristic for educational research. The cognitive element infers that students employ a wide range of cognitive processes during teaching and learning. The student's role as an active agent in the lesson is a critical element in this approach. Students enter the classroom with notions concerning their own abilities, ideas about the subject matter being taught, and attitudes about the class. The aptitudes, beliefs, and prior knowledge students bring with them affect their perceptions of instructional events and the nature of their interaction during class. All of these cognitive processes mediate the effects of instruction on achievement. While the role of the teacher remains a critical element in the teaching-learning process, what the student does is, in

fact, a more important determinant in the learning process that what the teacher does (Shuell, 1986). From this perspective, the nature of teaching is redefined. Rather than directly influencing student behavior, the goal of the teacher is to create an environment which motivates students to think in certain ways. The student's cognitive mediation, in turn, affects achievement.

The cognitive mediational processes which students may employ while learning comprise a complex interrelated network of operations. Their background and experience give them a framework from which they attend to instructional stimuli, perceive or give meaning to those stimuli, and actively employ learning strategies to acquire new information. These aspects of student cognition have been investigated in both the classroom and the gymnasium.

Attention

Attention is a term which is used in many contexts and consequently has no clearly delineated definition (Schmidt, 1988). Matlin (1983) offers a general definition of attention as a concentration of mental activity. Attention in the context of student thought processes during instruction implies a concentration of mental activity directed either toward instruction from the teacher or active engagement in learning tasks. Students choose the aspects of instruction and learning activities to which they attend. Student attention mediates student achievement by

determining what information is processed.

Observed time on task or student attention has been investigated as a predictor of achievement. However, student reports of attention during stimulated recall interviews, as compared to overt observer estimates of attention, have proven to be more valid predictors of achievement (Peterson & Swing, 1982; Peterson et al., 1984).

In an early investigation of student attention in a physical education setting, Locke and Jensen (1974) employed a thought sampling technique to study student attention. They concluded that self-report data gathered from thought samples provides a valid and reliable data source in the investigation of student thought and proposed the investigation of the relationship of skill acquisition and student attention as the next step of inquiry. Fahleson (1988) investigated self-report of students' attention and observed time on task during physical education instruction. She concluded that the assessment of student thoughts may be a more valid technique of evaluating attention than external observation, although both measures were significantly related to post test scores. High levels of attention were also positively related to favorable attitudes toward physical education. Although these two studies provide valuable insight into students' attention during motor skill instruction, much remains to be discovered about the relationships between teacher behavior, student attention,

and achievement during motor skill instruction.

Student Perceptions

Students enter classrooms with different attitudes, backgrounds, and experiences which give them a unique view of events that occur in school. A willingness on the part of students to exert effort in a teaching-learning situation is dependent partly on the ways students perceive their responsibility for learning. Research on motivational thought processes in teaching has attempted to explain and describe why some students seem to take more responsibility for their own learning and are more willing to sustain activity. Findings suggest that perceived competence, the need for achievement, and students' perceptions of the causes of success and failure as learners influence student interest and persistence in learning various school subjects (Wittrock, 1986).

The role of self perception in motivation to participate in youth sports has been studied extensively during the last decade (Duda, 1987; Feltz & Petilchkoff, 1983; Roberts, Kleiber, & Duda, 1981), and findings have supported the notion that a child's perceived physical competence or physical self esteem determines future motivation for participation. Harter's (1978) competence motivation theory has been used to explain the influence of perceived competence on motivated behavior. Harter's (1978) model suggests that individuals are motivated to be

competent in areas such as sport and movement activities and with successful performance competence motivation is enhanced. According to Harter (1978), those children who have successful experiences in sport situations develop a high sense of competence which motivates them to stay involved. Recent research by Klint and Weiss (1987) found that children high in perceived physical competence rated skill development as a more important reason for sport participation than did low perceived competence athletes. These findings provide a context for understanding motivation for skill learning in physical education. The level of perceived physical competence might be related to a learner's interest and persistence in practicing and learning sport skills in physical education class.

In the complex, dynamic environment of the gymnasium, it seems reasonable to believe that student perception of instructional stimuli could be a critical variable. Students enter physical education classes with perceptions of their own abilities, attitudes about physical activity, and ideas about what is important in class. To date, however, little information is available about the meanings students attach to instructional behaviors in physical education, and whether or not those behaviors are perceived in the manner intended. There is evidence to suggest that students in physical education classes are able to perceive differences in teacher expectations as related to perceived

skill level (Martinek, 1988), and teachers' task presentation and systems of accountability (Tousignant & Siedentop, 1983), and that the way in which students perceive instructional stimuli affects their class behavior and achievement.

Learning Strategies

Learning strategies are defined by Wittrock (1987) as procedures used to enhance the acquisition and retention of information. These procedures include behaviors and thoughts of the learner which influence the encoding process (Weinstein & Mayer, 1986). The goal of a learning strategy may be to influence the way a learner selects, organizes, or integrates new material or to affect the learner's motivational state.

When considering the use of learning strategies, a cognitive psychology perspective suggests that modification of strategies, or learning, occurs only when failure is experienced (Matlin, 1983). This view of learning as a failure-driven process may be especially applicable during the acquisition of motor skills. Feedback, or information about the correctness of a response, is a key element in models of information processing. The learner uses feedback or information about the movement and its outcome, to decide whether or not to modify the response or to try and repeat it (Spaeth-Arnold, 1981). According to Schmidt (1988), a major outcome of practice during motor skill acquisition is

an improved ability to evaluate errors. If a student is able to detect his or her errors, that student may be able to implement error correction strategies that would improve quality of practice and achievement.

There is evidence that students are aware of the cognitive strategies they employ and can recall them accurately enough to predict achievement (Wittrock, 1986). The use of specific cognitive strategies is positively related to achievement in mathematics (Peterson & Swing, 1982; Peterson et al., 1984), while the use of general strategies is unrelated (Peterson, et al., 1984) or negatively related (Peterson & Swing, 1982) to achievement. Students who experienced a high level of success during motor skill instruction were able to articulate specific strategies they employed to improve their performance, while low success students were more concerned about their inability to perform the skill than implementing strategies to improve their skill (Lee, Landin, Carter, & Fant, 1989). Taken together these studies support the notion that student ability and achievement are significantly related to students' reports of their thoughts during instruction, both in the classroom and the gymnasium.

Studying Student Thoughts

It has been recognized that the link between teacher behavior and student achievement is not direct (Doyle, 1977). Students actively process instructional events. It

is the manner in which they perceive and process these events which in turn impacts learning. In order to more fully understand and explain effective teaching in physical education, it is imperative that we learn more about students' thoughts as they acquire motor skills. Knowledge about student attention, perception, and learning strategies can enable teachers to teach more effectively by making their instruction more meaningful to their students.

The work that has been conducted in classroom research, as well as the initial work that has been done in physical education settings shows much promise. The study of student thoughts as mediating factors in the relationship between teacher behavior and student achievement appears to provide a viable approach to the examination of the relationship between these two variables. Cognition is internal and cannot be observed, so in order to investigate student thoughts, researchers by design must rely on verbal self-reports of mental processes as data. Although problems associated with accepting self-reports as data are well-documented (Bainbridge, 1979; Nisbett & Wilson, 1977), a thorough review of this issue by Ericsson and Simon (1980) led to the conclusion that data of this type, collected with care, are a valuable and reliable source of information about cognitive processes.

The focus of this study was the examination of relationships between initial skill level, observer

estimates of attention, student thoughts, quality of practice, and achievement during motor skill instruction. Specifically, the following questions were addressed:

1. What is the relationship between observed student behavior to quality of practice and achievement?
2. What is the relationship between student reports of their cognitive processes to quality of practice and achievement?
3. Does written self-report data produce the same information as data collected during stimulated recall interviews?
4. Are student self-report data about attention consistent with observer estimates of overt student behavior?

Methods

Subjects

The subjects for this investigation were 56 sixth grade male and female students in physical education classes at a university laboratory school. These subjects had not received any formal instruction in volleyball prior to this study. An expert volleyball teacher/coach agreed to participate in the investigation as the instructor.

Practice and Achievement Measures

Skill test. The Brumbach forearm pass wall-volley test (Cox, 1980) was administered to assess the skill level of the subjects.

Observation coding system. Student behavior was coded using a low-inference, 5 second interval system. Students were observed for 5 seconds, then the predominant category of behavior which occurred during that category was recorded during the next 5 second interval. During instruction, students were coded as receiving information when they appeared to be listening to the teacher. They were coded as off-task when they were looking away from the teacher, talking to another student, or were engaged in any behavior unrelated to the instruction. During practice sessions, students were coded as practicing, receiving information, waiting, chasing a ball, or off task. Practicing was defined as any interval in which a practice trial occurred. Receiving information was coded when the student was engaged during the interval with the teacher, receiving feedback. Waiting was coded if the student stood patiently during the interval waiting for his or her next trial. When the student spent the entire interval retrieving a ball, that interval was coded as chasing. Student behavior which was not related to practice, such as dribbling the volleyball, throwing the ball at other students, or shooting at the basketball goal, was coded as off-task. Receiving information and practicing were considered to signify engaged time, while waiting and chasing balls were

indicative of nonengaged behaviors.¹

Practice trial coding system. Practice trials were coded as correct or incorrect on the basis of identified skill components. These components were: knees bent, arms locked, level platform, arm action, feet position, and contact point. A trial was coded as correct if 4 of the 6 skill components were performed appropriately.

Measures of Cognitive Processes

Perceived competence scale. Subjects completed the physical and general self-worth subscales of Harter's (1979) Perceived Competence Scale for Children.

Cognitive Processes Questionnaire. In order to elicit information about students' attention levels, use of strategies, and motivation levels during motor skill instruction, a cognitive processes questionnaire (CPQ) for physical education was developed. This questionnaire was adapted from the one employed by Peterson et al. (1984). The scale consists of 15 questions, with 5 questions addressing each of the 3 subscales: attention, strategies and motivation. Subjects responded to questions such as "Do you listen closely to what your teacher says during the PE lesson?" and "Do you miss important things your teacher says because you are not paying attention?" by choosing from the responses usually, often, sometimes, not very often, and

¹A Manual for the coding system is available on request from the author.

almost never. Items were keyed so that positive responses were approximately equally distributed to the right and left sides of the response column. No more than two consecutive items were keyed in the same direction.

Error detection and correction samples. In order to get an open-ended, written sample of student thoughts during class, a very simple form was designed to collect data about students' perceptions of their own errors. Students completed the forms by answering 2 questions. The first required a short description of the errors that they had made. The second asked what they had done to try and correct those errors.

Stimulated recall interview. A structured stimulated recall interview was also employed in order to gather data about student thoughts. The format used for these interviews was patterned after the one designed by Peterson et al. (1984) and is illustrated in Figure 1.

Insert Figure 1 about here

Data Collection

All subjects completed the perceived competence scales and the skill test prior to receiving instruction. Students participated in an instructional unit on the forearm pass. Instruction was limited to one skill to avoid confounding student thoughts and strategies on different skills. The

instructor taught four classes with 14 students in each class for a 30-minute period on 4 consecutive school days. The researcher and the instructor collaborated to design lesson plans for the unit.

All classes were videotaped, using 4 cameras filming from the four corners of the instructional area. All students were filmed during instruction and practice daily.

Each day, once during a practice session and at the end of class, students were instructed to complete a short description of the errors they had made and to describe how they were trying to correct their errors. Recording forms were readily available around the instructional area.

A total of 30 students participated in stimulated recall interviews. Equal numbers of students identified as high skill or low skill based on the pretest were selected to be interviewed. This was done to insure that the range of skill ability was equally represented in the interview sample. The interviews were scheduled in such a manner that the same number of high and low skill students were interviewed on each day of instruction. Interviews were conducted within the hour following the lesson. In groups of three, students watched the first instructional segment of the lesson. At the conclusion of the instructional segment, each student was interviewed individually about that segment by a trained interviewer. When the initial interview segment was completed, students watched themselves

during the first practice segment of the lesson. Students were interviewed individually about their thoughts during practice by the same interviewer.

At the completion of the instructional unit, the skill test was re-administered. The objective CPQ was also given. Students were instructed to complete the questionnaire about the unit of volleyball instruction they had just completed.

Data Analysis

Skill Assessment. A dependent t-test was employed to determine whether or not students made a significant gain from pretest to posttest. Residual gain scores for each student were computed using a linear regression model in which the pretest was the predictor variable and the posttest was the criterion variable. These residual gain scores were used in the subsequent analysis as the primary indicant of achievement.

Video coding. In order to provide a measure of overt student attention during instruction and practice, student behavior was coded from the video tapes using the observation coding system. All students were coded during the same instructional segments and for equal amounts of time during the same practice sessions. Students were coded during practice when it was their turn to be the passer rather than the tosser. The inter-rater reliability coefficient for coding student behavior was .97.

In addition to the estimated time on task, quality of

practice was also coded from the video tapes. The total number of trials and the number of correct trials were recorded. A correct trial was defined as a legal hit in which at least 4 of 6 identified skill components were performed correctly. The inter-rater reliability coefficient for coding correct or incorrect trials was .96. The reliability coefficient for coding individual skill components was .92.

The scores resulting from the video coding were interval data. Relationships between these variables and skill level and achievement were analyzed using Pearson product moment coefficients of correlation.

Written Instruments. The perceived competence scales and the CPQ were scored as ordinal scales in which the most positive response was given the highest score and the most negative response was scored one.

The error detection and correction data were analyzed using the 5 point ordinal scale presented in Figure 2.

Insert Figure 2 about here

Each sample was scored according to this scale. The inter-coder reliability coefficient for this procedure was .90. The accuracy of each subject's assessment of his or her own errors was determined by comparison of the subject's response to the coded practice trials. When all samples had

been coded, the median score for each student was computed and used in the analysis.

Data from the perceived competence scales, cognitive processes questionnaire, and the error samples are ordinal data. For this reason, Kendall tau coefficients, a nonparametric measure of correlation, were used to examine the relationships involving these variables.

Interview data. Interviews were transcribed verbatim for analysis. Self-reports of level of attention during both instruction and practice, level of understanding, perceived success, and level of attention reflected in the practice thoughts were coded on ordinal scales presented in Figure 3.

Insert Figure 3 about here

A simple frequency count was used to score important points recalled from the lesson, reports of things the teacher said or did to help a student learn, and the general and specific strategies employed during instruction and practice. General strategies were defined as those in which no specific mention of skill components were mentioned, such as "trying to remember the things the teacher told me." Specific strategies were those which made specific reference to skill, such as "I imagined I had steel rods in my arms to help me keep them straight." The categories for the

frequency counts were derived from the interview questions. As these data are ordinal, Kendall tau correlation coefficients were employed to examine the relationships involving these variables.

Results

Descriptive Statistics

Interval Data. Descriptive statistics for skill assessment, observed student behavior, and quality of practice are found in Table 1.

Insert Table 1 about here

Students demonstrated a significant gain in skill over the course of the instructional unit, as reflected by the dependent t -test between the pretest and posttest ($t_{55} = 2.367$, $p < .0001$).

Ten minutes of instruction, or time that the teacher was teaching, were coded. The mean engaged instructional time score indicates that students were coded on task 80.5% of the time during instruction. It is of interest to note the wide range of scores on engaged time during instruction. The highest score reflects that the student was attending during instruction almost all of the time. The lowest score signifies a student was attending only half of the time.

During the 6 1/2 minutes of practice coded for each student, the mean engaged score indicates that students were

on task 64.7% of the time. Thirty-two percent of students' time during practice was coded as nonengaged behavior, translating to time spent waiting for a practice trial or chasing a ball. Again the wide range of scores is striking. The highest score indicates one student was actively engaged in practice trials in all but 2 intervals, while the lowest score signifies a student was engaged in practice trials in less than half of the intervals coded when it was his or her turn to pass the ball. Similarly, the highest number of nonengaged intervals indicates that a student spent over half of his or her practice time chasing the ball or waiting for a trial. A wide range of total practice trials and correct practice trials is also evident.

Ordinal Data. Descriptive statistics for the ordinal measures are presented in Table 2.

Insert Table 2 about here

The range of scores for perceived competence and the CPQ suggests that students responded to the instruments in a varied manner.

Special attention is given to the error sampling responses, as this data collection technique provided the only written open-ended responses from the subjects. Some students were able to accurately identify specific errors and actions to correct those errors. The largest number of

error sample responses were coded as 3's, in which students were aware of their errors, but failed to identify appropriate strategies to correct those errors. A few students were aware of their errors, but unable to identify them, or simply indicated that they had made no errors, when in fact their performance had not been successful.

Interview Data. The range for self-rating of attention levels during both attention and practice is limited from 3 to 5. No subject rated his or her attention less than some of the time. Inspection of the data reveals the most prevalent response was "I was paying attention most of the time." Although this self-rating of attention provided very little variability of responses, it is consistent with the observer estimate of attention, which averaged 80 %. Both indicants are comparable to the median of the attention subscale of the CPQ, which was 21 of a possible 25. When rating their understanding of the lesson, all students indicated they understood at least some of the lesson, so no responses were coded in the lowest category of the ordinal scale. Most students indicated that they understood the lesson pretty well or very well. When rating their level of success during practice, student responses were distributed in all 4 categories.

The same scale used for coding written responses for error detection and correction was used to rate the interview data. In contrast to the written responses, all

students were able to identify errors and at least a general correction strategy. The range of scores for the interview data was no lower than 3, resulting in a median of 4 as compared to the median of 3.25 for the written response data.

The attention level of practice thoughts ranged from class logistics to specific skill thoughts. A majority of practice thoughts were coded as reflecting general attention to the skill or level two. For example, a number of students said, "I was just thinking about hitting the ball." Other students made reference to correcting their errors when they were asked about their thoughts during practice. Statements like "I was thinking about trying to get my platform level, because I kept hitting off to the side" are representative of thoughts coded as level 3. When students made reference to specific skill components, their thoughts were coded as level 4, as in this example: "I was thinking I needed to keep my knees bent and my arms out to hit the ball out instead of just up."

Examination of the frequency counts for categories of teacher helps, important points, general and specific strategies, and affective thoughts revealed that all students mentioned at least one kind of strategy, teacher help and important point in the lesson.

When asked to recall the important points in the lesson, most students were able to accurately repeat the

skill components emphasized by the instructor, as illustrated by the following excerpt:

Well, all of it was important, but I thought the platform was the most important. When she was teaching us to get in the ready position, to stay balanced, keep our knees bent and our arms locked, to hold our arms up where we could see them, all that was important, too.

All students remembered something that the teacher had said or done that helped them to learn the skill. Very often, students stated that the teacher "showed me how to do it" or "showed me how I was jumping at the ball and told me to keep my feet on the floor."

General strategies that students mentioned included listening to the teacher, watching the teacher, or trying to remember what the teacher said. Specific strategies included thinking or concentrating on specific skill components, such as "I was thinking about keeping my arms in the ready position so I could see them." Several students made reference to using mental images as specific strategies they used to help them learn. For example, one student who was jumping to the ball said "I pretended that my feet were nailed to the floor."

Only 1 student in 3 made statements coded as affective during the interview. Most of these statements were motivational, as reflected in this passage:

I was saying to myself to watch her because she's an expert, and if you do what she tells you, you'll be a great volleyball player. I was telling myself, just try and you'll get it right.

This descriptive analysis of the interview data is limited to quantitative aspects of the data. In general, the content of the interviews supports the impression that the students understood the lesson and were able to recall details accurately. The frequency counts are included as descriptive or supportive data and were not included in the analysis of the relationships between the variables.

Observed Student Behavior, Practice and Achievement

Correlations between observed student behavior, practice variables and skill assessments are presented in Table 3.

Insert Table 3 about here

Engaged practice time, total number of trials, and the number of correct practice trials were all positively related to both the pretest and the posttest. Observed engaged time during instruction and nonengaged time during practice were negatively correlated with both the pretest and the posttest.

Of primary interest is the relationships of these variables to the residual gain scores, or the primary

indicant of achievement. Engaged practice time, total trials, and the correct number of trials were positively related to the residual gain scores. Nonengaged time during practice, or time spent waiting or chasing balls, was negatively associated with achievement.

Interrelationships between observer estimates of student behavior and quality of practice variables are very much as one would expect. The total number of trials, the number of correct trials, and the observed engaged practice time displayed a strong positive relationship. A strong negative relationship was evident between observed nonengaged time during practice and these variables. One unexpected result was that observed engaged time during instruction was not related to any of these variables.

Student Thoughts, Quality of Practice, and Achievement

The correlation matrix for relationships between measures of student thoughts, quality of practice, skill level and achievement is found in Table 4.

Insert Table 4 about here

The physical subscale of the perceived competence scale, the written measure of ability to identify errors, and the self rating of success were positively related to both initial and final skill level. It is of interest to note that attention level and use of strategies during

instruction as reported in the CPQ were negatively related to initial skill level.

The motivation subscale of the CPQ and the ability to detect and correct errors during the interview both reflect a positive association not only with the posttest, but perhaps of more consequence with the residual gain scores.

Physical perceived competence and self-rating of success in the interview were positively associated with the total number of trials and the number of correct trials. Motivation was also correlated with the number of correct trials, but unrelated to the total number of trials. Like motivation, the written ability to detect and correct errors was related the number of correct practice trials, but unassociated with the total number of trials.

Relationships Between Interview Data and Written Measures

The perceived competence physical subscale was positively related to the self-rating of understanding and success as well as the interview score on the ability to detect and correct errors. The attention subscale of the CPQ was positively associated with self-rating of attention during practice and the interview score on the ability to detect and correct errors. The motivation subscale of the CPQ exhibited a strong positive relationship with the interview score on the ability to detect and correct errors. Positive relationships were also evident between the written score on the ability to detect and correct errors and self-

ratings of attention during practice, understanding, and success.

The most direct comparison between written self-report data and interview data is made by contrasting responses on error detection and correction. Although the interviews seemed to have elicited a higher level of response, scores for the written and interview data on error detection and correction were positively related.

Comparison Between Self-report Data and Observer Estimates

The physical perceived competence subscale was positively associated with engaged time during practice. It was, however, negatively related to engaged time during instruction and nonengaged time during practice. The self-rating of success was negatively related to nonengaged time during practice, as well.

The relationships between the CPQ subscales and observed student behavior are of interest. Both attention and strategies were positively related to observed engaged time during instruction, while the motivation subscale was associated with engaged time during practice. The written ability to detect and correct errors was also positively related to engaged practice time.

Discussion

Correlates of achievement in this study, as reflected by residual gain scores, were identified as the number of practice trials, the number of correct practice trials,

engaged practice time, motivation as measured by the CPQ, and the ability to verbalize detection and correction of errors during interviews. The strong relationship between achievement and the amount of practice and the quality of that practice is consistent with findings from previous investigations (Ashy, Lee, & Landin, 1988; Silverman, 1985). The identification of self-reports of motivation and the ability to identify and correct errors during practice as correlates of achievement support the notion that student thoughts are important mediators between instruction and achievement.

Though many significant relationships exist between skill level and other variables investigated, no other variables were related to achievement. Notable in its absence from this category is any indicant, observed or self-report data, of attention during instruction. During the discussion that follows, this consistent artifact of the data will be examined.

The results suggest that skill level is an important factor in how students spend their time in physical education class. The relationships between physical perceived competence, skill level, and practice variables draw a picture of a physical education class in which low skill students appear to attend during instruction, but spend a considerable amount of time during practice chasing balls or waiting instead of practicing. Conversely, the

high skill students appear to be off-task during instruction, but are able to maximize their time spent in practice. This conceptualization supports Harter's competence motivation theory which predicts that students high in physical perceived competence are more likely to be active participants in physical activity.

Data from the CPQ and the ability to detect and correct errors are consistent with this picture. Low initial skill level is associated with self-report of attention and use of strategies, while self-report of motivation and the ability to detect and correct errors are associated with higher skill level and achievement, as well as the quality of practice. These results are consistent with those reported by Klint and Weiss (1987), in which children high in physical perceived competence placed a higher priority on skill development than children with low physical perceived competence. High skill students appeared disinterested during instruction, but were anxious to get to work during practice. Low skill students were very willing to listen to the teacher, but spent a lot of their practice time getting ready to practice.

It appears that motivation and attention to error detection and correction are closely related variables which impact the quality of practice. This conclusion gains strength when it is considered in light of a recent review by Roberts (1991) of motivation and perceived competence in

children's sports. Roberts approaches motivation from a cognitive perspective and views motivation as a cognitive process. It is closely related to goal orientation, which was not addressed in this study. However, some interesting parallels exist. Students whose goals are related to mastery of a task are more likely to engage in adaptive patterns of behavior. These include choosing moderately challenging tasks during practice, focusing on effort, and persisting in that effort over time and in the face of difficulty. Students with a competitive goal orientation are more ego-involved. Their evaluation of their own performance is dependent upon comparison to their peers, not to the mastery of the task. Those students with a competitive orientation are more likely to employ maladaptive behaviors in the face of difficulty, such as choosing tasks to avoid challenge, displaying less persistence, and being unwilling to expend effort during practice. A high level of perceived ability is associated with the use of adaptive behaviors while lower perceived competence and level of success experienced is associated with maladaptive behaviors.

In this study, students with a high level of skill and perceived competence seemed to engage in adaptive behaviors during practice. This is reflected in their engaged time during practice, the number of trials and the number of correct trials. Students of low skill, perceived

competence, and perceived level of success appeared to manifest maladaptive behaviors, as they spent much of their practice time nonengaged. It seems that this could be a reflection of students' goal orientation. Those students who were motivated to learn the task were more attentive to the errors that they made during practice and were able to verbalize strategies to correct those errors.

Students who perceived themselves to be low in skill level and were unmotivated to learn the skill did not use their practice time effectively and therefore did not improve. These relationships between perceived competence, skill level, motivation, and achievement appear to be very important in the investigation of teaching and learning in physical education. The inclusion of goal orientation in the study of motivation in physical education is a promising area for subsequent study.

There were several encouraging relationships between the written self-report measures and the interview data. However, based on the tendency of almost all students to report that they were paying attention "most of the time," any relationship involving the self-rating of attention level should be viewed with caution. In general, though, the interview data supported the use of the perceived competence scale and a cognitive processes questionnaire as methods to gather information about student thought processes during instruction.

The most direct comparison between the interview data and the written self-report data is the contrast between the responses concerning errors during practice. Although a higher level of responses seems to have been elicited during the interview process as compared to the written responses, the similarity of the relationships between these variables supports the notion that comparable information was obtained in both data collection procedures. Two possible explanations for the higher level of responses during the interviews are offered. It seems plausible that the opportunity to watch themselves practice on video tape could have enabled students to detect and correct their errors more effectively. It is also possible that students found it easier to verbalize their responses than to write them down.

Unlike results reported by Peterson et al. (1984), student estimates of attention were not more accurate predictors of student achievement than observer estimates of overt behavior. Responses on the CPQ attention subscale did relate significantly to a number of variables, but these relationships were entangled in a complex set of factors. Students' estimates during interviews of their attention level during instruction and practice during the interview process failed to yield useful information. The forced choice responses resulted in a practically unanimous answer of "most of the time."

The complex set of relationships involving attention during instruction seems to suggest that the higher skilled subjects may not have needed to attend closely or employ strategies in order to successfully perform the skill. Data from the interviews of high skill students support this notion. Many of these subjects indicated that the teacher helped them by "showing me what to do." They were able to recall important points of the lesson accurately and concisely. It seems possible that the degree of difficulty of the forearm pass may have been such that the highly skilled students were able to learn quickly by watching, though they had no experience in volleyball. They may have appeared to be off task during instruction because they grasped the basic skill components very quickly.

On the other hand, the lower skilled students encountered more difficulty in learning the skill, and tended to be more attentive during instruction and employ strategies as they tried to learn the skill. One low skill student responded to the question how well did you understand the lesson by saying "I understood everything, I just couldn't do it."

Observer estimates of attention during practice were related to achievement. Perhaps it is easier to accurately code student behavior in a setting such as the gymnasium in which students are actively involved in the learning process than to reliably code student engagement in a classroom

setting.

Conclusions

Addressing the specific research questions for this study, it appears that on-task behavior during instruction is, in this case, unrelated to achievement, while observed engaged time during practice is positively related to achievement. Student reports of their thoughts during instruction and practice have a mixed relationship with achievement as well. There is some indication that students of a lower skill level were more attentive during instruction than their more skilled class mates. It does appear, however, that student thoughts during practice, with specific regard for motivation and error detection and correction, are important mediators during practice between teacher behavior and student achievement.

The data from the stimulated recall interviews support the use of written self-report measures to gather data about student thought processes. The responses to questions in the interview were consistent with the responses on the CPQ. Responses regarding detection and correction of errors provided similar data, but the examination of the responses suggests that students were more likely to give higher level responses in an interview as compared to having to write them. The self-report data gathered from both written measures and stimulated recall interviews provided information of value. The concept of the CPQ also shows

promise, as does the error sampling technique employed.

In contrast to previous investigations, student reports of their thought processes were not more accurate predictors of achievement than observer estimates of attention during practice. It seems possible that observations of overt behavior during practice in a physical education setting could be more accurate than those in a classroom setting.

Throughout the analysis of the data, it is apparent that skill level and perceived competence impact how students spend their time in physical education classes. Student with higher levels of skill and perceived competence, despite their apparent lack of attention during instruction, used their practice time more effectively and were able to complete more trials in the same time period than their classmates.

It was possible in this investigation to identify some student thought processes as mediators between teacher behavior and student achievement. Motivation and the ability to verbally identify errors made and strategies to correct those errors seem to be variables which hold promise for future research.

Table 1.

Descriptive Statistics for Interval Data

Variable	Mean	Standard		
		Deviation	Minimum	Maximum
Pretest	3.10	2.70	0	9.5
Posttest	7.72	4.27	2	19.5
Engaged Intervals				
Instruction	48.30	6.94	30	59
Practice	25.23	3.80	18	37
Nonengaged Intervals				
Practice	12.71	3.91	1	21
Total Trials	38.00	10.29	27	71
Correct Trials	23.23	14.02	1	69

Table 2.

Descriptive Statistics for Ordinal Data

	Median	Minimum	Maximum
PC-Physical	22	12	28
PC-General	21	14	28
CPQ-Attention	21	13	25
CPQ-Strategies	16	8	25
CPQ-Motivation	20	13	25
Error-Written	3.25	0	5
Attention-Instruction	4	3	5
Attention-Practice	4	3	5
Understanding	3	2	4
Success	3	1	4
Error-Interview	4	3	5
Practice Thoughts	2	1	4
Teacher Helps	2	1	6
Important Points	2	1	5
General Strategies	1	0	3
Specific Strategies	1	0	3
Affective Statements	0	0	3

Table 3.

Correlation Matrix of Pearson Product Moment Coefficients

	1	2	3	4	5	6	7
1. Pretest	1.00						
2. Posttest	.77*	1.00					
3. Residual Gain	.00	.64*	1.00				
4. Instruction-Engaged	-.37*	-.38*	-.15	1.00			
5. Practice-Engaged	.51*	.58*	.30*	.02	1.00		
6. Practice-Nonengaged	-.58*	-.70*	-.40*	.18	-.94*	1.00	
7. Total Trials	.62*	.68*	.33*	-.25	.75*	-.78*	1.00
8. Correct Trials	.67*	.74*	.36*	-.19	.78*	-.78*	.91

* $p < .05$

Table 4.

Correlation Matrix of Kendal tau Coefficients

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Pretest	1.00													
2. Posttest	X	1.00												
3. Residual Gain	X	X	1.00											
4. PC-Physical	.41*	.41*	.17	1.00										
5. PC-General	.09	.15	.11	.17	1.00									
6. CPQ-Attention	-.21*	-.04	.17	-.09	.02	1.00								
7. CPQ-Strategies	-.19*	-.10	.05	-.11	.01	.34*	1.00							
8. CPQ-Motivation	.14	.25*	.20*	.16	.13	.37*	.17	1.00						
9. Error-Written	.24*	.20*	.02	.14	.23*	.18*	.06	.11	1.00					
10. Attention-Instruction	.08	.03	-.11	.02	.24	.20	-.17	.16	.16	1.00				
11. Attention-Practice	-.06	-.04	.03	.15	.24	.33*	-.16	.15	.34*	.43*	1.00			
12. Understanding	.09	.16	.01	.30*	.15	.13	.07	.15	.30*	.23	.46*	1.00		
13. Success	.40*	.45*	.12	.32*	.03	-.22	.07	.24	.06	.02	.05	.02	1.00	
14. Error-Interview	.20	.38*	.39*	.39*	.25	.26*	-.02	.54*	.30*	.18	.27*	.16	.14	1.00
15. Instruction-Engaged	X	X	X	-.22*	.01	.34*	.21*	.17	.17	.15	.15	.09	-.22	.09
16. Practice-Engaged	X	X	X	.25*	.04	.01	.01	.22*	.24*	-.10	.09	.10	.20	.17
17. Practice-Nonengaged	X	X	X	-.36*	-.01	.06	.11	-.16	-.17	.07	-.06	-.21	-.30*	-.21
18. Total Trials	X	X	X	.29*	-.03	-.01	-.14	.09	.11	-.06	.11	.11	.29*	.17
19. Correct Trials	X	X	X	.33*	.01	-.06	-.09	.20*	.23*	-.04	.09	.07	.35*	.16

* $p < .05$

X denotes Pearson product coefficient presented in Table 3

Figure 1.

Stimulated Recall Interview

Instructional Segment

Attention

While the teacher was teaching, did you think about other things besides what the teacher was saying or doing at least some of the time?

no

yes or no response

Tell me what you were thinking about besides volleyball.

Were you paying attention all of the time, most of the time, some of the time, a little bit of the time, or not very much of the time?

Understanding

How well did you understand the part of the lesson you just saw?

pretty well

not very well

What was the most important thing in the lesson?

What did you not understand?

What did the teacher say or do that helped you to understand?

Strategies and Motivational Thoughts

What did you think or say to yourself while the teacher was teaching to help you learn about the skill?

Figure 1 (continued).

Stimulated Recall Interview

Practice segment

Attention

While you were practicing, did you think about other things besides the skill at least some of the time?

no

yes or No response

Tell me what you were
thinking about besides volleyball.

Were you paying attention all of the time, most of the time, some of the time, a little bit of the time, or not very much of the time?

Strategies and Motivational Thoughts

What were you thinking about while you were practicing?

What things were you doing or thinking that helped you to learn the skill?

What did you say to yourself while you were practicing?

What did your teacher say or do that helped you to learn the skill?

How successful were you during the practice session today?

What errors did you make while you were practicing?

What did you do to try and correct your errors?

Figure 2.Ordinal Scale for Coding Error Detection and Correction

Score	Criteria	Example
1	Identify specific errors and action to correct	I didn't keep my arms high enough. I tried to keep my arms where I could see them
2	Identify general errors it and specific action to correct	I couldn't hit right. I straightened my arms.
3	Identify general errors and general action to correct	I was hitting it too hard. I hit it softer.
2	Identify general errors but unable to define corrective action	I hit high, not far. I couldn't figure it out.
1	Aware of errors, but unable to identify	I just kept missing. I don't know why.
0	Unaware of errors	No errors (when there were errors)

Figure 3.

Ordinal Scales for Interview Data

Attention

- 5 all of the time
- 4 most of the time
- 3 some of the time
- 2 a little bit of the time
- 1 not very much of the time

Understanding and Success

- 4 very well
- 3 pretty well
- 2 some
- 1 not very well

Practice Thoughts

- 4 specific skill points
 - 3 error detection and correction
 - 2 general skill, motivation, performance outcome
 - 1 logistics
 - 0 off task
-

References

- Ashy, M. H., Lee, A. M., & Landin, D. K. (1988). Relationship of practice using correct technique to achievement in a motor skill. Journal of Teaching in Physical Education, 7, 115-120.
- Bainbridge, L. (1979). Verbal reports as evidence of the process operator's knowledge. International Journal of Man-Machine Studies, 11, 411-436.
- Cox, R. H. (1980). Teaching volleyball. Minneapolis, Minnesota: Burgess.
- Doyle, W. (1977). Paradigms for research on teacher effectiveness. Review of Research in Education, 5, 163-198.
- Duda, J. L. (1991). Motivation in sport settings: A goal perspective approach. In G. C. Roberts (Ed.), Motivation in sport and exercise. Champaign, IL: Human Kinetics.
- Ericsson, K. A., & Simon, H. A. (1980). Verbal reports as data. Psychological Review, 87, 215-251.
- Fahleson, G. A. (1988, April). Self-report of students' cognition and time on task during physical education instruction. Paper presented at the annual meeting of the American Alliance of Health, Physical Education, Recreation and Dance, Kansas City, MO.

- Felts, D., & Petilchkoff, L. (1983). Perceived competence among interscholastic sport participants and drop-outs. Canadian Journal of Applied Sport Science, 8, 231-235.
- Harter, S. (1978). Perceived competence scale for children manual (Form O). Denver: University of Denver.
- Harter, S. (1982). The perceived competence scale for children. Child Development, 53, 87-97.
- Klint, K. A., & Weiss, M. R. (1987). Perceived competence and motives for participating in youth sports: A test of Harter's competence motivation theory. Journal of Sport Psychology, 9, 55-65.
- Lee, A. M., Landin, D., Carter, J. A., & Fant, H. E. (1989, April). Student thoughts during tennis instruction. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.
- Locke, L. F., & Jensen, M. K. (1974). Thought sampling: A study of student attention through self-report. Research Quarterly, 45, 263-275.
- Martinek, T. J. (1988). Confirmation of a teacher expectancy model: Student perceptions and causal attributions of teaching behaviors. Research Quarterly for Exercise and Sport, 59, 118-126.
- Matlin, M. (1983). Cognition. Chicago: Holt, Rinehart and Winston.

- Nisbett, R. E., & Wilson, D. (1977). Telling more than we know: Verbal reports on mental process. Psychological Review, 84, 231-279.
- Peterson, P. L. (1988). Teachers' and students' cognitional knowledge for classroom teaching and learning. Educational Researcher, 5, 5-14.
- Peterson, P. L., & Swing, S. R. (1982). Beyond time on task: Students' reports of their thought processes during classroom instruction. In W. Doyle & T. L. Good (Eds.), Focus on teaching: Readings from the Elementary School Journal (pp.228-238). Chicago: The University of Chicago Press.
- Peterson, P. L., Swing, S. R., Stark, K. D., & Waas, G. A. (1984). Students' cognition and time on task during mathematics instruction. American Education Research Journal, 21, 487-515.
- Roberts, G. C. (1991). Motivation in sport: Understanding and enhancing the motivation and achievement of children. In G. C. Roberts (Ed.), Motivation in sport and exercise. Champaign, IL: Human Kinetics.
- Roberts, G. C., Kleiber, D. A., & Duda, J. L. (1981). An analysis of motivation in children's sport: The role of perceived competence in participation. Journal of Sport Psychology, 3, 206-216.

- Schmidt, R. A. (1988). Motor control and learning: A behavioral emphasis. Champaign, IL: Human Kinetics.
- Schuell, T. J. (1986). Cognitive conceptions of learning. Review of Educational Research, 56, 411-436.
- Silverman, S. (1985). Relationship of engagement and practice trials to student achievement. Journal of Teaching Physical Education, 5, 13-21.
- Spaeth-Arnold, R. K. (1981). Developing sport skills: A dynamic interplay of task, learner, and teacher. Monograph 2 Motor Skills: Theory into Practice.
- Tousignant, M., & Siedentop, D. (1983). A qualitative analysis of task structures in required secondary physical education classes. Journal of Teaching in Physical Education, 3(1), 47-57.
- Weinstein, C. E., & Mayer, R. E. (1986). The teaching of learning strategies. In M. C. Wittrock, (Ed.), Handbook on Research on Teaching (3rd ed.), (pp. 297-314). New York: Macmillan.
- Winnie, P. H., & Marx, R. W. (1982). Students' and teachers' views of thinking processes for classroom learning. Elementary School, 82, 493-518.
- Wittrock, M. C. (1986). Students' thought processes. In M. C. Wittrock, (Ed.), Handbook on Research on Teaching (3rd ed.), (pp. 297-314). New York: Macmillan.
- Wittrock, M. C. (1987). Teaching and student thinking. Journal of Teacher Education, 38, 30-33.

Appendix A
Extended Review of Literature

Examining Effective Teaching in Physical Education:
Student Thoughts as Mediators Between Teacher
Behavior and Student Achievement

Efforts to delineate the distinctions between effective and ineffective teachers began as early as the 1920's and have, over the course of the ensuing years, accounted for a substantial proportion of the scientific inquiries conducted in the broad field of educational research (Doyle, 1977). Dissatisfaction with laboratory-based theories of learning (Gage, 1972) and research that failed to examine actual teaching in the classroom (Dunkin & Biddle, 1974) resulted in the adoption of the process-product approach in the early 1970's (Putnam, Lampert & Peterson, 1990). The intent of the process-product studies, often referred to as teacher effectiveness studies, was to establish relationships between process variables, defined as teacher behaviors, and product variables, defined as student achievement (Brophy & Good, 1986; Gage, 1978). Dunkin and Biddle's (1974) model for classroom teaching has had a substantial impact on the selection of variables used in this research. This performance-based model of teaching effectiveness is based on a simplistic view of teaching and learning, a cause and effect chain in which teacher behavior generates student achievement (Marx & Winnie, 1987).

During the last two decades researchers have incorporated a wide range of variables to study teacher

effectiveness in the classroom and the gymnasium. Results, for the most part, have been insignificant, inconsistent and often conflicting. In an attempt to synthesize and relate the findings of the classroom studies, Rosenshine and Furst (1971) categorized variables based on their perceived potential to predict product outcome. Clarity, enthusiasm, variability, task orientation, and student opportunity to learn were factors identified as having the most promise for a relationship with student achievement. Variables identified as having a moderate level of promise included use of student ideas, criticism with negative affect, use of structuring comments, perceived course difficulty, and probing. Praise, warmth, flexibility, type of question, teacher talk, student participation, number of teacher-student interactions, time spent on classroom participation, teacher experience, and teacher knowledge of subject area were identified as components which had demonstrated little or no promise in predicting product outcomes. In a subsequent summary, Rosenshine (1976) asserted that direct instruction, clear goals, systematic procedures, and an accepting climate were elements which merited further study. Although there was criticism of these reviews, the delineation of these variables gave structure to subsequent research. Even so, results from this line of research continued to be relatively nonproductive, failing to clearly define variables related to student learning or explain the

nature of the relationship.

Research on teacher effectiveness in physical education, although lagging behind the classroom research, closely paralleled its development. A number of process-product studies have been conducted (Ashy, Lee, & Landin, 1988; DeKnop, 1986; Graham, Soares, & Harrington, 1983; Phillips & Carlisle, 1983; Rink, Werner, Hohn, Ward & Timmerman, 1986; Rolider, Siedentop, & Van Houten, 1984; Silverman, 1985b; Silverman, Tyson, & Morford, 1988, Yerg, 1981). For the most part the results of these studies, like those in the classroom, have been conflicting and inconclusive.

With the advent of systematic observation systems in the mid-seventies, the focus of educational research expanded to include student processes. Perhaps the most significant and consistent outcome of the research from this period was the emergence of academic learning time (ALT) as a mediating factor between teacher behavior and student achievement (Fisher, Filby, Marliave, Cahen, Disha, Moore, & Berliner, 1978). A construct defined as the amount of time a student spends engaged in an academic task at a high success rate, ALT is distinguished from the amount of time the teacher allocates for learning by consideration of student involvement.

The construct of ALT was modified for use in physical education by Siedentop, Birdwell, and Metzler (1979) and

simplified in an 1982 revision (Siedentop, Tousignant, & Parker). A number of studies incorporating the ALT-PE system have been published (Godbout, Brunelle, & Tousignant, 1983; Placek & Randall, 1986; Shute, Dodds, Placek, Rife, & Silverman, 1982; Silverman, Dodds, Placek, Shute, & Rife, 1984). Although ALT-PE has been accepted to some degree as an appropriate measure of student achievement during motor skill instruction (Beauchamp, Darst, & Johnson, 1990), there is controversy in this regard. Metzler (1989) contends that, as in classroom research, the correlation of ALT-PE and student achievement is sufficient to use students' functional time as an indicator of increased learning, although the evidence he cites is without substance. Lee and Poto (1987) take issue with this contention, concluding that the time measure in physical education has not shown the predictive qualities that it has in classroom research. Likewise, Rink and Werner (1987) state that when motor skill acquisition is the dependent variable, ALT-PE alone is not a predictor of teacher effectiveness. In a recent investigation Buck and Harrison (1989) concluded that ALT-PE, as defined by motor engagement at a high success rate, does not even exist in physical education classes.

Pedagogical research published during the 70's and 80's provided a clear picture of what was happening in physical education classes, but fell short when examining the correlates of teacher effectiveness. Methodological

problems such as incorrect units of analysis, use of instructional units of insufficient duration, and inappropriate statistical design and analysis (Silverman, 1985a) limited the extent to which the findings could produce a cohesive knowledge base. Of central concern was the failure to relate instructional variables to student achievement. When an achievement measure has been incorporated, engaged time has often been accepted as that measure. Very few of these studies have demonstrated a significant relationship between instructional variables and a reliable measure of students' motor skill acquisition. Unfortunately, the problems encountered in the educational research conducted in classrooms were replicated in the gymnasium, with the additional complication of assessment of student learning.

Criticisms of the Process-Product Approach

For years process-product research has been criticized on a number of bases with the inconsistency of the conclusions drawn being the most visible. Doyle (1977) found fault with the low-inference observational systems which have traditionally been used to study dimensions of teacher behavior. The implication is that a linear relationship exists between teacher behavior and achievement, but there is evidence to suggest that nonlinear relationships may occur. An optimal level rather than absolute quantity of some behaviors may most effectively

facilitate product outcome. Doyle also questions the assumption of the direction of causality (teacher behavior causes student achievement), based only on correlational studies. He cites evidence to support the notion that student behavior can also be the cause of teacher behavior and suggests that the study of teacher behavior variables in isolation is an oversimplification of processes which occur in the classroom.

Other criticisms of the process product model include lack of consideration of the subject matter being taught (Shulman, 1986) and a tendency to limit research questions to the study of existing practice (Romberg & Carpenter, 1986). Marx and Winnie (1987) argue further that this performance-based model of teacher effectiveness fails to explain what exactly makes teaching effective. The failure to consider how students actually learn from teaching and the focus on overt, observable behavior resulted in disregard for the cognitive activities both of teachers and students (Shulman, 1986).

Despite the criticism leveled and the limitations inherent in its use, the process-product paradigm has produced some important results and has provided a foundation for further inquiry. There is now general agreement, however, that this two-factor model of overtly defined teacher behaviors producing or causing student achievement is an oversimplification of the complex

interactions which occur in the teaching and learning process.

Expanding the Process-Product Paradigm

It is of interest to note that the most stable, significant component identified in the classroom research as a predictor of student achievement was ALT, which incorporates student engagement at a high rate of success as a criterion. The construct of ALT-PE has not proven to be as useful as its classroom counterpart, but Silverman (1985c) reported that process product relationships using student engagement as the process measure are discernible when student characteristics such as skill level are considered as mediating factors. As an alternative to ALT-PE, Lee and Poto (1987) suggest the number of correct practice trials may be a more significant indicant of achievement in physical education. Support for this notion is found in studies by Silverman (1985b) and Ashy, Lee, and Landin (1988).

Cognitive involvement on the part of the student during practice is an inherent component underlying student engagement in both academic learning time and correct practice trials. This suggests that mediating factors, incorporating the role that students play in formulating classroom conditions, link teacher behavior to student achievement.

Mediating Processes Paradigm

Development of the Paradigm

Educational researchers attempting to explain the inconsistent results and lack of support for a performance-based model of teacher effectiveness proposed a major modification to the two-factor process-product paradigm (Winnie & Marx, 1982). Simply stated, a third factor was inserted into the model between the process and the product, allowing for the inclusion of mediating elements. The focus of the mediating process research is on implicit processes which students employ to mediate instructional stimuli and produce learning outcomes (Levie & Dickie, 1973). Prose learning research (Anderson & Biddle, 1975) provides a clear representation of this paradigm and contributes the mathemagenic hypothesis. This hypothesis proposes a set of mediational responses used by learners to process instructional stimuli (Faw & Waller, 1976). These mathemagenic responses, literally defined as behaviors that give birth to learning, include a number of information processing operations such as attending, translating, segmenting and rehearsing (Doyle, 1977). Rower's (1972, 1973) research on the mediating effects of elaboration provides a practical illustration of the paradigm's structure.

The three-factor approach provides a new perspective in the study of teacher effects. Student information

processing responses to instructional stimuli intercede in the direct link between teacher behavior and student achievement assumed in the process-product paradigm. Rather than causing student learning, teacher behaviors impact student learning only to the degree that they activate information processing responses, which, in turn, determine what a student learns (Doyle, 1977). A cognitive approach stresses that learning is an active, constructive process which depends on the mental activities of the learner (Shuell, 1982). From this perspective, students become active agents in the lesson, actively mediating what information is processed, how that information is processed, and consequently, what is learned.

Applications of the Mediating Processes Paradigm

The mediating processes paradigm provides a framework for interpreting existing teacher effectiveness studies, synthesizing results from various lines of educational research (Doyle, 1977) and making sense of inconsistent findings of previous work (Marx & Winnie, 1987). For example, type of question and praise were two variables identified by Rosenshine and Furst (1971) as having little or no promise in predicting product outcomes. Interpreting results from relevant studies using the mediating processes paradigm, it is possible to shed some light on these conclusions, which are in conflict with a performance-based model of teacher effectiveness. In an examination of

research about the effectiveness of teachers's use of higher cognitive questions, Winnie (1979) noted that none of the studies reviewed had reported specific cognitive operations higher order questions were designed to illicit. Furthermore, none of the investigations included any mechanism to determine what kind of cognitive processes students did employ. Marx and Winnie (1987) suggest that the use of higher order questioning could have been ineffective because students' mediation of the teacher's behavior failed to support learning.

The finding that teacher praise fails to correlate significantly with product outcome can also be clarified when viewed through the lens of the mediating processes paradigm. Students perceive praise differently from one another and often not as the teacher intends (Wittrock, 1986b). Two complications arise from this condition. First, praise may affect individuals differently because they perceive it differently. By examining praise from a process-product viewpoint and simply relating teacher praise to student achievement in a class, this individualized effect based on individual student perception will not be evident. Second, if students perceive teacher praise in a manner different from the way in which it was intended, then it seems logical that it may not produce the results intended.

These two situations illustrate the manner in which the

mediating processes paradigm can be used to explain inconsistent results of early educational research. Perhaps of more importance, however, is the fact that the use of this paradigm enables researchers to more accurately describe the process of teaching and learning and to better understand the effect that teacher behavior has on student achievement. Doyle (1977) suggests that perhaps the question of interest is changing from "Which instructional conditions are most effective?" to "How do instructional effects occur?" (p.188).

This cognitive mediational model of teaching and learning adds two important components to the performance-based model of teaching effectiveness (Marx & Winnie, 1987). First is the cognitive element, which implies that students can employ different cognitions in response to teacher behaviors while trying to achieve objectives. Second is the mediational element, inferring the role of the students' interpretation of teacher behaviors in the learning process. Not only does this paradigm provide a framework for interpreting and synthesizing other lines of research, it also affords a promising approach to direct inquiry concerning effective teaching and to generate and test hypotheses that elucidate some of the effects of teaching (Wittrock, 1986b).

Studying Student Thoughts

Doyle (1977) criticized the early research on teacher

effectiveness using the mediating processes paradigm for its limited conceptualization of student mediating responses. This work was characterized by the use of overt, observable variables such as estimates of attention, time utilization and task completion rates. These are considered to be gross measures of information processing procedures which, by nature are not directly observable. In order to better understand the covert information-processing operations that occur during active learning, it is necessary to define and measure them by investigating students' thoughts during instruction.

The investigation of the thought processes of students as they learn is increasingly being recognized as an important consideration in the study of teaching (Peterson, 1988). Two major national reports on education, published in 1986, are cited as evidence of this phenomenon. The Holmes Group Report (1986), from the viewpoint of deans of education at major research universities, and the Carnegie Commission Report (1986), from the perspectives of business people, educators, minorities, and educational policymakers, both acknowledge the importance of focusing on student thinking. Further support for this notion is found in the Handbook of Research on Teaching (Wittrock, 1986a), in which a strong interest in student thoughts and an improved understanding of the learner is evident. The belief that teaching can be better understood, and consequently improved

by delineating the effect that it has on the learners' thoughts that mediate achievement is evident (Wittrock, 1986b). From the research that has been conducted in classroom settings, there is ample evidence to suggest that the study of students' thoughts has the potential to be a fruitful endeavor.

Cognition During Motor Skill Acquisition

Consideration of the manner in which learners acquire motor skills provides additional rationale for the investigation of student thoughts in physical education classes. The initial phase of learning a motor skill is characterized by cognitive concerns (Magill, 1989). Stages of learning motor skills have been described in models by Fitts and Posner (1967) and Adams (1971). In the three-stage model proposed by Fitts & Posner, the first stage of learning is labeled the cognitive stage. In his two-stage model, Adams' first stage is the verbal-motor stage, which is analogous to Fitts and Posners' first stage. In both of these initial stages, considerable cognitive activity is required and the learner's primary concern is understanding the task. As learners progress in both of these models, motor performance becomes more automated. Cognition is refined as the skill itself becomes automatic and the learner's attention can be directed toward finer points of technique or strategies associated with performing the skill. The dominant role that learner cognition plays in

motor skill acquisition is apparent in both models.

Given the cognitive demand in the initial stages of motor skill acquisition, a comprehensive understanding of student cognition during instruction is needed. In her model of skill acquisition, Gentile (1972) relates the cognitive activity associated with the stages of learning motor skills to instruction, delineating applications of the model for teaching. She makes recommendations about teacher behaviors which, based on these models, should facilitate skill acquisition in various stages of learning. Although practical application of a theoretical model to teaching is a valuable contribution, no consideration is given to how the learner actually assimilates the teacher behaviors associated with each stage.

Methods of Studying Student Thoughts

If student cognition is accepted as an important research variable then the measurement of student thoughts becomes a topic of interest. Cognition is internal and cannot be observed, so in order to investigate student thoughts researchers, by design, must rely on verbal self-reports of mental processes as data. Problems associated with accepting self-reports as data are well-chronicled (Bainbridge, 1979; Nisbett & Wilson, 1977). Ericsson and Simon (1980) developed a model of verbalization and tested that model against empirical evidence. They suggested that many problems encountered in the use of verbal data resulted

from the use of probes so general they did not evoke the desired information. They also attributed difficulties to the subjects' tendency to infer mental processes or to supplement incomplete or missing memories. These authors assert that the inconsistencies reported in these studies would have been predicted by the model that they developed and conclude that:

verbal reports, elicited with care and interpreted with full understanding of the circumstances under which they were obtained, are a valuable and thoroughly reliable source of information about cognitive processes. It is time to abandon the careless charge of "introspection" as a means for disparaging such data (p. 227).

Howard (1981) cites evidence to suggest that self-report measures are more valid than the behavioral indices used as criteria to assess the validity of those self-reports. Similarly, Locke and Jensen (1974) concluded that it is possible to collect subjective reports under conditions which foster honesty and accuracy and that the information obtained from these data can be useful in understanding learning.

Several methods have been employed to collect self-report data. Studies of problem solving have used think aloud techniques in which subjects are asked to verbalize their thoughts as they complete a task. Investigations of

cognition in classrooms have typically utilized a stimulated recall procedure. Subjects view or listen to tapes of a lesson and respond to interview questions about their thoughts during the class. Thought sampling is another useful approach in the study of student thoughts. On a designated signal, each student immediately records what he or she was thinking at that point in the lesson. Journals or diaries have also been used to study cognition.

A number of considerations in an investigation may dictate the technique employed in data collection. Based on the reviews of literature concerning investigations using self-report data, several factors should be considered to facilitate the accuracy, reliability, and validity of self-report data. The time between the actual occurrence of the process and the report should be as short as possible (Brown, Bransford, Ferrara & Campione, 1983; Nisbett & Wilson, 1977). It should be recognized that nonevents and nonverbal behaviors are more likely to be omitted or overlooked by subjects, and that self-report data will likely be most accurate when influential stimuli are available and plausible, while logical, noninfluential stimuli are minimized (Nisbett & Wilson, 1977). Asking subjects what they would do in a particular situation to collect self-report data seems to be the least preferred method of inquiry (Brown, 1988). Self-report in retrospect, as in the stimulated recall procedure, is preferable to

hypothetical situations, but a concurrent chronicle of thoughts and actions as they occur appears to provide the most accurate self-report data. The use of these techniques, which require the subjects to monitor their thought processes during a lesson seems also to facilitate the learning process (Brown & Kane, 1988; Chi, Bassok, Lewis, Reimann, & Glaser, 1989).

Student Thoughts as Mediators

Investigations conducted on student thought processes are grounded in the belief that learning from teaching does not occur automatically (Wittrock, 1986b). Rather it requires active, effortful information processing or manipulation on the part of the student (Peterson & Swing, 1982). As early as 1953, Bloom studied student thought processes using a stimulated recall technique to compare student cognition in lecture and discussion classes. He concluded that the students' thoughts did differ as function of class type. Lectures were successful in evoking thoughts central to comprehension of information while a discussion format was more successful in eliciting complex problem-solving thoughts. Despite the early use of this design, consideration of student cognition in research paradigms was essentially overlooked until the advent of the cognitive mediational paradigm in the late 1970's.

It has been demonstrated that students do mediate instructional events with their cognitive processing to the

extent that Winnie and Marx (1982) referred to the cognitive mediational paradigm as a heuristic for educational research. Results from studies using this approach have suggested that students' reports of their thought processes are more accurate predictors of achievement than overt observations of student behavior (Peterson & Swing, 1982). Students can cognitively mediate instructional stimuli in several ways. These can most easily be described and understood in a sequential or stepwise fashion. Using this conception of student thoughts as mediators as a framework, a summary of results from recent research on student thoughts follows. It should be recognized, however, that these mediational processes do not occur in isolation, but instead as an interrelated network of operations.

The initial step in students' cognitive mediation of instruction is attention to the stimuli. This is followed by the student's perception of the instructional behavior, or the meaning which each individual attaches to the stimuli which he or she attends. Learning strategies, or processes students actively employ to acquire new information is the final aspect of cognitive mediation.

Attention

In order to profit from instruction, students must first have the opportunity to learn, and subsequently be actively engaged in the lesson to acquire new knowledge or attend instructional stimuli. Allocated time for learning

emerged from the process-product studies as a variable showing a promising relationship with achievement (Rosenshine and Furst, 1971). It seems very logical that increased time allotted for learning would correlate positively with increases in achievement. Observed time on task or student engagement naturally followed as a variable investigated as a predictor of achievement. However, student reports of attention during stimulated recall interviews, as compared to these overt observer estimates of attention, have proven to be more valid predictors of achievement (Peterson & Swing, 1982; Peterson, Swing, Stark, & Waas, 1984). This line of research supports the assertion by Brophy & Evertson (1976) that time on task or observer estimates of student attention do not reliably measure anything. According to these authors students can acquire the ability to convincingly fake attention as early as the second grade.

There is sufficient evidence to suggest that students' reports are more accurate estimates of attention than are observer estimates and that teachers and researchers should not rely on observed behavior to assess student attention (Peterson & Swing, 1982). Assessment of student cognitions seems to be a more valid measure of attention than observation of overt behavior (Peterson et al. 1984).

Directing student attention to relevant learning tasks can increase achievement in schools (Wittrock, 1987). Both

the use of questions in the lesson (Andre, 1979) and making behavioral objectives explicit (Duchastel, 1979) serve to direct learner attention. Presented a priori to the material, these techniques facilitate verbatim or factual learning while conceptual learning is facilitated when questions or objectives are presented after the material (Boker, 1974; Kaplan & Simmons, 1974).

Some difficulties encountered by children with learning problems have been attributed to attention deficits (Wittrock, 1987). Although results are not always clear, it does appear that attentional training programs such as a "stop, look and listen" strategy implemented by Camp (1980) can, in some cases, ameliorate these deficits, thereby reducing or eliminating the need for drug treatment. The study of attention from the perspective of student cognitions has the potential to develop cognitive training programs not only to facilitate achievement in classroom instruction, but also to remediate learning deficits.

With regard to the role of attention in the acquisition of motor skills, most of the research conducted has been in laboratory settings in motor learning. The nature of attention, its principles of operation, and even its definition remain unclear (Schmidt, 1988). We do know from research that attention demand during motor performance declines with practice and that the ability to select and attend to meaningful information facilitates successful

motor performance (Magill, 1989). These factors seem to have practical application in the design of effective instruction.

In an early investigation of student attention in a physical education setting, Locke and Jensen (1974) employed a thought sampling technique to study student cognitions. Thoughts were collected in four college physical education classes representing a wide range of situations. Thought samples were coded into five categories based on the level of attention reflected in the data. There were differences between levels of attention for individual students, whole classes and type of instructional operation. It was hypothesized that subject variables such as estimate of ability and attitude toward and perception of physical education classes would be related to the level of attention. The precursor variables identified a priori were not related to level of attention, suggesting that the factors which interact to affect attention are more complex than the authors initially theorized. They concluded that self-report data gathered from thought samples provided a valid and reliable data source in the investigation of student thought and proposed the investigation of the relationship of skill acquisition and student attention as the next step of inquiry.

Despite the potential evident in this line of research, well over a decade elapsed before student attention in a

physical education setting was again explored. Fahleson (1988) investigated self-report of students' cognitions and time on task during physical education instruction. A stimulated recall interview was used to quantify student cognitions and external observation to code engagement. She concluded that the assessment of student thoughts may be a more valid technique of evaluating attention than external observation, although both measures were significantly related to post test scores. High levels of attention were also positively related to favorable attitudes toward physical education. Although these two studies provide valuable insight into students' attention during motor skill instruction, much remains to be discovered about the relationships between teacher behavior, student attention, and achievement during motor skill instruction.

Student Perceptions

Students enter classrooms with different attitudes, backgrounds, and experiences which give them a unique view of events that occur in school. The manner in which students interpret instructional actions, including teacher behaviors, should play a major role in their cognitive and motor performance. The meanings students attach to various stimuli in the learning environment do much to determine the effect those stimuli have. There is evidence from classroom research to suggest that learners not only do not perceive and understand instruction uniformly, but also that they

often do not perceive teacher behaviors as they are intended (Wittrock, 1986b). Recent research portrays the learner as an active processor of events, capable of perceiving subtle occurrences and inferring meaning from them. Although most research-based descriptions of how students respond to subject matter activities have focused on interactions in classrooms, the same processes should be apparent in the gymnasium. Some recent research is available to support this premise.

Teacher expectations. Students are able to discern teachers' differential treatment of high and low achievers in the classroom. They perceive low achievers as receiving more direction, instruction about rules, restrictions and negative feedback, while high achievers are perceived as receiving higher expectations for success and more freedom and opportunity (Weinstein, Marshall, Brattesani, & Middlestat, 1982; Weinstein & Middlestat, 1979). Cooper (1983) developed a model of the teacher expectancy effect as mediated by student thoughts. He suggests that students for whom teachers have high expectations receive positive feedback dependent upon effort. Students for whom teachers have low expectations tend to receive negative feedback unrelated to their effort which is designed to control disruptive behavior. Consequently, these students are not apt to recognize the importance of effort in academic success and are less likely to work diligently toward that

end.

Martinek and his colleagues (Martinek, 1988; Martinek, Crowe & Rejeski, 1982; Martinek & Johnson, 1979) have examined teacher expectancy effects in physical education, framing their work with the Pygmalion theory. According to this theory, teachers develop preconceptions about students based on factors such as ability and attitude which impact student behavior and learning (Rosenthal & Jacobsen, 1968). These studies, in general, found that physical education teachers tend to have a more positive attitude toward higher skilled students as compared to students of lower skill levels. Other researchers have reported no differences in teacher behavior based on skill level, but instead have suggested that student behavior varies as a function of skill level (Pieron, 1982; Shute et al., 1982; Telama, Varstala, Heikimaro-Johansson & Utriainen, 1987).

Although teacher expectancy effects have been investigated, the influence they have on individual students is unclear. These studies have for the most part not considered the student's perception or interpretation of teacher behavior. Recognizing this, Martinek (1988) used structured interviews to assess students' perceptions of three specific teacher behaviors and this study deserves special consideration. He compared coded observations of three teacher behaviors (praise/encouragement, corrective skill feedback, and corrective behavior feedback) with

students' estimations of those behaviors, contrasting students for whom teachers expressed high expectations with those for whom teachers had expressed low expectations. Results from the coding of teacher behaviors indicated that high expectation students received more corrective behavior feedback and less praise but their perception of teacher behaviors indicated they thought they were praised more than corrected. The low expectation students received more praise than corrective behavior feedback. Their perception of the teacher behaviors more closely corresponded to the coded behaviors than did the high expectation group. Martinek also collected attributional data concerning the perceived teacher behaviors. Students in the high expectation group attributed corrective behavior feedback to teacher characteristics while students in the low expectation group attributed that behavior to personal causes, or something they had done.

The results of this study by Martinek seem to be in conflict with those reported in classroom research. It should be noted, however, that his study took place in a real class setting and compared actual coded behavior patterns to the students perceptions of those behaviors. Most of the classroom work cited employed a design in which students responded to hypothetical situations rather than actual instructional settings. Even though high expectation students actually received a greater proportion of

corrective behavior feedback than praise or encouragement, they believed that they received more praise. When they did recognize corrective behavior feedback, they believed it was not caused by themselves, but instead by some external factor like the teacher's mood. The low expectation students neither perceived or received excessive corrective behavior feedback, but they did take the responsibility for causing that behavior. This seems to suggest that corrective behavior feedback has little or no salience for high expectation students and has a more profound effect on low expectation students. When the difference in experimental design is considered, these results become somewhat more reconcilable.

Although Martinek's study is an important first step in describing the students' interpretation of teacher behaviors, some methodological shortcomings are evident. Students were interviewed at the end of six week instructional units about their perceptions of the targeted teacher behaviors. We have no way of knowing if the behaviors they reported as perceiving were the same behaviors the coders identified. The procedure used to identify high and low expectation students can also be questioned, as more than 25% of the students initially included in the study were classified at the end of the study in the other group and were eliminated from the analysis. It is apparent that teacher expectations are

perceived by students in physical education and that this perception, in turn may have a significant effect on student behavior and skill achievement. However, much remains to be learned about the manner in which individuals perceive this teacher behavior and mediate its effect on achievement.

Motivation. Motivation, defined as the process of initiating, sustaining, and directing activity, has been a frequently studied aspect of thought processes involved in learning from teaching. Teacher behavior can affect achievement through student motivation, which can be influenced by the teacher, the student, or other factors (Wittrock, 1986b). Positive self-motivational thoughts have been related to positive attitudes about math class (Peterson & Swing, 1982; Peterson et al. 1984) and a negative relationship between negative self-evaluations and achievement in math has been demonstrated (Peterson et al. 1984). Based on their results, these authors suggested that motivation may be a prerequisite for task engagement. Similar results were reported by Meece, Blumenfeld, and Hoyle (1988) in an investigation of the relationship between student goal orientation and cognitive engagement patterns. They found task-mastery goals to be associated with high levels of engagement while goals concerned with social recognition, pleasing the teacher, or avoiding work were related to lower levels of cognitive engagement.

A model of attribution based on the concept of locus of

control serves as a useful tool in conceptualizing how students' motivational processes mediate achievement. Perceived causes of success are ability, effort, luck, and task difficulty (Weiner, 1983). There is empirical evidence to support the notion that when students attribute success or failure to their own effort or lack of it they will be highly motivated to learn. Effort is a factor which they control. When students ascribe the cause of their success or failure to factors beyond their control, such as ability, luck, or task difficulty they are less likely to persist on academic tasks (Bar-Tal, 1978; Dweck, 1975; Wang & Stiles, 1976). An environment which ensures that students experience success alone is not sufficient to enhance motivation to achieve. Student cognition must include a perception of a causal relationship between effort and success in order to enhance motivation (Wittrock, 1986b).

As in the area of attention, much of the research related to motivation in the area of motor skill and physical activity has been done in motor learning and sport psychology. Motivation is seen as an important aspect of learning because of its role in the initiation, maintenance, and intensity of behavior (Magill, 1989). Learning and motivation are viewed as reciprocal processes, with the development of one facilitating the other. However, data collected in laboratory setting^t suggests~~x~~ that motivation techniques are not effective in producing changes in motor

skill acquisition (Schmidt, 1988). Attempting to explain these results, Schmidt hypothesized that experimental procedures could have masked the effects of motivation and that motivation may affect subjects differentially. He concluded that the assumption of a linear relationship between increased motivation and increased motor learning (assuming more is always better) is an oversimplification of the process. There may likely be an optimal level of motivation for subjects which if exceeded may actually yield a performance decrement. There is a consensus that motivation is related to goal or intent, which in turn impacts behavior during motor skill acquisition (Magill, 1989; Schmidt, 1988).

Though motivation would appear to be an important variable in physical education settings, very little is known about student incentive in the gymnasium. Greenockle, Lee, & Lomax (1990) investigated the relationship between selected student characteristics and activity patterns in a required secondary physical education setting. They determined that exercise behavior was mediated by student motivation or intention, which in turn was affected by a personal perception of the expectations of significant others.

In a study of student cognitions during tennis instruction, Lee, Landin, Carter, and Fant (1989) reported that both high and low success students related positive

motivational thoughts during instruction. In a finding similar to that of Peterson et al. (1984), however, low success students also expressed negative feelings about the likelihood of experiencing success even before they attempted the skill. These authors speculated that this negative self-evaluation could have interfered with the students' ability to understand what was required in the skill. Although motivation is believed to be an important factor in all types of learning, and it appears to be an influential factor motor skill acquisition, at this time we have little information about motivation in physical education classes from the students' perspective.

Teacher praise and reinforcement. Two functions of teacher praise and reinforcement have been consistently identified (Wittrock, 1978). The first, motivation, is based on the principle of increasing the likelihood of a desired behavior by rewarding it and does not involve learning with awareness. Providing information about the correctness of a response is the second function. Evidence suggests that in actuality praise does not usually serve as a motivator, but instead provides information about desired behavior to all students who observe the praise (Brophy, 1981).

Many factors, such as developmental level, intellectual ability, and cognitive style affect the student's perception of praise. Praise is likely to have a positive effect on

students with low ability, young children, and students eager to please the teacher. For other students, though, praise can be counterproductive. It may change intrinsic motivation to extrinsic motivation (Lepper, 1983), or lessen a child's perception of her or his ability if praised for success on an easy task (Morine-Dershimer, 1982). The student's cognitive mediation of teacher praise determines how it is perceived and in turn, the effect that it has on the individual. While Martinek's work suggests that a student's perception of teacher praise is related to that student's in-class behavior, the whole issue of cognitive mediation of praise and reinforcement remains a fascinating subject of investigation for researchers in physical education.

Instructional Behaviors. In addition to actively processing and interpreting affective teacher behaviors, students also perceive and give meaning to teachers' instructional behaviors (Winnie & Marx, 1982). Increased teacher emphasis on academic performance is associated with an increase in children's realization of the importance of academics (Blumenfeld, Hamilton, Basser, Wessels, & Meece, 1983). Students are able to perceive relatively subtle differences in instructional stimuli, as demonstrated in Duffy, Roehler, & Rackliffe's (1986) investigation of the influence of instructional talk on students' understanding of lesson content. They found that the teachers'

interpretation of what was to be learned about the skill and the process to be used in its implementation was reflected in what the students remembered about the lesson and affected their understanding of it. They suggested that a teachers' effectiveness is related to the extent which the reasoning process behind the strategy is described.

A vast array of instructional stimuli are employed by teachers attempting to elicit various cognitive processes. In their study of students' and teachers' views of thinking processes for classroom learning, Winnie and Marx (1982) reported that instructional stimuli do not always cue the type of cognitive strategy the teacher intends and may prompt different cognitive processes for different students. They advocate teachers knowing and understanding the students' perceptions and previously learned strategies to facilitate instruction.

In the complex, dynamic environment of the gymnasium, it seems reasonable to believe that student perception of instructional behavior could be a critical variable. To date, however, little information is available about the meanings that students attach to instructional behaviors in physical education, and whether or not those behaviors are perceived in the manner in which they are intended. Task presentation serves the function of providing the learner with information about the task. It is critical that the physical education teacher communicates her or his intention

to students accurately, and that student and teacher intentions correspond (Rink & Werner, 1987).

At least one study in physical education (Tousignant & Siedentop, 1983) described how students responded to various tasks presented by three teachers. Findings indicated that while some students listened and became engaged with the tasks as stated by the teacher, others found the level of task difficulty to be inappropriate and drifted toward a modified task. Two other response categories were grouped under the general labels deviant off-task behavior and competent bystanders. The competent bystander represented a subtle approach to avoiding participation by staying in the back of the line and choosing positions and partners to minimize involvement. The foci of the teachers' accountability systems were also described. One teacher held students responsible for only minimal participation. In another class, effort was rewarded. The third teacher focused on skill performance. The pattern of task accomplishment displayed by students was related to the system of accountability employed by the teacher. When the teacher held students accountable for their motor performance, students tended to remain engaged on the assigned task. This suggests that students were able to perceive differences in the teachers task presentation as related to the system of accountability and adjusted their behavior accordingly.

Although teacher behavior was not coded systematically, Greenockle et al. (1990) speculated that students in their study were influenced by their perceptions of instructional behaviors. The teachers in the study appeared to be content with a high percentage of on task behavior at a low intensity level. The authors suggested that the students engaged in walking rather than jogging in part because they perceived the teachers satisfaction with that low intensity level and speculated that student behavior patterns could have been altered by teachers holding different beliefs about fitness.

Hanke (1987) selected critical incidents from physical education classes and interviewed students and teachers about them. Teachers and students agreed for the most part on their descriptions of the incidents, but differed in their perceptions of causal attributions. Teachers seldom considered student thoughts about class events. Likewise, students seldom considered the teachers' point of view. When they did, the conclusions they drew about the teachers behavior were not what the teacher had intended. Hanke suggests that teachers need to know more about student cognitions and how to incorporate that knowledge in their instruction.

Comprehension, Acquisition and Learning Strategies

Procedures used to enhance the acquisition and retention of information are referred to as learning

strategies (Wittrock, 1987). Metacognition, defined as the students' awareness of, knowledge about, and control over the cognitive strategies they employ, is a closely related construct which is useful in the interpretation and investigation of learning strategies. There is evidence that students are aware of the cognitive strategies that they employ and can recall them accurately enough to predict achievement (Wittrock, 1986b).

The use of specific cognitive strategies is positively related to achievement (Peterson & Swing, 1982; Peterson et al. 1984), while the use of general strategies is unrelated (Peterson et al. 1984) or negatively related (Peterson & Swing, 1982) to achievement. The results of both of these studies support the notion that student ability and achievement are significantly related to students' reports of their thoughts during instruction. Successful specific learning strategies reported include relating information to prior knowledge, trying to understand the teacher or the problem, and students checking their answers.

In his comprehensive review of research on student thought processes, Wittrock (1986b) concluded that memorization of factual material is facilitated by the learners' use of interactive associations about the information. He also identified the generation of relationships between knowledge and experience with information to be acquired as well as interrelationships

among the components of that material as important mediators is teaching. The role of prior knowledge and its relationship to domain-specific knowledge is also viewed as an important factor in the acquisition of new knowledge (Shuell, 1986). Weinstein and Mayer (1986) summarized the research about teaching learning strategies and identified three major categories of learning strategies: 1) strategies for active learners such as rehearsing, elaborating and organizing; 2) management strategies such as comprehension monitoring; 3) affective strategies such as anxiety reduction. It is important to note that much of the research on which this is based was conducted in a laboratory rather than an instructional setting.

Examining these conclusions from a metacognitive perspective, Peterson (1988) scrutinizes these assertions. She reports that, although students describe a wide variety of cognitive strategies which they use, the ones they report are not in strict agreement with those identified by educational researchers and cognitive psychologists, such as Wittrock (1986b) and Weinstein and Mayer (1986). It is of interest to note, however, that Peterson and Swing (1982) identified relating new information to prior knowledge as one of two specific strategies having a significant relationship with achievement.

Based on her research findings, Peterson (1988) suggests that the students' ability to judge, monitor, and

diagnose difficulty within their own understanding, along with the reported use of specific strategies during instruction are significantly related to learning and achievement. Rather than concluding that the educational researchers and cognitive psychologists are inaccurate in their conclusions about effective learning strategies, she asserts that students' lack of metacognitive knowledge--awareness and control over their cognitive processes--may be limiting students' learning potential.

This brings to light the question of the feasibility of training students to become more aware of their cognitive processes and to use effective learning strategies.

Weinstein and Mayer (1986) provided evidence that learning strategies can be described and taught to learners at appropriate developmental levels, although much of the data they cite are laboratory based. In a recent classroom-based study by Swing, Stobier, and Peterson (1988), teachers in the experimental group received training on the cognitive skills of defining and describing, comparing, thinking of reasons, and summarizing. Teachers in the comparison group received information on techniques for improving student engaged time. Students in thinking skill classes reported using more thinking skills than students in learning time classes. Students in learning time classes increased their engaged time over the course of instruction, but a strong relationship between ability and achievement existed in

these classes. Aptitude and treatment interactions were evident. Higher ability classes seemed to benefit more from cognitive intervention than lower ability classes, but the lower ability students within those classes benefited more than highly skilled students. The authors speculated that the cognitive skill training provided these students with skills they had not already acquired and in effect enabled them to "catch up" with their classmates. They also suggested that the ineffectiveness of the thinking strategies with the lower level classes could be attributed to the teachers failure to adapt their instruction so that it would be more meaningful to those students.

The results of this and other studies (Wittrock, 1986b) underscore the role that increased knowledge about student cognitions could play in understanding the teaching and learning process. Not only can teachers' knowledge and understanding of strategies enable them to teach students to use more effective strategies, it can also help them to understand the reasoning the students use. There is evidence to suggest that this increased understanding enables teachers to understand repeated errors and give students valuable and meaningful feedback about the errors that they make (Brown and Vanlehn, 1982).

In their study of student thoughts during tennis instruction, Lee et al. (1989) examined students' understanding of the tennis lesson and their use of

strategies. They reported that all students believed they had understood the teachers' explanation, but high success students were able to describe the sequence of movement in more detail and identify more points about technique than low success students. High success students were able to articulate specific strategies they employed to improve their own performance. Low success students were more concerned about their inability to perform the skill than implementing strategies to improve and did not always understand the goal of the task. Although these students were able to recall specific feedback statements made by the teacher, this information was not useful to them. These results are congruent with those reported in classroom studies and suggest that increased knowledge about students' thoughts and strategies can facilitate effective instruction in the gymnasium as well as in the classroom.

Conclusions and Implications

In its relatively brief history, research on teacher effectiveness in physical education has yielded inconsistent and sometimes uninterpretable results. It now seems apparent that the two-factor model of the process-product paradigm is not of sufficient complexity to explain the complex process of teaching and learning. It has been recognized that the link between teacher behavior and student achievement is not a direct one. Students actively process instructional behaviors. It is the manner in which

they perceive and process these behaviors which in turn, impacts learning. The opportunity to learn, whether it is referred to as time on task, engaged time or ALT, is certainly a necessary component in the teaching-learning process, but it alone is not sufficient to produce achievement. ALT-PE, employed as both a student process variable and as a measure of teacher effectiveness, has been a useful construct, but the quantity of time in which learners are actively engaged in motor activity has not proven to be significantly related to motor skill acquisition. In order to more fully understand and explain effective teaching in physical education, it is imperative that we learn more about students' thoughts as they acquire motor skills, or what goes on during ALT-PE. Knowledge about student attention, perception, and learning strategies can enable teachers to teach more effectively by making their instruction more meaningful to their students. The work that has been conducted in classroom research, as well as the initial work that has been done in physical education settings shows much promise. The study of student thoughts as mediating factors in the relationship between teacher behavior and student achievement appears to provide a viable approach to the examination of the relationship between these two variables.

Additional References

- Adams, J. A. (1971). A closed loop theory of motor learning. Journal of Motor Behavior, 3, 111-149.
- Anderson, R. C., & Biddle, W. B. (1975). On asking people questions about what they are reading. In G. H. Bower (Ed.), The psychology of learning and motivation (Vol. 9). New York: Academic Press.
- Andre, T. (1979). Does answering higher-level questions while reading facilitate productive learning? Review of Educational Research, 49, 280-318.
- Bar-Tal, D. (1978). Attributional analysis of achievement-related behavior. Review of Educational Research, 48, 259-271.
- Beauchamp, L., Darst, P. W., & Thompson, L. P. (1990). Academic learning time as an indication of quality high school physical education. Journal of Physical Education, Recreation, and Dance, 61(1), 92-95.
- Bloom, B. S. (1953). Thought-processes in lectures and discussions. Journal of General Education, 7(3), 160-169.
- Blumenfeld, P. C., Hamilton, V. L., Bossert, S. T., Wessels, K., & Meece J. (1983). Teacher talk and student thought: Socialization into the student role. In J. Levine & M. C. Wang (Eds.), Teacher and student perceptions: Implications for learning. Hillsdale, NJ: Lawrence Erlbaum.

- Boker, J. R. (1974). Immediate and delayed retention effects of interspersing questions in written instructional passages. Journal of Educational Psychology, 66, 96-98.
- Brophy, J. E. (1981). Teacher praise: A functional analysis. Review of Educational Research, 51, 5-32.
- Brophy, J. E., & Evertson, C. (1976). Learning from teaching: A developmental perspective. Boston: Allyn & Bacon.
- Brophy, J. E., & Good, T. L. (1986). Teacher behavior and student achievement. In M. C. Wittrock (Ed.), Handbook of research on teaching (3rd ed., pp. 328-375). New York: Macmillan.
- Brown, A. L. (1988). Motivation to learn and understand: On taking charge of one's own learning. Cognition and Instruction, 5(4), 311-321.
- Brown, A. L., Bransford, J. D., Ferrara, R. A., & Campione, J. C. (1983). Learning, remembering, and understanding. In J. H. Flavell & E. M. Markman (Eds.), Handbook of child psychology: Vol. 3. Cognitive development (4th Ed., pp. 77- 166). New York: Wiley.
- Brown, A. L., & Kane, M. J. (1988). Preschool children can learn to transfer: Learning to learn and learning from example. Cognitive Psychology, 20, 493-523.

- Brown, J. S., & Vanlehn, K. (1982). Towards a generative theory of "bugs." In T. P. Carpenter, J. Moser, & T. Romberg (Eds.), Addition and subtraction: A developmental perspective. Hillsdale, NJ: Lawrence Erlbaum.
- Buck, M., & Harrison, J. M. (1989, October). An analysis of learning trials and their relationship to achievement in volleyball. Paper presented at the R. Tait MacKenzie Symposium on Sport, Knoxville, TN.
- Camp, B. W. (1980). Two psychoeducational treatment programs for young aggressive boys. In C. K. Whalen and B. Henker (Eds.), Hyperactive children, the social ecology of identification and treatment. Hillsdale, NJ: Lawrence Erlbaum.
- Carnegie Commission Task Force. (1986). A nation prepared: Teachers for the 21st century (The Report of the Task Force on Teaching as a Profession). New York: Carnegie Corporation.
- Chi, M. T. H., Bassok, M., Lewis, M. W., Reimann, P., & Glaser, R. (1989). Self-explanations: How students study and use examples in learning to solve problems. Cognitive Science, 13, 145-182.
- Cooper, H. (1983). Communication of teacher expectations to students. In J. Levine & M. C. Wang (Eds.), Teacher and student perceptions: Implication for learning. Hillsdale, NJ: Lawrence Erlbaum.

- DeKnop, P. (1986). Relationship of specified instructional teacher behaviors to student gain on tennis. Journal of Teaching Physical Education, 5, 71-78.
- Duchastel, P. (1979). Learning objectives and the organization of prose. Journal of Educational Psychology, 71, 100-106.
- Duffy, G. G., Roehler, L. R., & Rackliffe, G. (1986). How teachers' instructional talk influences students' understanding of lesson content. Elementary School Journal, 87, 3-16.
- Dunkin M. J., & Biddle, B. J. (1974). The study of teaching. New York: Holt, Rinehart & Winston.
- Dweck, C. (1975). The role of expectations and attributions in the alleviation of learned helplessness. Journal of Personality and Social Psychology, 31, 674-685.
- Faw, H.W., & Waller, T. G. (1976). Mathemagenic behaviors and efficiency in learning from prose materials: Review, critique, and recommendations. Review of Educational Research, 46, 691-720.
- Fisher, C. W., Filby, N. M., Marliave, R., Cahen, L. S., Disha, M. M., Moore, J. E. & Berliner D. C. (1978). Teaching behaviors, academic learning time and student achievement: Final report of Phase IIIB, Beginning Teacher Evaluation Study (Technical Report V-1). Washington, DC: The National Institute of Education.

- Fitts, P. M. & Posner, M. I. (1967). Human performance. Belmont, California: Brooks/Cole.
- Gage, N. L. (1972). Teacher effectiveness and teacher education. Palo Alto, CA: Pacific Books.
- Gage, N. L. (1978). The scientific basis of the art of teaching. New York: Teachers College Press.
- Gentile, A. M. (1972). A working model of skill acquisition with application to teaching. Quest, Monograph 17, 3-23.
- Godbout, P., Brunelle, J. & Tousignant, M. (1983). Academic learning time in elementary and secondary physical education classes. Research Quarterly for Exercise and Sport, 54 (1), 11-19.
- Graham, G., Soares, P. & Harrington, W. (1983). Experienced teachers' effectiveness with intact classes: An ETU study. Journal of Teaching Physical Education, 2, 3-14.
- Hanke, U. (1987). Cognitive aspects of interaction in physical education. In G. T. Barrette, R. S. Feingold, C. R. Rees, & M. Pieron (Eds.), Myths, models, and methods in sport pedagogy (pp. 135-141) (Proceedings of the Adelphi-AEISEP '85 World Sport Conference). Champaign, IL: Human Kinetics.
- Howard, G. S. (1981). On validity. Evaluation Review, 5(4), 567-576.

- Holmes Group, Inc. (1986). Tommmorow's teachers: A report of the Holmes Group. East Lansing, MI.
- Kaplan, R., & Simmons, F. G. (1974). Effects of instructional objectives used as orienting stimuli or as summary/review upon prose learning. Journal of Educational Psychology, 66, 614-622.
- Lee, A. M., & Poto, C., (1987). Instructional time research in physical education: Contributions of current issues. Quest, 38, 63-73.
- Lepper, M. R. (1983). Extrinsic reward and intrinsic motivation. In J. Levine & M. C. Wang (Eds.), Teacher and student perception: Implications for learning. Hillsdale, NJ: Lawerence Erlbaum.
- Levie, W. H., & Dickie, K. E. (1973). The analysis and application of media. In R. M. W. Travers (Ed.), Second handbook on research on teaching. Chicago: Rand McNally,
- Magill, R. A. (1989). Motor learning : Concepts and application. Dubuque, Iowa: Wm. C. Brown Company.
- Martinek, T., Crowe, P., & Rejeski, W. (1982). Pygmalion in the gym. Champaign, IL: Leisure Press.
- Martinek, T., & Johnson, S. (1979). Teacher expectaions: Effects on dyadic interaction and self-concept in elementary-age children. Research Quarterly, 50, 60-70.

- Marx, R. W., & Winnie, P. H. (1987). The best tool teachers have--their students' thinking. In D. C. Berliner & B. V. Rosenshine (Eds.), Talks to Teachers (pp. 267-304). New York: Random House.
- Meece, J. L., Blumenfeld, P. C., & Hoyle, R. H. (1988). Students' goal orientation and cognitive engagement in classroom activities. Journal of Educational Psychology, 80, 514-523.
- Metzler, M. (1989). A review of research on time in sport pedagogy. Journal of Teaching in Physical Education, 8, 87-103.
- Morine-Dersheimer, G. (1982). Pupil perceptions of teacher praise. Elementary School Journal, 82, 421-434.
- Phillips, D. A. & Carlisle, C. (1983). A comparison of physical education teachers characterized as most and least effective. Journal of Teaching Physical Education, 3, 55-67.
- Pieron, M. (1982). Behaviors of low and high achievers in physical education classes. In M. Pieron & J. Cheffers (Eds.), Studying the teaching in physical education (pp. 53- 60) (Proceedings of the AIESEP 1982 World Convnetion). Liege, Belgium: University of Liege.
- Placek, J. H. & Randall, L. (1986). Comparison of academic learning time in physical education: Students of specialists and nonspecialists. Journal of Teaching Physical Education, 5, 157-165.

- Putnam, R. T., Lampert, M., & Peterson, P. L. (1990).
Alternative perspectives on knowing mathematics in
elementary schools. Review of Research in Education,
16, 57-150.
- Rink, J. E., & Werner, P. (1987). Student responses as a
measure of teacher effectiveness. In G. T. Barrette,
R. S. Feingold, C. R. Rees, & M. Pieron (Eds.),
Myths, models, and methods in sport pedagogy (pp. 199-
206) (Proceedings of the Adelphi-AEISEP '85 World Sport
Conference). Champaign, IL: Human Kinetics.
- Rink, J. E., Werner, P., Hohn, R., Ward, D., & Timmermans,
H. (1986). Differential effects of three teachers
over a unit of instruction. Research Quarterly for
Exercise and Sport, 57, (2), 132-138.
- Rolider, A., Siedentop, D. & Van Houten, R. (1984). Effects
of enthusiasm training on subsequent teacher
enthusiastic behavior. Journal of Teaching Physical
Education, 3, 47-59.
- Romberg, T. A., & Carpenter, T. P. (1986). Research on
teaching and learning mathematics: Two disciplines of
scientific inquiry. In M. C. Wittrock (Ed.), Handbook
of research on teaching (3rd ed., pp. 376-391). New
York: Macmillan.

- Rosenshine B. (1976). Classroom instruction. In N. L. Gage (Ed.), The Psychology of Teaching Methods. 75th Yearbook of The National Society for the Study of Education, Pt. 1. Chicago: University of Chicago Press.
- Rosenshine, B., & Furst, N. (1971). Research on teacher performance criteria. In B. O. Smith (Ed.), Research in teacher education: A symposium. Englewood Cliffs, NJ: Prentice-Hall.
- Rosenthal, R., & Jacobson, L. (1968). Pygmalion in the classroom. New York: Holt, Rinehart, & Winston.
- Rower, W. D., Jr. (1972). Decisive research: A means for answering fundamental questions about instruction. Educational Researcher, 1(7), 5-11.
- Rower, W. D., Jr. (1973). Elaboration and learning in childhood and adolescence. In H. W. Reese (Ed.), Advances in child development and behavior (Vol. 8). New York: Academic Press.
- Shulman, L. S. (1986). Paradigms and research programs in the study of teaching: A contemporary perspective. In M. C. Wittrock (Ed.), Handbook of research on teaching (3rd ed., pp. 3-36). New York: Macmillan.
- Shute, S., Dodds, P., Placek, J., Rife, F., & Silverman, S. (1982). Academic learning time in elementary school movement education: A descriptive analytic study. Journal of Teaching in Physical Education, 1(2), 3-14.

- Siedentop, D. Birdwell, D., & Metzler, M. (1979). A process approach measuring teacher effectiveness in physical education. Paper presented at the AAHPERD Annual Conference, New Orleans, LA.
- Siedentop, D., Tousignant, M., & Parker, M. (1982). Academic Learning Time-Physical Education Coding Manual. Columbus: The Ohio State University.
- Silverman, S. (1985a). Critical considerations in the design and analysis of teacher effectiveness research in physical education. International Journal of Physical Education, XXII, 17-24.
- Silverman, S. (1985b). Relationship of engagement and practice trials to student achievement. Journal of Teaching Physical Education, 5, 13-21.
- Silverman, S. (1985c). Student characteristics mediating engagement outcome relationships in physical education. Research Quarterly for Exercise and Sport, 56, 66-72.
- Silverman, S., Dodds, P., Placek, J., Shute., & Rife, F. (1984). Academic learning time in elementary school physical education (ALT-PE) for student subgroups, and instructional activity units. Research Quarterly for Exercise and Sport, 55, 365-370.
- Silverman, S., Tyson, L., & Morford, L. (1988). Relationships of organization, time, and student achievement in physical education. Teaching and Teacher Education, 4, 247-257.

Swing, S. R., Stoiber, K. C., & Peterson, P. L. (1988).

Thinking skills versus learning time: Effects of alternative classroom-based interventions on students; mathematics problem solving. Cognition and Instruction, 5, 123-191.

Telama, R., Varstala, V., Heikinaro-Johansson, P.,

Utriainen, J. (1987). Learning behavior in PE lessons and physical and psychological responses to PE in high-skill and low-skill pupils. In G. T. Barrette, R. S. Feingold, C. R. Rees, & M. Pieron (Eds.), Myths, models, and methods in sport pedagogy (pp. 239-248) (Proceedings of the Adelphi-AEISEP '85 World Sport Conference). Champaign, IL: Human Kinetics.

Wang, M. C., & Stiles, B. (1976). An investigation of children's concept of self-responsibility for their school learning. American Educational Research Journal, 13, 159- 179.

Weiner, B. (1983). Speculations regarding the role of affect in achievement-change programs guided by attributional principles. In J. Levine & M. C. Wang (Eds.), Teacher and student perceptions: Implications for learning. Hillsdale, NJ: Lawrence Erlbaum.

- Weinstein, R. S., Marshall, H. H., Brattesani, K. A., & Middlestat, S. E. (1982). Student perceptions of differential teacher treatment in open and traditional classrooms. Journal of Education Psychology, 74, 678-692.
- Weinstein, R. S., & Middlestat, S. E. (1979). Student perceptions of teacher interactions with male and high and low achievers. Journal of Educational Psychology, 71, 421-431.
- Winnie, P. (1979). Experiments relating teachers' use of higher cognitive questions to student achievement. Review of Educational Research, 49, 13-50.
- Wittrock, M. C. (1978). The cognitive movement in instruction. Educational Psychologist, 13, 15-30.
- Wittrock, M. C. (Ed.) (1986a). Handbook of research on teaching (3rd Ed.). New York: Macmillan.
- Wittrock, M. C. (1986b). Students' thought processes. In M. C. Wittrock, (Ed.), Handbook on Research on Teaching (3rd ed.), (pp. 297-314). New York: Macmillan.
- Yerg, B. J. (1981). The impact of selected presage and process behaviors on the refinement of a motor skill. Journal of Teaching in Physical Education, 1, 38-46.

Appendix B
Pilot Study

Pilot Study

Most of the studies conducted on student cognition during instruction have employed a stimulated recall interview technique to assess student thoughts. Although this procedure has provided useful information about student thoughts, a concurrent chronicle of thoughts as they occur appears to provide the most accurate self-report data (Brown, 1988). Locke and Jensen (1974) used a thought sampling technique with college-aged students in physical education classes to provide such an on-line commentary, but to date this approach has not been utilized with younger children. The purpose of the pilot experiment was three fold. The first objective was to investigate the utility of written self-report measures with sixth grade physical education students. The second purpose was to establish reliability and validity for a written knowledge test in volleyball for use with this age group. The third intention was to examine the relationships between various measures of cognitive processes, students attitudes and level of perceived competence, and skill level in a physical education setting.

Methods

Subjects

The subjects for the pilot experiment were 30 male and 18 female sixth grade students in regular physical education classes at a local middle school. Signed parental

permission was obtained for each student. Additionally, 10 female sixth grade students who are participating on their school volleyball teams were used to establish validity for the written knowledge test.

Instruments

Activity and Sports Background Survey. Each student completed a survey about his/her involvement in sports and activities, along with questions about their parents and siblings and their involvement in sports and fitness activities.

Attitude Scale. The revised Children's Attitudes Toward Physical Activity (CAPTA) Scale (Schutz, Smoll, Carre, & Mosher, 1985) was administered to assess the students attitudes toward physical education and activity. This scale has been validated for use with elementary-aged children and determined to be a reliable assessment of group status (Smoll & Schutz, 1980).

Perceived Competence Scale. Three scales were administered to assess the students' perceived competence. Subjects completed the physical and general self-worth subscales of Harter's (1979) Perceived Competence Scale for Children and a modification of the physical competence subscale specifically applicable to volleyball. The "structure alternative format" designed by Harter (1982) to offset the tendency of subjects to give socially desirable responses was used. Each subscale consisted of seven items.

All three subscales were administered in one sitting, with items interspersed. No more than two consecutive items were from the same subscale. Positive answers appeared on either the right or left side of the response column, and the order of the items was such that no more than two consecutive items were keyed for positive responses on the same side of the response form. Within each subscale, at least three items were keyed with positive responses on the right side, and at least three were keyed for positive responses on the left side of the response form. The direction for the positive response for seventh item on each subscale was chosen at random.

Knowledge Test. An objective written test was designed to assess knowledge about volleyball. Toward that end, a 60 item objective test was administered to the subjects so that appropriate test questions could be selected and inappropriate items deleted. Although emphasis on achievement in motor skill was the primary focus of this investigation, the test was designed to be a comprehensive test of volleyball knowledge. One half of the items were concerned with skill and technique, while the other half dealt with rules and scoring.

Skill Tests. The AAHPER serving accuracy test (AAHPER, 1969) and the Brumbach forearm pass wall-volley test (Cox, 1980) were administered to assess the volleyball skill level of the subjects.

Cognitive Processes Questionnaire. In order to elicit information about students' attention level, use of strategies, and motivation level during physical education class, a cognitive processes questionnaire was administered. The questionnaire was developed by adapting a similar instrument employed by Peterson, Swing, Stark, and Waas (1984).

Thought Samples. On-line commentary of student thoughts were collected using the thought sampling technique employed by Locke & Jensen (1974). This format has been used in earlier research with college students (Solmon, Lee, Landin, & Cutton, 1991).

Student Journal. In order to examine each students' perception of the physical education lesson and to elicit information about attention level and strategies used during instruction and practice, subjects completed the student a journal.

Data Collection

The background survey, attitude scale and the perceived competence scale were administered to all students during their physical education class on the first day of data collection. The knowledge test was given on the second day, followed by the skill tests on the third and fourth days. The students completed the cognitive processes questionnaire after they had taken the skill tests.

After these measures had been completed by all

subjects, the researcher explained to the subjects how to complete the thought sample form. Students then participated in an introductory volleyball lesson. The students' regular physical education teacher taught the lesson from a plan written by the researcher. The lesson was monitored by the researcher to verify that the plan was followed. At two pre-determined intervals during the lesson, the researcher signaled for the students to record exactly what they were thinking about when the signal was given. At the conclusion of the lesson, each student was asked to complete a student journal about the lesson.

The volleyball knowledge test was given separately to a group of students who are participating in organized volleyball programs in order to establish validity.

Data Analysis

Descriptive statistics and Kendall's tau correlation coefficients were used to analyze the data. This nonparametric measure of correlation was employed because the scales in the experiment produced ordinal data. A significance level of $p < .05$ was used.

In order to establish reliability for the written knowledge test, a K-R formula 20 reliability coefficient was calculated (Baumgartner & Jackson, 1982). Validity was established by comparing the scores of the subjects in the physical education classes with those of students participating in an organized volleyball program using a t-

test. An item analysis was completed, including difficulty and discrimination indices in order to ensure each test item selected for the final test was appropriate.

Results

Descriptive Statistics

Responses on the background survey reflected a wide range of student involvement in physical activities, but indicated that only 4 students had experience in volleyball. Although the information from this instrument was analyzed qualitatively, because of the similarity of responses it was not coded for analysis. Descriptive statistics for the CAPTA, the perceived competence scales, the skills tests, the cognitive processes questionnaire, the knowledge test, and the thought samples are found in Table 1. Like the background survey, the student journals were analyzed qualitatively but were not coded for analysis because of the heterogeneity of responses.

Insert Table 1 about here

The descriptive statistics reported on the CAPTA, the perceived competence scales, and the skill test measures are comparable to those reported in the literature. The scores reported on the cognitive processes questionnaire and the thought samples reflect an appropriate range and distribution of scores.

Knowledge Test

The 60 item knowledge test was administered to a total of 60 sixth grade students. Nineteen female and 33 male students in regular physical education classes and eight female students who had experience playing volleyball in another setting took the test. Each student had a written copy of the test, but all questions were read aloud to the subjects to minimize the effects of reading level. Indices of item discrimination and difficulty are found in Table 2.

Insert Table 2 about here

Based in the item analysis, 20 items were eliminated from the tests and the scores reported are based on the shortened version of the test. All items with a difficulty index below .10 or over .90 or a discrimination index of less than .20 were deleted (Baumgartner & Jackson, 1982). The mean percentage score for all students completing the test was 43.96%. The K-R formula 20 reliability coefficient was .754.

The four female students in the regular physical education classes who had experience in volleyball were members of the school volleyball team. These students, along with the eight female students from another setting who had experience playing volleyball combined to form a group of students presumed to have knowledge about

volleyball. The remaining 15 female students from the regular physical education classes who had no experience in volleyball were used as a comparison group to determine if the written test would reflect the presumed difference in the knowledge base of the two groups. A t -test comparing the means of the two groups determined the scores to be significantly different ($t_{25} = 5.736, p < .0001$). The mean for all female students taking the test was 50.37%. The mean for those students who had volleyball experience was 63.12% while the mean for the comparison group was 40.18%.

Relationships Between Variables

The significant correlation coefficients between variables are found in Table 3.

Insert Table 3 about here

The perceived competence scale for volleyball was related to the perceived competence physical scale, and both of these measures were related to skill level and the motivation subscale of the cognitive processes questionnaire. The perceived competence subscales were also related to various subdomains of the CAPTA, and various subdomains of the CAPTA were related to each other.

The significant but relatively low correlation between the two skills tests suggests that they are related measures but that they do provide information about specific skill

domains within the sport of volleyball. Both tests are suitable for use with sixth grade males and females to assess skill level.

The knowledge test, even after inappropriate items had been discarded, was not significantly related to any variable although its validity and reliability are estimated to be acceptable. Thought samples, though of sufficient quality and variability to be coded, were also not related to other variables. This technique does not appear to be a useful method to assess the cognitive processes of a particular student in an instructional setting in physical education.

The cognitive processes questionnaire, though only the motivation subscale was related to other variables, does show some promise. Students were able to report levels of motivation during physical education class which were related to their perceived competence. The distribution of scores on this instrument was suitable despite a problem with the response choices.

Discussion

Based on the results of the pilot experiment, it appears that the written self-report measure of thought samples and student journals do not provide sufficient information about attention, level of understanding, and strategies students employ during instruction. While thought samples do appear to provide useful information

about the attention level of a class and how it may vary as a function of instructional events (Solmon, et al. 1991), they do not seem to be significantly related to an individual's overall class performance. The minute proportion of the thoughts that each student has during a class that are sampled using this procedure is offered as an explanation of this finding. It seems possible, though, that this method of data collection could, if adapted, could provide some valuable information about student thoughts during class. Rather than using this technique to inquire about students' attention at a particular instant, perhaps investigation of understanding of the lesson or strategies during practice using this self-report technique could be of interest.

Although the responses on the student journal were appropriate, they were lacked variability and did not provide information of value.

The written test of knowledge also failed to provide information of value. A possible explanation for this is that the subjects had not received any instruction or experience in volleyball prior to the administration of the knowledge test. It seems plausible that, since the students had very little if any prior knowledge or skill in this sport, the measure of knowledge could be unrelated to other variables. As the students in the follow-up study also do not have any prior knowledge concerning volleyball rule and

techniques, it is unlikely that a measure of their knowledge level would yield useful data.

The similarity of the physical and volleyball perceived competence subscales, coupled with the lack of volleyball experience of the subjects in the second experiment, suggests that the administration of the volleyball perceived competence subscale is not warranted. It seems unlikely that it will yield unique information in this setting. The physical and general self-worth perceived competence subscales were related to other variables and warrant inclusion in the follow-up study.

Although the scores of this sample were comparable to those reported for the CAPTA, the relationships with the other variables in this experiment did not provide much useful information. For this reason, this scale will not be repeated in the second experiment.

Perceived competence is related to both skill level and motivation and this relationship seems to show some promise in the prediction of achievement. Although only the motivation subscale of the cognitive processes questionnaire was related other variables in the pilot, this instrument is suitable for use with this age group and may provide valuable information about the attention level, strategies used, and motivation during instruction. The "don't know" indicator resulted in a unbalanced scoring format. The form has been amended to eliminate this incongruity. Because of

time constraints, this instrument was administered prior to the instructional day of the data collection. The problems alluded to during the discussion of the knowledge test with regard to lack of volleyball experience could also explain the failure of the cognitive processes questionnaire to relate to other variables.

Although it has been criticized, the stimulated recall technique does seem to elicit more useful information concerning students' thoughts (Lee et al., 1989; Peterson et al., 1984) than the thought sampling technique or the student journals employed in this preliminary investigation. From the information gathered it seems appropriate to incorporate stimulated recall procedures to examine student cognition as it relates to other variables during motor skill acquisition.

Additional References

- AAHPER. (1969). Volleyball skills test manual.
Washington, D.C.: American Association for Health,
Physical Education and Recreation, 1969.
- Baumgartner, T. A., & Jackson, A. S. (1982). Measurement
for evaluation in physical education. Dubuque, Iowa:
Wm. C. Brown.
- Schutz, R. W., Smoll, F. L., Carre, F. A., & Mosher, R. E.
(1985). Inventories and norms for children's attitudes
toward physical activity. Research Quarterly for
Exercise and Sport, 56, 256-265.
- Smoll, F. L., & Schutz, R. W. (1980). Children's attitudes
toward physical activity: A longitudinal analysis.
Journal of Sport Psychology, 2, 144-154.
- Solmon, M. A., Lee, A. M., Landin, D. K., & Cutton, D.
(1991, February). Student thoughts during tennis
instruction. Paper presented at the annual meeting of
the Southern District of the American Alliance of
Health, Physical Education, Recreation and Dance,
Norfolk, VA.
- Tousignant, M., & Siedentop, D. (1983). A qualitative
analysis of task structures in required secondary
physical education classes. Journal of Teaching in
Physical Education, 3(1), 47-57.

Table B1.

Descriptive Statistics

	Mean	Standard Deviation	Range
Serve	8.19	6.49	0 - 28
Forearm Pass	4.24	2.20	0 -10
Knowledge Test	17.58	5.72	4 -32
	Median	Mode	Range
PC-Volleyball	2.64	2	1.00 - 3.57
PC-Physical	2.78	3.57	1.14 - 3.57
PC-General	2.64	2.57	1.42 - 3.71
Attitude			
Social Growth	4.5	5	2.6 - 5
Social Relations	4.8	5	3.0 - 5
Health Value	5	5	2.5 - 5
Health Enjoyment	4.6	5	1.6 - 5
Vertigo	3	3.2	1.0 - 5
Aesthetic	3.6	5	1.0 - 5
Catharsis	4.6	5	1.0 - 5
Ascetic	3.1	3	1.0 - 5
CPQ-Attention	20	18	12 -25
CPQ-Strategies	17	16	10 -24
CPQ-Motivation	20	20	14 -25
Thought Sample 1	4	4	0 - 6
Thought Sample 2	4	4	0 - 6

Table B2.

Item analysis of written test

Item	Diff.	Discrim.	Item	Diff.	Discrim.
Number	Index	Index	Number	Index	Index
1.	.52	.6	31.	.50	.3
2.	.48	.3	32.	.52	.5
3.*	.25	-.2	33.*	.10	.3
4.*	.07	.3	34.	.35	.4
5.	.75	.7	35.*	.43	.1
6.	.57	.2	36.	.23	.4
7.	.53	.8	37.	.25	.6
8.	.68	.4	38.	.18	.2
9.*	.3	.0	39.	.23	.3
10.	.25	.2	40.	.13	.2
11.*	.10	.1	41.	.23	.3
12.	.30	.7	42.*	.15	-.1
13.*	.08	.3	43.*	.43	.0
14.	.38	.6	44.	.58	.7
15.	.42	.3	45.*	.12	.3
16.	.57	.6	46.*	.12	.1
17.	.35	.3	47.*	.08	.1
18.*	.47	.0	48.*	.25	.0
19.	.15	.3	49.*	.33	.0
20.	.52	.6	50.	.73	.6
21.	.63	.5	51.	.33	.2
22.	.73	.3	52.	.27	.4
23.	.60	.3	53.	.37	.2
24.	.20	.3	54.*	.12	.2
25.	.73	.6	55.	.40	.4
26.	.55	.9	56.*	.33	-.1
27.	.57	.2	57.*	.22	.0
28.	.55	.4	58.	.52	.6
29.	.60	.2	59.*	.10	-.1
30.	.37	.7	60.*	.25	.1

* denotes item deleted from analysis

Table B3.

Correlation coefficients

Perceived Competence Volleyball

Perceived Competence Physical	.50
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Perceived Competence General	.22
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Perceived Competence Physical

Perceived Competence General	.23
------------------------------	-----

Perceived Competence Volleyball

Serve	.20
-------	-----

Forearm Pass	.22
--------------	-----

Perceived Competence Physical

Serve	.21
-------	-----

Forearm Pass	.33
--------------	-----

Serve

Forearm Pass	.21
--------------	-----

Cognitive Processes Questionnaire Motivation

Perceived Competence Volleyball	.28
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Perceived Competence Physical	.21
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Thought Sample 1

Thought Sample 2	.19
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Appendix C

Skill Test

Brumbach Forearm Pass Wall-Volley Test (Cox, 1980)

Objective: To assess ability and speed in the forearm pass.

Directions: The player stands holding a volleyball facing a wall. To begin the player tosses the ball against the wall into the area above a 2.44 (8 ft) meter line taped on the wall. On the rebound the ball is volleyed using the forearm pass against the wall and above the line.

Scoring: The total score is the number of legal volleys executed within 30 seconds. Each player receives three trials. The average of the two best trials is the final score. Tosses do not count in the score.

Appendix D
Coding System

Video Coding System

The video coding system designed for this study consists of 2 steps: 1) the observation coding system which is a low-inference, 5 second interval system used to code observer estimate of student engagement and 2) the practice trial coding system used to record the total number of trials and the number of correct trials which occur during the coded intervals. For the purpose of this investigation, each student in the study was coded during instruction and practice. All coding of behavior during practice was done during drills in which students were tossing balls to each other to practice the forearm pass. Students were coded only when it was their turn to be the passer, not the tosser. All students were coded during the same periods of while the teacher was teaching. Students were coded during practice for equal amounts of time each day.

Observation Coding System

During a segment of film to be coded, students were observed for 5 seconds. During the subsequent 5 second interval, the predominant behavior which occurred during the interval was recorded. The categories used during the observation coding and their definitions are presented in Figure 1.

Insert Figure 1 about here

During instruction, if any off task behavior occurred, that interval was coded as off task. Otherwise, the interval was coded as receiving information.

During practice, if any part of a practice trial occurred during an interval, that interval was coded as practicing. If no trial occurred, but some off task behavior was observed, off task was coded. If no trial or off task behavior occurred, the remaining behavior which took most of the interval was recorded.

Receiving information and practicing are considered to be on task or engaged behaviors. Waiting and chasing a ball are considered to be nonengaged behavior, but are not off task.

To establish reliability, 2 trained coders independently coded students during the same intervals from the same tape simultaneously. Responses were compared interval by interval. The reliability coefficient for this process, determined by dividing the number of agreements by the total number of intervals coded, was .97.

Practice Trial Coding

After the observer estimate of student behavior had been coded for a particular segment of tape, that segment was replayed to code the practice trials. The total number of trials, as well as the number of correct trials, which occurred during the segment were recorded. All trials, whether or not they occurred during a coding or a recording

interval, were coded.

Practice trials were coded as correct or incorrect on the basis of identified skill components. These components were derived from student responses about their errors and the key words that the teacher stressed in teaching the skill. The specific components and the criteria used to evaluate them are found in Figure 2.

Insert Figure 2 about here

A trial was coded as correct if 4 of the 6 skill components were performed appropriately. To establish reliability, 2 trained coders independently coded students on the same trials simultaneously. First responses were coded as correct or incorrect. The reliability coefficient for coding correct or incorrect trials, determined by dividing the number of agreements by the total number of trials coded, was .96. To establish reliability for the individual skill elements, responses were compared component by component. The reliability coefficient for this process, determined by dividing the number of agreements by the total number of components coded, was .92.

Figure D1.Categories for the Observation Coding System

<u>Category</u>	<u>Definition</u>
Receiving information	Student apparently attending to the teacher
Practicing	Any interval in which some part of a practice trial occurred
Waiting	Student waits patiently for a practice trial
Chasing	Student spends interval retrieving a ball
Off Task	Any behavior unrelated to instruction or practice

Figure D2.Skill Components

<u>Component</u>	<u>Criteria</u>
1. Knees bent	Knees are bent, not locked, in preparation for a trial
2. Arms locked	Arms extended and elbows locked at contact with the ball
3. Level platform	Level surface for contact; ball goes toward the target
4. Arm action	Follow through not above shoulders; Sufficient force imparted to send ball into flight
5. Feet position	Feet to the ball, balanced and in contact with the floor at contact (no jump)
6. Contact point	Ball is met out in front of body with the wrist/forearm area (not hands or upper arms)

Appendix E
Perceived Competence Scale

The physical and general self-worth subscales of Harter's (1979) Perceived Competence Scale for Children were administered to assess students' perceptions of their own abilities. The "structure alternative format" designed by Harter (1982) to offset the tendency of subjects to give socially desirable responses was used. Each subscale consists of 7 items. Both subscales were administered in one sitting with the items interspersed. The form used is found on the next page. No more than two consecutive items are from the same subscale. Positive answers appear on either the right or left side of the response column, and the order of the items is such that no more than two consecutive items are keyed for positive responses on the same side of the response form. Within each subscale, at least 3 items are keyed with positive responses on the right side, and at least 3 are keyed for positive responses on the left side of the response form. The direction for the positive response for the seventh item on each subscale was chosen at random.

During the administration of the perceived competence scale, students were instructed to choose the response that described them the best. The form was read aloud to the students to insure they understood each item.

HOW I SEE MYSELF

Really true for me	Sort of true for me			Sort of true for me	Really true for me
	Some kids are usually chosen first for games	but	Other kids are usually chosen after the best players at the game have been picked		
	Some kids want to be different	but	Other kids are happy the way they are		
	Some kids are not good at sports but are good at other things	but	Other kids are good enough sports		
	Some kids are sure of themselves	but	Other kids often doubt themselves		
	Some kids do well at new activities	but	Other kids have to work hard to learn new activities		
	Some kids often wonder if they are doing the right thing	but	Other kids are always sure they are doing the right thing		
	Some kids think they are doing things just fine	but	Other kids often think they need to do things better		

Really true for me	Sort of true for me			Sort of true for me	Really true for me
	Some kids don't feel they can play sports as well as others their own age	but	Other kids feel that they are better than others their age at sports		
	Some kids don't feel that they are very good when it comes to sports	but	Other kids do very well when it comes to all kinds of sports		
	Some kids feel that they should be better people	but	Other kids feel that they are good people		
	Some kids would rather play than watch	but	Other kids would rather watch than play		
	Some kids often want to change	but	Other kids just want to stay the same		
	Some kids are only good at games they already know	but	Other kids are good at new new games		
	Some kids feel good about the way they act	but	Other kids wish they could act differently		

Appendix F
Cognitive Processes Questionnaire

Usually Often Sometimes Not very Almost

Often Never

- | | | | | | |
|-------|-------|-------|-------|-------|---|
| _____ | _____ | _____ | _____ | _____ | 1. Do you listen closely to what your teacher says during the PE lesson? |
| _____ | _____ | _____ | _____ | _____ | 2. Do you think about other things while your PE teacher is talking? |
| _____ | _____ | _____ | _____ | _____ | 3. Do you miss things your teacher says because you are not paying attention? |
| _____ | _____ | _____ | _____ | _____ | 4. When you practice, do you think about the skill you are working on? |
| _____ | _____ | _____ | _____ | _____ | 5. During PE class, do you think about the lesson and skills being taught? |
| _____ | _____ | _____ | _____ | _____ | 6. When your teacher explains a skill, do you practice the skill in your mind? |
| _____ | _____ | _____ | _____ | _____ | 7. If you don't understand something that your PE teacher says, do you just forget that part of the lesson? |

8. When you practice a skill, if the ball goes in the wrong direction do you try to figure out why?
9. Do you watch other kids in your class to try and help you learn how to do a skill?
10. When you practice a skill, is it more like playing than thinking?
11. When you are practicing skills in PE class, do you try to get better each time you hit the ball?
12. When you watch the teacher explain a skill, do you say "Oh, I can't do that"?
13. When you hit the ball the wrong way, do you say to your self "I can do better"?
14. When your PE teacher shows you how to do a skill do you think "Oh, this is easy"?
15. During PE class do you give up when the skill is hard?

Appendix G
Error Samples

Error Samples

Form used during class:

Name_____

On your last three hits, what was the biggest error that you made?_____

What did you do to try and correct your error?_____

Form used at the end of class:

Name_____

While you were practicing today, what was the main thing that you did wrong?_____

What did you do to try and correct your errors?_____

Appendix H
Sample Transcript

+Instructional Segment

Q: While the teacher was teaching, did you think about other things besides what the teacher was saying or doing at least some of the time?

A: Yes

Q: Tell me what you were thinking about besides volleyball

A: Uh I was thinking about what we were going to do in science, cause science is the next class and I was thinking about the mice in science

Q: Anything else that you could think about?

A: Lunch

Q: Were you paying attention all of the time, most of the time, some of the time, a little bit of the time, or not very much of the time?

A: Most of the time.

Attention level 4

Q: How well did you understand the part of the

lesson you just saw?

A: I understood it pretty well and I just kind of got it that we shouldn't put our thumbs over each other and that if we have, if our arms are hurting to clench your wrists real, clench your fists real tight.

Understanding level 3

Important point

Important point

Q: What was the most important thing in the lesson?

A: Uh, to try to stay in one place while hitting it pretty high up

Important point

Q: Any other important aspects?

A: Keep your arms straight out without bending your elbows

Important point

Q: Anything else?

A: Not put your thumbs over each other

Important point

Q: Anything else?

A: That's about it

Q: What did the teacher say or do that helped you to understand?

A: She like demonstrated
what we were supposed to do
and then if somebody didn't
understand she talked to them

Teacher Help

Q: Anything else?

A: Not really

Q: What did you think or
say to yourself while the
teacher was teaching to help you
learn about the skill?

A: I was kind of just
following her actions

Specific strategy

Q: So when you say her
actions...

A: Like when she bent over,
I'd bend over and keep my
arms straight

Q: So when she demonstrated
you tried to copy what she
was doing?

A: Yea

Q: Anything else that you
were thinking or saying to
yourself while the teacher
was teaching?

A: Not really

+Practice segment

Q: While you were practicing,
did you think about other
things besides the skill at
least some of the time?

A: Lunch

Q: You were thinking about
lunch while you were
practicing?

A: uh huh, Well, not really
while I was practicing but in
between, like break, like when
I hit it up and I missed it I
held it for a while

Q: And you were thinking
about lunch?

A: Yea

Q: Anything else that you
were thinking about besides
volleyball?

A: Not really

Q: What were you thinking
about while you were
practicing, while you were
hitting it up and down?

A: I was thinking that it's pretty hard but I can do it pretty good and I was dizzy.

Affective thought

Q: Would you say you were paying attention to your practice of the task all of the time, most of the time, some of the time, a little bit of the time, or not very much of the time?

A: Most of the time

Attention level 4

Q: Good. Can you tell me what were you thinking about while you were practicing, while you were actually hitting the ball?

A: uh, it was, I was, I thought it was pretty hard and I was dizzy. I was thinking, I kept on bending my arms and my back was pretty straight and I thought I needed to bend my back and stick my arms out straight.

Practice thoughts

Level 4

Q: What things were you

doing or thinking that helped you to learn the skill?

A: uh, what?

Q: What would you say are some of the things that helped you become better?

A: Watching the teacher demonstrate, and listening to her talk and then like mimicking what she did.

Specific Strategy

Q: What did you say to yourself while you were practicing while you were actually hitting the ball?

A: I kept on reminding myself to bend my knees and keep my arms straight.

Specific strategy

Q: What did your teacher say or do that helped you to learn the skill?

A: Well, once my arms were bent and she came up and told me to keep my fists tight and she bent my, she made my arms so they

Specific strategy

wouldn't bend

Q: How successful were you during the practice session today?

A: I thought I was doing pretty good.

Success Level 3

Q: What errors did you make while you were practicing?

A: I would hit it either in front of me or to the side and I would hit it too hard.

Q: What did you do to try and correct your errors?

A: I hit it softer and I tried to hit it just straight up.

Error detection and correction level 3

Q: Good. O.K., anything else that you can think about?

A: Not really

Q: Thank you very much.

Vita

Melinda Ann Solmon was born in Paris, Tennessee on December 25, 1955. She graduated from Henry County High School in Paris in May of 1973. In May of 1977, she graduated from the University of Tennessee at Martin with a Bachelor of Science.

Melinda began her graduate studies at Florida State University in the fall of 1977. She transferred to Louisiana State University in January of 1978 and completed her Master of Science in 1979.

In the fall of 1979, Melinda began working for the East Baton Rouge Parish School System as an adapted physical education teacher. In 1981, she was promoted to the position of Instructional Specialist for adapted physical education for the school system. She also served as the Area Coordinator for Louisiana Special Olympics, Capital Area from 1983 through 1988.

Melinda began her doctoral program at Louisiana State University in 1988, when she was awarded an Alumni Fellowship. She completed the Doctor of Philosophy degree in August, 1991 and accepted the position of Assistant Professor in the Department of Kinesiology at Louisiana State University.

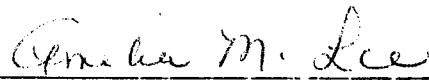
DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Melinda A. Solmon

Major Field: Kinesiology (Pedagogy)

Title of Dissertation: Student Thought Processes and Quality of Practice During Motor Skill Instruction

Approved:

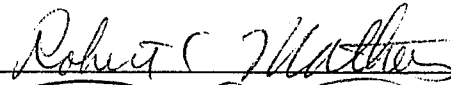


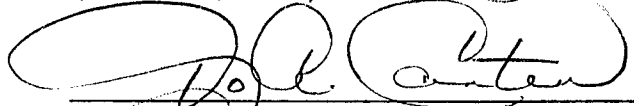
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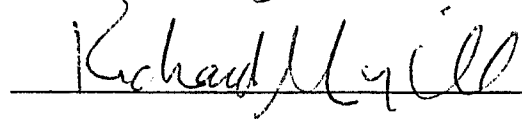
Dean of the Graduate School

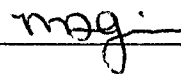
EXAMINING COMMITTEE:











Date of Examination:

July 16, 1991