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RELATIONSHIPS AMONG PROCESS AND PRODUCT VARIABLES IN AN EXPERIMENTAL TEACHING UNIT

The Ohio State University

Ph.D. 1983

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RELATIONSHIPS AMONG PROCESS AND PRODUCT VARIABLES
IN AN EXPERIMENTAL TEACHING UNIT

DISSERETATION

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

By
Donna Marie Dugas, B.S., M.S.

* * * * *

The Ohio State University
1983

Reading Committee:
Dr. Daryl Siedentop
Dr. Charles Mand
Dr. James Sweeney

Approved By

Department of Physical
Education, School of
Health, Physical
Education & Recreation
To my MOM and DAD, who have been
a constant source of love
and encouragement
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VITA

January 10, 1951 ........... Born - Donaldsonville, Louisiana

1969 ......................... High School Graduation, Donaldsonville High School, Donaldsonville, Louisiana

1973 ......................... B.S., Health, Physical Education and Recreation, Louisiana State University, Baton Rouge, Louisiana


1974-1975 .................... Health and Physical Education Instructor, St. Joseph Academy, Baton Rouge, Louisiana

1975-1976 .................... Teaching Assistant, Health, Physical Education and Recreation Department, Louisiana State University, Baton Rouge, Louisiana

1977 ......................... M.S., Physical Education, Louisiana State University, Baton Rouge, Louisiana


1981-1983 .................... Teaching Associate, School of Health, Physical Education and Recreation, The Ohio State University, Columbus, Ohio
FIELDS OF STUDY

Major Field: Physical Education Teacher Education
Minor Field: Applied Behavior Analysis
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2. Which of the three process variables is most highly correlated with student achievement as measured by the A.A.H.P.E.R. Archery Skill Test, after accounting for initial ability?

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Seldom before has there been such widespread concern regarding the apparent mediocrity in American education. Previous conjecture regarding the decline in overall student achievement has now gained substance through such reports as "A Nation at Risk: The Imperative for Educational Reform" (1983). The report expresses the need for the pursuit of excellence throughout education. One of the recommendations is that excellence in education can be achieved by more effective use of the existing school day. Since teachers have considerable control over the use of the school day, perhaps the best hope for achieving such excellence lies in improving the effectiveness of teachers (Medley, 1979).

Improving the effectiveness of teachers requires obtaining accurate information about differences in the behavior patterns of more effective and less effective teachers. The most reliable source of such information is sound research. Fortunately, in the search for teacher effectiveness several useful research strategies have been utilized.

Dunkin and Biddle (1974) suggest that the strongest research strategy documenting teacher effectiveness is the process-product design. Through systematic observation, researchers have examined the degree to which process variables of teacher behaviors are related to product measures of student achievement.
Several comprehensive process-product studies have been conducted in education (Brophy & Evertson, 1976; McDonald, 1976; Rosenshine, 1976). These studies were conducted over many months with relatively large numbers of teachers. Studies of this magnitude, while impacting substantially on the search for teacher effectiveness, are costly, both in terms of time and money. However, within the process-product approach, several promising alternatives to these large scale, large sample research designs have emerged (Berliner, 1976; Graham & Siedentop, 1978).

One of these is the Experimental Teaching Unit (Arehart, 1979; Popham, 1971; Ward & Tikunoff, 1976; Gage, 1976), the conceptual basis for which was reviewed and discussed during Phase II of the Beginning Teacher Evaluation Study (Tikunoff, Berliner & Rist, 1974). This research tool was to be used to study teacher effectiveness (Filby, 1976, 1977). An ETU consists of a standardized instructional package which includes a rationale, objectives, curricula materials, and sample test items to be implemented over a relatively short period of time. The process for achieving the objectives is left entirely to the teacher. Every teacher has similar objectives and material with which to work under these conditions. Student achievement, thus teacher effectiveness, is assessed via pre-posttests carefully constructed to tap many dimensions of the material in the ETU.

ETUs have also been utilized in physical education studies employing a process-product research design (Yerg, 1977, 1981A, 1981B; Pieron, 1981; Young & Metzler, 1982; Keller, 1982; Silverman, 1982; Graham, Soares & Harrington, 1983). Since physical education ETUs have typically been shorter in length and have involved smaller class sizes than classroom ETUs, they have been referred to as mini-ETUs. The results of the mini-ETU studies conducted in physical
education are consistent with the lengthier and larger classroom process-product studies related to student utilization of time (Graham, 1982).

Recently, the search for teacher effectiveness in physical education has identified several process variables which seem to refer to this phenomenon of time utilization. These variables are academic learning time-physical education (Metzler, 1979; Birdwell, 1980; Rate, 1980; Whaley, 1980; Young & Metzler, 1981; McLeish, 1981), opportunity to respond (Siedentop, 1983), and number of criterion trials (Pieron, 1981). Academic learning time-physical education (ALT-PE) is the amount of time accrued by a student while directly engaged in motor skill tasks with a high rate of success. Opportunity to respond (OTR), defined within the context of the situation, is the opportunity provided to the student to make a relevant learning response. Criterion trial refers to any student attempt at the task which defines the outcome variable. The analysis of these three process variables and how they relate to gains in student achievement, or product measures, is an important step in the teacher effectiveness search.

Since the focus of the ETU is on process-product research, and its usefulness in determining teacher effectiveness has already been demonstrated, its choice as the methodology in continuing the search seems logical. Another important step is the application of the ETU methodology with student teachers. ETUs would serve as a valuable training tool since student teachers would be better able to understand the relationship between their instructional objectives and pupil outcomes and, thus, the ways in which their teaching effect students in schools. Once student teachers study teaching in this manner, they will be more likely to become active participants in the ongoing teacher effectiveness research
process (Ward & Tikunoff, 1976).

The selection of the task for an ETU is also important. Emphasis has often been given to selection of tasks which are novel. Certain physical education activities in the school setting provide students with their first exposure to a particular sport. In this sense, the sport is novel. Archery is one such example. The sport is scored in a standardized manner. For these reasons, the selection of archery seemed a good choice.

Therefore, this study utilized an archery experimental teaching unit with student teachers to investigate the relationships among ALT-PE, opportunity to respond, and criterion trials and their relationships to two measures of student achievement in high school archery classes.

Purpose

The purpose of this study was to investigate the relationships among academic learning time-physical education, opportunity to respond, and number of criterion trials as process variables and their relationships to two measures of student achievement in high school archery classes instructed by student teachers. These relationships were examined separately with the student as the unit of analysis, and with the class as the unit of analysis. More specifically, it attempted to answer the following research questions:

(1) What is the relationship among academic learning time-physical education, opportunity to respond, and number of criterion trials?

(2) Which of the three process variables is most highly correlated with student achievement as measured by the A.A.H.P.E.R. Archery Skill Test, after accounting for initial ability?
(3) Which of the three process variables is most highly correlated with student achievement as measured by the Archery Knowledge Test, after accounting for initial ability?

(4) If there are substantial interclass differences, which teacher and student process variables are the possible sources of those differences?

Limitations

This study was limited by the following factors:

1. This study was causal comparative in nature, and did not attempt to determine a cause and effect relationship, rather it was to investigate relationships among selected variables.

2. This investigation focused on students enrolled in archery classes in a public secondary school in the central Ohio area during April 11 through May 6, 1983.

3. Student achievement as measured by the Archery Knowledge Test and the A.A.H.P.E.R. Archery Skill Test served as product measures.

4. The process measures were limited to ALT-PE, opportunity to respond, and number of criterion trials.

5. This study was limited to observations of four student teachers' classes from The Ohio State University, whose assignments to the public secondary school were not under the control of the investigator.

6. The study was limited to observing each student teacher's class 15 times, 42 minutes each session.

7. This study was limited to observing videotapes of selected target students in each teacher's class in order to gain information on the three process variables.
Assumptions

The following assumptions were assumed to be true and relevant to this study:

1. The interval recording technique employed in coding the ALT-PE variable constituted a representative sample of student behaviors found in continuous observations of behavior.

2. The selected target students for observation in each class were representative of the students participating in the class.

3. The observer agreement/accuracy measures conducted throughout the coding were representative of the accuracy of each observation.

4. Teacher's and student's actual day-to-day behavior was not affected unduly by the presence of a video camera and camera person.

Definitions

The following terms are used throughout the text of this study. The definitions of terms used in the ALT-PE and Opportunity to Respond and Number of Criterion Trials observation instruments can be found in Appendixes A and B.

Academic Learning Time (ALT) - The amount of time a student spends engaged in directly relevant tasks with a high rate of success.

Academic Learning Time-Physical Education (ALT-PE) - The amount of time a student is directly engaged in motor skill tasks in physical education class with a high success rate.

Achievement - Student learning as measured by the Archery Knowledge Test and the A.A.H.P.E.R. Archery Skill Test.
Behavior - "...that portion of an organism's interaction with its environment that is characterized by detectable displacement in space through time of some part of the organism and that results in a measurable change in at least one aspect of the environment" (Johnston & Pennypacker, 1980).

Criterion Trial - Shooting an arrow at a standard 48-inch target from a distance of 10 or 20 yards is one criterion trial.

Experimental Teaching Unit (ETU) - A standardized instructional package which includes an overview, performance objectives, a list of archery resources, guidelines for using the unit, sample test items from the Archery Knowledge Test and a copy of the A.A.H.P.E.R. Archery Skill Test.

Interval Recording - A type of observational recording of one, or several described behaviors within a specified time interval.

Observer Agreement/Accuracy - The percentage of agreement for how often two observers watching one or several subjects and equipped with the same definitions of behavior, see it occurring or not occurring at the same standard time (agreement). Disagreements are then reanalyzed and coded so that the resulting data reflects as close an estimate as possible to the absolute true value of the phenomenon (accuracy) (Johnson & Pennypacker, 1980).

Opportunity to Respond (OTR) - Defined within the context of the situation the student is provided an opportunity to make a relevant learning response.

Target Students - Refers to the three students from each class whose selection was based on a multi-criterion system.
Teachers - Refers to the four student teachers from The Ohio State University, who were the teachers of the four classes for this study.

True value - "...a measure determined independently from which all possible bias and random measurement error have been removed" (Johnston & Pennypacker, 1980).

Summary

In this chapter, a brief introduction which included a rationale was presented. The purposes of the study and the specific research questions to be addressed in the study were stated. The limitations, assumptions, and definitions of terms appropriate to this study were also delineated.

The next chapter will review the literature focusing upon these specific topics:

1. Process-product research involving experimental teaching units, both in the classroom and in physical education.
2. Academic learning time-physical education research.
3. Opportunity to respond research.
4. Criterion trials research.
5. Achievement tests in physical education.
CHAPTER II

REVIEW OF LITERATURE

This study investigated the relationships among ALT-PE, opportunity to respond, and criterion trials as process variables, and their relationship to two measures of student achievement as product variables, in high school archery classes. An archery experimental teaching unit was employed to hold certain contextual variables constant. Therefore, this review of related literature has five sections: (1) Process-Product Research Involving Experimental Teaching Units, in both classroom and physical education settings; (2) ALT-PE Research; (3) Opportunity to Respond Research; (4) Criterion Trials Research; and (5) Achievement Tests in Physical Education.

Process-Product Research Involving Experimental Teaching Units

Classroom ETUs

In 1964, Popham (1971) secured support from the U.S. Office of Education for a four year investigation designed to develop and sequentially test an untried procedure for assessing teacher competence. The approach involved the use of performance tests of teaching proficiency in the fields of social science, electronics, and auto mechanics. Fifty-seven matched pairs of volunteer teachers and nonteachers taught 2,326 public school students in the San Diego City Schools. All teachers and nonteachers were given sets of
instructional objectives and resource units approximately two weeks prior to the time instruction was to begin. On the first day a written pretest was administered to all vocational education students, but not social science students. The two vocational education units were taught for nine hours, while the instructional time for the social science unit was only four hours. All students were administered a written posttest and questionnaire. In all three instances, there were no significant differences between teachers and nonteachers in promoting student achievement of explicitly stated instructional objectives.

Two studies, directed by Gall as part of the Effective Teacher Education Program (ETEP), were designed to examine teacher use of questioning skills (Ward & Tikunoff, 1976). Study I was conducted by Gage and others (1976) to determine what student achievement outcomes were affected by presence or absence of probing and redirection in discussions, and presence or absence of discussions themselves. The format in which questions were delivered, written or oral, were also investigated. Study II, conducted by Ward and Tikunoff (1976), investigated the effects of teacher use of higher cognitive questions on student achievement.

Gage and others (1976) at the Stanford Center for Research and Development in Teaching, conducted an experimental study in which four experienced teachers were trained to vary systematically the way in which they performed the recitation strategy in a two-week ecology unit. Each teacher taught about thirteen sixth graders in public school classrooms. There were nine lessons taught for about forty minutes per day. Students were pretested on vocabulary, memory, knowledge and attitude toward ecology. The first five minutes of each lesson were devoted to the students reading a short ecology unit, while the remainder of the time
was spent in classroom recitation. Each teacher taught from a scripted lesson plan. All four teachers were observed and recorded on audiotape as they taught. After nine days of instruction, students were posttested on their knowledge and understanding of ecology, and attitude toward ecology. A follow-up was conducted three weeks later to measure retention of ecology material and attitude. They concluded that all four teachers were able to control the way they performed the recitation strategy, students remembered more information if the teacher asked mostly recall questions during class, students' attitudes toward ecology were generally unaffected by the variations in recitation strategy, and students who received praise and corrective feedback did slightly better than those who received neutral or no feedback.

Ward and Tikunoff's study (1976) included four treatment conditions - a 25 percent higher cognitive question (HCQ) discussion treatment, a 50 percent HCQ discussion treatment, a 75 percent HCQ discussion treatment, and an art activity (no discussion) treatment. A specially prepared curriculum on ecology (prepared curricular materials and semi-programmed discussion scripts) was administered to sixth grade students randomly formed into treatment groups in the cooperating school district. All treatments were administered by specially trained teachers, each teaching the four different treatment groups each day, for a total of 10 lessons. The length of each lesson was approximately 30 minutes. Students were administered a written test battery before, immediately after, and/or two weeks after the treatments related to the specific curriculum they studied. Students were also tested orally, with responses audiorecorded. The results on all information tests indicated that the treatments seemed to have had more influence upon recall of information than upon higher cognitive outcomes. In all cases, the 50 percent HCQ
treatment had considerably lower student outcomes than the other two discussion treatments. The 25 and 75 percent HCQ treatment outcomes were similar. The art activity treatment outcomes approximated those of the 50 percent HCQ treatment. A requested reanalysis of the data identified several complex aptitude-treatment interactions. These interactions suggested cautiously that no one treatment was best for all students.

As one part of the multiyear research effort entitled The Beginning Teacher Evaluation Study (BTES), The Far West Laboratory for Educational Research and Development during 1974-75 selected forty classrooms to study the teaching-learning process using ethnographic protocols (Berliner & Tikunoff, 1976). Two-week curriculum units (10 lessons) in both second and fifth grade reading and mathematics, called Experimental Teaching Units (ETUs), were voluntarily used by experienced teachers. Written pretests and posttests were administered. The resulting residual gain scores served as the basis for identification of ten more—and ten less-effective teachers in both second and fifth grades for both reading and mathematics. This known sample of forty teachers was then used for intensive analysis of classroom practice. Sixty-one dimensions or variables were identified which differentiated between more—and less-effective classrooms. Twenty-one of these variables were universal for both subjects and both grades, while other variables were dependent upon subject matter and/or grade level.

In the Arehart study (1979), twenty-three teachers from eight central and southern Virginia school districts, taught a mathematics' probability unit containing eighteen objectives to twenty-six classes ranging from grades 8 to 11. Three of these twenty-three teachers taught the unit to two of their classes. Five fifty- to fifty-five minute classes were required of all teachers. They gave a pretest for a
half to a full period, instructed for three class periods, and gave a posttest for a period. Process data was gathered using OSCAR-5V, coded from audiotape recordings. The teachers tape-recorded their instructional sessions. The product measure was achievement gain on a written test. A two-way nested analysis of covariance was the design for the analysis. The findings indicated that opportunity to learn specific objectives related positively to a student's achievement. Teachers' perceptions of emphasis, amount of student work, and teacher information and questions about lesson objectives also related positively to achievement.

Physical Education ETUs

Yerg (1977, 1981A, 1981B) utilized a process-product design, a modified ETU, to determine relationships between selected teacher behaviors and pupil achievement in a twenty-minute cartwheel lesson. The teacher effectiveness criterion was pupil achievement following instruction. It also proposed several variables to explain the variation in pupil achievement: pupil entry ability, teacher knowledge and performance of the cartwheel task, task presentation, providing opportunity for practice, and providing specific, task-related feedback. Forty pre-service physical education majors volunteered to participate. Each taught the twenty-minute cartwheel lesson to three randomly assigned third and sixth grade students. Students were pretested and post-tested on the cartwheel with individual performances filmed. Analysis of filmed cartwheels provided data on the product measure. The Teacher Behavior Observation System (TBOS) yielded frequency counts for each process variable at a rate of three times per minutes (a total of 60 observations per lesson). The study concluded that (1) students did improve performance on a cartwheel task as a result of a twenty-minute instructional lesson, (2) pupil entry ability
explained a significant portion of the variability in final achievement, and (3) combined teacher behavior variables of knowledge and skill, task presentation, providing opportunity for practice, and providing specific, task-related feedback did not contribute significantly to pupil achievement.

Utilizing a similar mini-ETU format, Pieron (1981) proposed to ten physical education majors in their last year of professional teacher training to help students make the greatest learning gain in the handstand roll over. The students were 40 freshmen physical education majors assigned randomly to the ten micro-classes. Each teacher taught two, nine-minute lessons. Both the pretest and posttest involved each student performing two successive trials of the handstand roll over. Both trials were videotaped, ratings of students performance was determined by an expert gymnast, not involved in the study. Based upon students residualized gain scores, classes were distributed into more effective (n = 4) and less effective (n = 4) groups. All teaching sessions were video and audio taped. A time analysis of the teaching performance along with written transcripts of all teachers and students verbal behaviors were compiled. The OBEL/Ulg student observation system was applied. The two main findings were that criterion time-on-task/number of criterion trials and teacher's skill attempt reactions (feedback, praise) differed significantly between more and less effective teachers, and may increase learning gains.

Graham, Soares, and Harrington (1982) investigated the differences in time utilization and feedback variables by more effective and less effective in-service teachers when teaching a novel golf task to entire classes of fourth and/or fifth grade children. Eleven elementary physical education specialists volunteered to teach one twenty-minute ETU lesson to a class of children at their school. Each class
was videotaped and the teacher wore a cordless mike. Classes ranged in size from 14-30, with the average being 27. Several days prior to actually teaching the ETU lesson, each teacher received a copy of the Teacher's Guide. Teachers and students received two trials during pretesting, and three trials during posttesting. Both teachers and students also completed a questionnaire soliciting demographic items and their reaction to the lesson. The teachers were classified into a more effective group (n = 4) and a less effective group (n = 4) based on students' adjusted mean scores (covariate pretest scores on the product variable). Teaching performances of teachers whose students' scores were in the midrange were not analyzed. The results indicated that differences between time utilization and feedback of more effective and less effective teachers were not statistically significant.

Keller's study (1982) also utilized a novel golf task in a mini-ETU format. Two graduate students served as teachers for 3-4 ETU lessons, varying in length between 20, 30, and 40 minutes. Each followed a semi-programmed format employing one of two approaches, lecture demonstration or reverse chaining. Fifth graders served as students in class sizes ranging from 8-14. Keller employed the ALT-PE observation system to examine the time spent on physical education content, either in cognitive or motor engagement. Neither of the two approaches was found to be more effective in promoting student learning. However, both approaches were significantly more effective than no instruction, the condition imposed upon the control group who practiced on their own.

A study conducted by Silverman (1982) at the University of Massachusetts examined the relationships among student achievement, student engagement, and the selected student characteristics of initial ability, previous experience, and sex. University intermediate swimming classes were taught
two aquatic skills, breaststroke and survival float. Students were pretested and posttested on both skills, and student achievement was measured by using trained observers. After pretesting and before posttesting, four 15-minute classes of instruction in breaststroke and two 15-minute classes of instruction in survival floating were provided. All instruction was videotaped and coded for student engaged time. The results indicated that when all students were grouped together, no engagement variable (motor engaged, cognitive engaged, nonengaged) was a significant predictor of residualized achievement for either skill. When analysis was performed on student subgroups of high, medium, and low initial skill, and for males and females, a number of significant relationships were found. This suggested that relationships between engagement and achievement were mediated by the characteristics of the student.

In one of the first attempts to examine the relationship between ALT-PE and student achievement, Young and Metzler (1982) employed the ETU methodology. The ETU used was taken from the Georgia Physical Education Experimental Teaching Unit Project (Graham, 1979). The only modification involved tennis balls instead of the type used in the Georgia Project. The study involved two teachers, one experienced teacher and one inexperienced student teacher, and their physical education classes of fourth graders. Each teacher taught one 20-minute lesson on the task, between the three pretest trials and the three posttest trials. The classes were videotaped during the 20-minute ETU lesson. Each student was then coded using the ALT-PE observation system, with a two-student rotation. Of the three variables (general ALT-PE, motor engagement, and motor ALT-PE) correlated with student achievement, motor ALT-PE showed the strongest (−.25) and statistically significant relationship (p = .05) with achievement.
In another study examining the relationships among ALT-PE and student cognitive and psychomotor achievement, Wurzer (1982) utilized a cardiopulmonary resuscitation (CPR) ETU. The teachers were twelve American Red Cross CPR lecture method instructors. Thirty-six randomly selected students in the Basic Life Support/CPR courses for the first time served as the target students. The standardized nine-hour course was divided into 3 three-hour sessions which were videotaped. All students were pretested on a 50-item multiple choice examination and three trials at one-rescuer CPR on each of three recording mannequins. Each teacher taught one class, ranging in size from 10 to 12 students. Each target student was coded with the ALT-PE-Teacher Behavior Observation System (Siedentop, et al., 1982 system, modified by Wurzer, 1982). Correlations were computed among ALT-PE categories and student gain scores. The results indicated that psychomotor gain scores in one-rescuer CPR increased as students increased motor practice times - Subject Matter Psychomotor, ALT-PE (Motor) and ALT-PE (Motor 1). The same relationships were not noted among cognitive gain scores on the 50-item written test and motor practice times. This study illustrated a significant relationship between ALT-PE (Motor) and student psychomotor achievement.

Several other studies involving ETUs in physical education are in various stages. Paese (1983) at Southwest Texas State University has completed collecting data for one study comparing elementary methods students with elementary student teachers employing The Georgia Project novel golf task. He is presently conducting a study comparing elementary education majors with physical education majors. Cross and Woodford (1983), at The University of Oklahoma, are working on a study based on a frisbee ETU.
ALT-PE Research

The ALT-PE instrument was developed in 1978 by Siedentop, Birdwell, and Metzler at The Ohio State University. A series of papers explaining the original ALT-PE model, coding format, and conventions were presented at the AAHPERD National Convention in 1979 by Siedentop, Birdwell, and Metzler (1979). The model is adapted from the original BTES work and has retained the underlying principles of the ALT model, while making considerable changes in the observational procedures. Since its inception, both descriptive-analytic and experimental studies have been conducted using the ALT-PE instrument at The Ohio State University and in other settings.

The first ALT-PE study was conducted by Metzler (1980). He used the ALT-PE instrument to describe physical education settings in a sample of thirty-three elementary, junior high, and high school classes in the Columbus, Ohio area. Either two or three students from each class, a total of 92, were observed from three to seven times in fourteen separate physical education activities. Approximately 18,000 intervals of data were subjected to descriptive statistical analysis. A rigorous training program was provided for all coders and an inter-observer reliability of an acceptable level was attained before they were permitted to record. Three reliability checks were made of each coder over the observation period. Some of the major findings include the following: (1) direct instruction, task, and group instruction were the three instructional modes observed with direct and task instruction accounting for over 99% of all observed intervals; (2) scrimmage accounted for less than 1% of all intervals; (3) 15.1% of all intervals in all observations were spent in knowledge content; (4) students spend slightly more
class time not engaged, 50.8% than engaged; (5) students spent more time in cognitive, rather than motor engagement; (6) nearly 80% of all tasks were performed at an easy level of difficulty; (7) ALT-PE for all observations was 26.8%, with elementary students accruing slightly more ALT-PE, while spending less time in class than junior high and high school students; (8) ALT-PE(M) for all grade levels was 7.5%; and (9) of the two variables, general ALT-PE and ALT-PE(M), ALT-PE(M) is the better indicator of a student's opportunity to learn motor skills.

A similar study was conducted by Rate in 1980. His primary focus was secondary interscholastic athletic settings. A fifth level was added to the ALT-PE instrument to provide data about coaching behavior. Two observational techniques were used - interval recording for the first four levels and time sampling for the fifth level. Data was obtained on 46 teams from five sports. Three randomly selected target students were observed each session. Some of the results include the following: (1) practice sessions averaged 49.3% ALT-PE; (2) ALT-PE(M) averaged 33.2% across all sessions; (3) athletic sessions only spent one-third as much time on content-general activities (9%) as physical education settings; (4) over 87% of all practice sessions involved skill practice, scrimmage, and game playing, compared to just over 50% in physical education sessions; (5) in comparisons of ALT-PE in athletic settings and physical education, almost twice as much in the athletic settings (49% to 27%) and over four times as much ALT-PE(M) (33% to 8%); and (6) ALT-PE(M) represented two-thirds of ALT-PE in all sports.

Birdwell (1980) conducted one of the first experimental studies utilizing ALT-PE. The ALT-PE instrument was modified so that teacher behaviors could be recorded concurrently with the three randomly selected target students' ALT. An interval recording format that allowed for six seconds to observe
and six seconds to record was utilized. Three in-service physical education teachers, one each at the elementary, junior high, and high school level, participated in this study. Birdwell attempted to intervene on three targeted teacher behaviors - management time, feedback, and student non-engaged time - and to determine if resulting changes in teacher behavior were associated with increases in student ALE-PE and ALT-PE(M). The results indicated that significant increases in student ALT-PE and ALT-PE(M) appeared to be associated with decreases in teachers' management time, increases in feedback to students, and decreases in student non-engagement time.

Whaley (1980) conducted an experimental study similar to Birdwell's (1980). The purpose of his investigation was to determine if ALT-PE could be increased by daily monitoring and feedback. The intervention consisted of providing graphic feedback on ALT-PE categories to the teachers and feedback on motor response attempts to the student. Four physical education classes, three from high schools and one from middle schools, in the Columbus, Ohio area served as the setting. Three students selected randomly from each of the four classes were observed daily for seven weeks. All teachers were experienced public school teachers. A three student rotation utilizing a six-second observe, six-second record format was used. The following conclusions were noted: (1) graphic feedback to teachers had no effect on the amount of content-physical education, or engaged time of students; (2) graphic feedback to teachers and students had no effect on ALT-PE(M) or the amount of ALT-PE; (3) changes that did occur in ALT-PE and ALT-PE(M) occurred with changes in activities, rather than with interventions; and (4) feedback on aspects of ALT-PE had no effect on teacher behavior. These findings were in complete contradiction with those found in Birdwell's study (1980).
In the Province of British Columbia, McLeish and colleagues (1981) analyzed seventeen tapes with four different systems of analysis (Flanders, Gasson, McLeish, and Siedentop's ALT-PE) and studied the relationships among these systems. Matched groups of sixteen student teachers (physical education specialists and elementary teachers) were videotaped in gymnasium throughout the province. Two of the systems (Gasson's and Siedentop's), which were specially devised for the analysis of physical education lessons, were rated superior by expert judges. The ALT-PE system was referred to as learning theory, because of acceptance of the following principles: (1) learning is maximized in direct proportion to the number and type of opportunities to learn; (2) one learns best by actually practicing the skill; (3) one learns by observing others perform the skill; and (4) practice should be at a difficulty level that maximizes success. McLeish also concluded that positive affect was noticeably absent in these lessons, that the normal way of evaluating physical education lessons (i.e., intuitive judgments of the evaluators) was not a valid assessment, and that the majority of the lessons were quite boring.

Two studies (Young & Metzler, 1982; Wurzer, 1982) reviewed in the section on physical education ETUs involved correlating ALT-PE with student achievement. In both studies, ALT-PE(M) had significant relationships with student achievement in a motor skill. The Young and Metzler study (1982) utilized a novel golf task, and the Wurzer study (1982), one-rescuer CPR.

Opportunity to Respond Research

The Juniper Gardens Children's Project (JGCP), under the direction of R. Vance Hall, was a community-based research program sponsored by The Bureau of Child Research, The
Department of Human Development and Family Life, and The Department of Special Education at The University of Kansas (Hall, Delquadri, & Harris, 1977). The purpose of the research was to find ways to remediate and prevent the high incidence of academic failure and educational retardation associated with inner city poverty areas by conducting research in the schools and homes of children from those deprived environments.

Numerous studies were conducted in preschool settings, special classrooms, regular classrooms, and homes. Most of these studies focused on demonstrating that children from the inner city could be motivated to learn if appropriate behaviors (i.e., time on task) were systematically consequated. While these earlier efforts at reducing the incidence of educational retardation and academic failure in inner city areas by rearranging elements of the environment were partially successful, it became evident that a new direction in the research effort was needed (Hall et al., 1977). The realization was that a lack of opportunity for children to make active learning responses was the basic element lacking in the inner city homes and classrooms.

Speculations upon the reasons for the lack of opportunity to respond in classrooms included: (1) teachers and parents may not be aware that students need to spend more time responding if they are to learn, (2) the curriculum training of the teaching systems operating in the classrooms may work against providing opportunities for students to make responses, (3) having pupils increase their rates of responding may be punishing to teachers, parents, and students themselves, and (4) school policy and/or classrooms are not engineered to maximize responding (Hall et al., 1977).

In an update to their earlier research efforts, Delquadri, Greenwood, and Hall (1978) described the sequential
development of an observation system for assessing the base-rate levels of instructional opportunity provided and student responding (CISSAR). A pilot study was conducted with twelve elementary students in a Title I school over a five-week period. A momentary time sampling procedure (1 to 6 sampling pattern) with rate of responding as the unit of measurement was utilized. The results indicated that on the average, half of the school day was spent in reading and math instruction combined, with only a small proportion of that time and total time (25%) involving active academic responding (i.e., reading aloud, writing, etc.). The major student response was attending (i.e., looking at), which accounted for 45% of the school day.

The next use of the CISSAR system was a descriptive study of over 90 fourth grade students in Title I and non-Title I schools during the 1979-80 school year. Further refinement of the variables in the system and their relationships to achievement were assessed. One of the most important findings was that students in Title I schools emitted less academic behavior within an equivalent amount of instruction time per day. This suggested the need to experimentally increase this variable (Greenwood, Delquadri, & Hall, 1983).

Several intervention studies were then conducted: the use of a grandmother as tutor for a child placed in an EMR classroom, the rearrangement of text materials in a first grade reading class to increase responding and progress through the material, the effect of tutoring on a letter-naming in kindergarten and a child's ability to utilize and participate in a teacher-led discussion later in the day, the use of a token reinforcement game to increase weekly spelling responses of all children in a class, and others. The overall consensus reached was that a school program's ability to provide a sense of success to children is an
extremely important variable that will have far reaching effects on their overall development in the future. The role of opportunity to respond was both a correlate and a causal variable in achievement gain. As previously described, the remediation of low achievement can benefit from instructional practices that provide high opportunity to respond (Greenwood et al., 1983).

In physical education settings, Siedentop (1983) has repeatedly noted the importance of the variable, opportunity to respond, in the development of motor skills. He has suggested that teachers in training understand the importance of the variable as it relates to student achievement in motor skills and develop skills which would allow for maximal student responding.

Criterion Trials Research

In the Pieron study (1981), previously reviewed in the section - Physical Education ETUs, the frequency of criterion trials of the handstand roll over was significantly different between the more effective and less effective groups. Students in the more effective group had 514 criterion trials, compared to 163 trials for students in the less effective group. The relationship of frequency of criterion trials to allocated time for practice (1 trial each 23.1 seconds compared to 1 trial each 77.4 seconds) and to allocated time for criterion practice (1 trial each 15.9 seconds compared to 1 trial each 22.3 seconds) was also in favor of the more effective group. All three variables were intended to reflect the students' opportunity to learn and were under the control of the teacher.

Student opportunity to learn criterion material was first identified as one of ten variables by Rosenshine and Furst
(1971) in their synthesis of 50 process-product studies. They attempted to identify generic variables that consistently discriminated between more effective and less effective teachers.

In a conference held in 1975 at The University of Texas entitled "Research on Teacher Effects: An Examination by Policy Makers and Researchers", two important findings emerged (Graham & Heimerer, 1981). One of those findings was that the variable, student opportunity to learn criterion material appeared in several studies (Berliner & Tikunoff, 1976; McDonald, 1976; Cruickshank, 1976) to frequently discriminate between more effective and less effective teachers.

**Achievement Tests in Physical Education**

**Skill Tests**

Skill tests are used to measure achievement in many sport activities. They require creating a testing environment similar to the game environment and standardizing procedures. However, in some sports, such as archery, bowling, golf, and certain track events, the actual performance of the skill (i.e., a player's score) is an objective, valid, and reliable measure of achievement (Johnson & Nelson, 1974; Baumgartner & Jackson, 1975). In these instances, the testing environment is the performance environment. Many physical educators also refer to such measures as skill tests.

The most common achievement test used at the secondary level to measure the students' accuracy in shooting at a standardized target from a specified distance is the A.A.H.P.E.R. Archery Skill Test (A.A.H.P.E.R., 1967). The test consists of shooting two ends of six arrows each from distances of 10, 20, and 30 yards (optional). The test has face validity. The reliability of the test is dependent
Knowledge Tests

Knowledge tests are frequently used by physical educators to assess students' understanding of sports rules, etiquette, terminology, strategy, and technique. The importance of knowledge testing has been emphasized by such researchers as Johnson and Nelson (1974) and Baumgartner and Jackson (1975).

The relationship that exists between knowledge about an activity and skill in the activity is controversial (Scott, 1941; Hewitt, 1964). Johnson and Nelson (1974) have noted that skilled performers sometimes take their knowledge about an activity for granted and do not perform as well on a knowledge test as the less skilled performers.

Nevertheless, knowledge about sport is a desirable outcome of any physical education program and is a necessary part of measurement (Johnson & Nelson, 1974; Baumgartner & Jackson, 1975).

Summary

This chapter has reviewed the literature relevant to the scope of this study. The usefulness of the ETU as a viable research tool has been demonstrated in both classroom and physical education studies. The importance of ALT-PE, opportunity to respond, and criterion trials as process variables in physical education has been cited. Finally, the significance of achievement tests in physical education, both skill and knowledge measures, has been noted. Chapter III will delineate the sources of data, the procedures, and methods of data analysis.
CHAPTER III

SOURCES OF DATA, PROCEDURES
AND METHODS OF DATA ANALYSIS

The first section of this chapter describes the method of data collection involving machine observation and recording. In the second part of the chapter the collection of data using human observation and recording is presented. Included in this discussion is a short description of the establishment of observer agreement/accuracy. The third section delineates the methods of data analysis to be utilized to answer the research questions posed in Chapter 1.

Arranging Machine Observation and Recording

The first phase of this study involved arranging for machine observation and recording or videotaping. Prior to the time that videotaping began, several details had to be determined and guidelines established.

Selection of Setting and Tasks

The setting selected for this study was four archery classes in the physical education program at a public secondary school in the central Ohio area. The instructors for the classes were student teachers from The Ohio State University. The investigator had no control over which student teachers were assigned to this particular school. The cooperating teacher at this school supported the study and served as a valuable resource person. This was useful since it was
essential that the student teachers have the flexibility to teach the selected activity within the guidelines established for this study. Therefore, this particular public secondary school setting provided a combination of access, stable student population, program flexibility, and support from the cooperating teacher.

Archery was selected as the activity to be used in answering the questions posed in Chapter 1. The primary reasons for selection of archery skills were: (1) there should be high congruence between the skills being taught (performance environment) and the skills being tested (evaluation environment); (2) archery instruction is highly standardized and formalized which makes videotaping easier; (3) students have limited chance for outside practice of the archery skills; (4) the number of trials for selected process variables that a student attempts per lesson are easily observed; and (5) archery is an activity commonly taught in secondary schools and, oftentimes the school setting provides the students with their first exposure to the sport.

Gaining Access to Subjects

Permission to conduct this study was secured from the Coordinator of the Physical Education and Recreation Section, School of Health, Physical Education and Recreation, The Ohio State University, and the Director of Physical Education at the Dublin Center, Dublin, Ohio. The investigation was exempt from review by The Ohio State University's Human Subject Review Committee. The exemptions are included in Appendix C.

The investigator met initially with the four student teachers assigned to the Dublin Center for their student teaching experience. Table 1 summarizes the background data for each teacher. A brief explanation of the purposes of
the study and the requirements related to their participation was presented. A brief discussion period followed.

Students enrolled in physical education archery classes during the Spring quarter, 1983, were students enrolled at the public secondary school. Table 2 summarizes the background data for each class. Background data for each student in each class is located in Appendix D. All classes were coeducational and graded pass/fail.

Table 1
Background Data for Teachers

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Age &amp; Sex</th>
<th>Archery Knowledge Test Score</th>
<th>Archery Skill Test Scores</th>
<th>Prior Archery Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Test Scores</td>
<td>10 yds.</td>
<td>20 yds.</td>
</tr>
<tr>
<td>1</td>
<td>21/F</td>
<td>33</td>
<td>48</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>26/M</td>
<td>34</td>
<td>81</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>24/F</td>
<td>32</td>
<td>56</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>22/M</td>
<td>32</td>
<td>56</td>
<td>51</td>
</tr>
</tbody>
</table>

*These test scores were recorded prior to the time that the actual teaching unit began.*
Table 2
Background Data for Classes

<table>
<thead>
<tr>
<th>Class No./Period/Time</th>
<th>Teacher</th>
<th>Class Size</th>
<th>Males/Females</th>
<th>Grade Range</th>
<th>Age Range</th>
<th>Prior Archery Experience Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4th/9:45-10:27</td>
<td>1</td>
<td>12</td>
<td>4/8</td>
<td>9-10</td>
<td>15-17</td>
<td>None – 1 unit</td>
</tr>
<tr>
<td>2/5th/10:30-11:12</td>
<td>2</td>
<td>18</td>
<td>10/8</td>
<td>9-10</td>
<td>14/18</td>
<td>None – 1 unit + 1 yr. experience</td>
</tr>
<tr>
<td>3/6th/11:15-11:57</td>
<td>3</td>
<td>16</td>
<td>4/12</td>
<td>9-10</td>
<td>14-17</td>
<td>None – 1 unit</td>
</tr>
<tr>
<td>4/9th/1:30-2:15</td>
<td>4</td>
<td>15</td>
<td>12/3</td>
<td>9-10</td>
<td>14-16</td>
<td>None – 1 unit</td>
</tr>
</tbody>
</table>
Teacher Orientation

Two weeks prior to the time that the archery unit was to begin, an orientation meeting was held. After reviewing the content of the initial meeting, a copy of the Archery Experimental Teaching Unit (Appendix E) was distributed to each teacher. The investigator explained in detail the components and the following guidelines of the unit, and entertained questions from the teachers.

(1) Testing will be done during regular class time, the two days prior to the beginning of the unit and the two days following the end of the unit. The Archery Knowledge Test will be proctored by the teacher responsible for the class and the investigator. The A.A.H.P.E.R. Archery Skill Test will be administered by a team of evaluators: the teacher responsible for the particular class, the cooperating teacher, and three graduate students in physical education at The Ohio State University.

(2) There will be 15, forty-two minute teaching sessions. Each teaching session will be videotaped for the entire forty-two minutes. Instructors may use the 15, forty-two minute sessions to teach the unit as they wish so that the students learn the most that they can as defined by the stated performance objective (Appendix E).

(3) Teacher-student interaction concerning cognitive and/or psychomotor skills should be limited to the videotaped sessions.
(4) Students should be encouraged to attend all classes and should be discouraged from practicing archery shooting outside of class time.

(5) Use only facilities and equipment specified in the unit (Appendix E). The specifications represent the limitations of the facilities and the maximum amount of equipment available for use, but teachers are not required to use all of either.

(6) Each instructor should submit a chart indicating class location so that the investigator can position the videotaping equipment.

Inservice Workshop

In an attempt to eliminate any distinction between those teachers who had archery teaching experience, or some other type of related experience, an inservice workshop was conducted by the cooperating teacher at the public secondary school. The workshop started two weeks prior to the start of the archery unit and lasted two days. The primary focus of the workshop was the task analysis of archery shooting and safety. Other parts of the presentation included the following: equipment, terminology, scoring and recording, history and values of the sport, and games and variations. Following the inservice workshop, student teachers were pretested on the Archery Knowledge Test (Appendix F) and the A.A.H.P.E.R. Archery Skill Test (Appendix E). The results of the pretesting are indicated in Table 1.

Validity and Reliability

The three person committee consisting of a secondary physical education teacher who teaches archery, an expert
archer, and a professor in physical education teacher education analyzed the Archery Knowledge Test for clarity, design, and content. Adjustments and revisions were made prior to pretest administration. To determine an estimate of the Archery Knowledge Test reliability the test was administered to four high school archery classes. The scores were subjected to the "split half method" (odd-even) which yielded an $r$ of .92 for half of the whole test. The Spearman-Brown Prophecy Formula predicted an $r$ of .96 for the whole test.

The A.A.H.P.E.R. Archery Skill Test is accepted as a valid and reliable measure of shooting ability. Distance A - 10 yards and Distance B - 20 yards, for both boys and girls were used.

Pretesting and Posttesting

Pretesting and posttesting for each class on the Archery Knowledge Test was proctored by the teacher responsible for the class, and the investigator. The student teachers were provided both pretest and posttest scores for all students in their classes.

Pretesting and posttesting for each class on the A.A.H.P.E.R. Archery Skill Test were administered by a team of evaluators: the teacher responsible for the particular class, the cooperating teacher, and three graduate students in Physical Education at The Ohio State University. All evaluators were given a copy of the test and a 15 minute debriefing prior to actual testing. The teachers were provided both pretest and posttest scores for all students in their classes.

Videotaping Procedures

Classes were videotaped using the following equipment: Panasonic WV-3400/12X camera; Panasonic VHS NV-1300 video
tape recorder; Panasonic Power Supply and adaptor; AIWA stereo radio cassette recorder, Model No. C6-660H; 1/2-20 threaded hole camera tripod; 15, 1/2 inch two-hour Maxell tapes; and two 100 feet extension cords. Since the setting for an indoor and an outdoor session differed, a different videotaping set-up was employed for filming each. When the setting was the indoor area, the camera was located in a corner position (Figure 1). Cones were placed to indicate the areas out of the view of the camera. The camera was located in the same corner position for each indoor session. When the setting was the outdoor area, the camera was located on a hill above and to one side of the outdoor area (Figure 2). The camera was located in line with the targets facing the shooting line.

![Diagram](image1.png)

Figure 1. Camera Location for Indoor Sessions.

![Diagram](image2.png)

Figure 2. Camera Location for Outdoor Sessions.
The particular camera used had a built-in timer. The elapsed time display was superimposed on the left bottom corner of the picture.

Each instructor wore a cordless portable microphone, Realistic Model No. 33-1076, which transmitted sound onto an FM radio frequency which then fed into the videotape system. The microphone was placed on each teacher as the teacher came into the videotaping area.

Taping began prior to the school bell, which indicated the start of class. At the sound of the tardy bell the video timer was started so that the elapsed time coincided with the elapsed time of the class. The videotimer was turned off at the sound of the bell indicating the end of the class.

**Videotaping Difficulties**

Establishing the guidelines and details of videotaping prior to the time that data collection began was only the first step in the taping procedure. Several difficulties emerged after videotaping began and were handled individually as they arose. Each videotaping location, whether indoors or outdoors, presented special problems. Indoor videotaping had two major problems, lighting and camera placement. Generally, more lights had to be turned on during inclement weather. The camera location was determined prior to videotaping, but adjustments were made when students moved into "dead space" area (i.e., area outside the view of the camera).

Outdoor videotaping was very difficult since the wind, temperature, and other weather conditions (i.e., snow, rain) were not under the control of the investigator. The different angles of the sun during the day and the size of the area
also presented problems.

Since both locations were available, and their use was usually determined by the weather, this presented another problem. If the videotaping equipment was assembled for an outdoor lesson and it rained, to disassemble and then reassemble the equipment indoors required time and energy. These difficulties were presented to forewarn future researchers envisioning data collection via videotaping.

Sequencing of Sessions

The study required twenty class sessions for each of the four classes involved. The first session involved equalizing the number of students per class in archery. There were two additional elective activities being offered at the same time which allowed some flexibility in adjusting the class size. The acceptable range for number of students per class was between 15 and 21. Using the first day of a new unit in this manner was routinely done at this school. The next two sessions were devoted to pretesting. The A.A.H.P.E.R. Archery Skill Test was administered during session two. The third session was used to give the Archery Knowledge Test. The order of testing was determined by the weather. The subsequent fifteen sessions involved archery instruction and practice. The final two sessions were used to posttest students, using the same order of testing as in pretesting. The sequence of sessions is presented in Figure 3.
<table>
<thead>
<tr>
<th></th>
<th>CS</th>
<th>Pre</th>
<th>Pre</th>
<th>I&amp;P</th>
<th>I&amp;P</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
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</tr>
<tr>
<td>7</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
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<td>I&amp;P</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
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<tr>
<td>9</td>
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<td>I&amp;P</td>
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<td>I&amp;P</td>
<td>I&amp;P</td>
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<td>10</td>
<td>I&amp;P</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>11</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
</tr>
<tr>
<td>12</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
</tr>
<tr>
<td>13</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
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<td>I&amp;P</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
</tr>
<tr>
<td>15</td>
<td>I&amp;P</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
<td>Post</td>
<td>Post</td>
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<td>17</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
<td>I&amp;P</td>
<td>Post</td>
<td>Post</td>
</tr>
</tbody>
</table>

CS = Class Size  
Pre = Pretest  
Post = Posttest  
I&P = Instruction and Practice

Figure 3. Sequencing of Sessions.
Arranging Human Observation and Recording

Once videotapes had been obtained, the investigator and two colleagues observed the tapes and recorded specific process variables relevant to the present study. Only six of the fifteen lessons involved data relevant to this study, and were the tapes analyzed. The remaining lessons were hampered by bad weather conditions. Each human observer performed observation and recording responsibilities.

Equipment and Materials

To collect data from the videotapes, a videorecorder, coding sheets, pencils, and a cassette tape player with a cuing tape were used. Tapes were replayed on a Panasonic video cassette recorder NV-1300 which featured both fast and slow motion replay capabilities. The recorder was connected via a VHF matching box to a Truetone color television. The equipment was located in the investigator's study.

Selection of Target Students

Selection of target students for each class was based on a multi-criterion system. The students had to have: (1) complete scores on both pretests and posttests, (2) attended all 15 sessions, and (3) skill achievement categorically defined as high, medium, or low. (Student posttest scores for each class were rank ordered and subsequently divided into a high, medium, and low category and a minimum of one student from each category was selected.) Once target students were selected, the process variables were coded directly from the videotapes.
Coding the Process Variables

ALT-PE. The observation instrument used to code ALT-PE for this study was the ALT-PE system originally developed by Siedentop, Birdwell, and Metzler (1979) and later revised by Siedentop, Tousignant, and Parker (1982). Basically, ALT-PE is a two level, hierarchical decision system. The first level requires a decision on the context of the setting, which is group focused, the second level, a decision on individual learner involvement, which is individually focused.

The ALT-PE categories for the first level decision are summarized in Table 3.

Table 3
Context Level Categories

<table>
<thead>
<tr>
<th>General Content</th>
<th>Subject Matter Content</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Knowledge</td>
</tr>
<tr>
<td>Transition</td>
<td>Technique</td>
</tr>
<tr>
<td>Management</td>
<td>Strategy</td>
</tr>
<tr>
<td>Break</td>
<td>Rules</td>
</tr>
<tr>
<td>Warm-up</td>
<td>Social Behavior</td>
</tr>
<tr>
<td></td>
<td>Background</td>
</tr>
</tbody>
</table>
The second level decision categories are summarized in Table 4.

<table>
<thead>
<tr>
<th>Not Motor Engaged</th>
<th>Motor Engaged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interim</td>
<td>Motor Appropriate</td>
</tr>
<tr>
<td>Waiting</td>
<td>Motor Inappropriate</td>
</tr>
<tr>
<td>Off-task</td>
<td>Supporting</td>
</tr>
<tr>
<td>On-task</td>
<td></td>
</tr>
<tr>
<td>Cognitive</td>
<td></td>
</tr>
</tbody>
</table>

For the coding conventions and definitions of each category, see the Academic Learning Time-Physical Education Coding Manual in Appendix A.

Any observation sample in which a subject matter motor category is chosen at the context level and motor appropriate is chosen at the learner involvement level is one ALT-PE sample.

Several of the ALT-PE category definitions have been further defined for purposes of this study. On page 13 of the Academic Learning Time-Physical Education Coding Manual (Appendix A) under the subdivision, "Subject Matter Motor Categories", Skill Practice (P) is defined as follows:
Time devoted to practice of skills or chains of skills outside the applied context with the primary goal of skill development, such as a circle drill in passing a volleyball, one against one practice of dribbling a basketball, exploration of movement forms, practicing the Schottische step, or practicing a particular skill on a balance beam.

It has been further defined by the following:

\( (P_1) \) Time devoted to practice of archery shooting skills without nocking a real arrow.

\( (P_2) \) Time devoted to practice of archery shooting skills which involves nocking arrows and releasing the bow-string and arrow.

Also, Game (G) is defined as follows:

Time devoted to the application of skills in a game or competitive setting when the participants perform without intervention from the instructor/coach - such as a volleyball game, a complete balance beam routine, the performance of a folk dance, or running a half-mile race.

To the above definition, the following was added:

or shooting for a score.

On page 15 of the Coding Manual (Appendix A) under the subdivision "Not Motor Engaged Categories", Cognitive (C) is defined as follows:

The student is appropriately involved in a cognitive task such as listening to a teacher describe a game, listening to verbal instructions about how to organize, watching a demonstration, participating in a discussion, or watching a film.

It has been further defined by the following:

or scoring and/or recording for self and/or other class members.
The observation technique utilized was interval recording. A three student rotation was employed with a five second observe, five second record format. The coding instrument that was used is shown in Figure 4. The interval system produces highly reliable data when the intervals are relatively short and spread evenly across time.

Accuracy of timing for each interval was ensured by the use of a cassette tape player with a cuing tape. Figure illustrates the cuing sequence. To facilitate proper observation and recording, the coder first heard the number of the target student and then the interval number. The cuing tape was also synchronized with the elapsed time on the videotape.

One ALT-PE coding sheet was time coded at the beginning of each interval (Figure 6). This time coded sheet was used when two observers were employed simultaneously for observer agreement/accuracy measures.
Figure 4. ALT-PE Coding Sheet
Figure 5. Cassette Tape Recorder Program Format for Coding with ALT-PE Observation System.
Figure 6. Time Coded ALT-PE Coding Sheet.
After coding was completed, the frequency of occurrence and percent of total intervals for student behaviors in the contextual and learner involvement categories were tabulated on a single tally sheet (Appendix G). Percent of total intervals was obtained by counting the number of intervals for each behavior and then dividing that figure by the total number of coded intervals in that category.

**OTR.** Opportunity to respond was tabulated as the total number of frequencies using the coding sheet shown in Figure 7. In addition to a numerical count, responses were coded topographically as either Acceptable (A), Unacceptable (U), or No Response (NR).

**Topographical Definitions:**

**Acceptable (A)** - Archery shooting skill is classified as acceptable when it is executed in accordance with the topographical specifications for that skill. The skill must be performed at the appropriate time.

**Unacceptable (U)** - Archery shooting skill is classified as unacceptable when it is not performed in accordance with the topographical specifications for that skill. The skill may be performed at an inappropriate time.

**No Response (NR)** - The flow of the lesson is such that the target student is placed in a position that requires a specific shooting skill response. Placed in this situation, the target student does not perform the skill response. The target student may exhibit avoidance behavior (not making any attempt to shoot an arrow), escape behavior (moving away from the shooting line to select a different bow and/or arrow(s)), or may be out of the class or position and unable to respond.

**Topography of Archery Shooting Skill:**

- **Stance**
  - Standing position
  - Straddling shooting line
### OTR & # CRITERION TRIALS
### ARCHERY CODING SHEET

**SUBJECT(S):** ___________________________  **TAPE # & DAY #:** ___________  **DATE OF LESSON:** ___________________________

**OBSERVER:** __________________________________________  **DATE OF OBSERVATION:** ___________________________

**SHOOTING AT:**

<table>
<thead>
<tr>
<th>yds.</th>
<th>yds.</th>
<th>yds.</th>
<th>yds.</th>
<th>yds.</th>
<th>yds.</th>
<th>yds.</th>
<th>yds.</th>
<th>yds.</th>
</tr>
</thead>
<tbody>
<tr>
<td>End 1</td>
<td>End 2</td>
<td>End 3</td>
<td>End 4</td>
<td>End 5</td>
<td>End 6</td>
<td>End 7</td>
<td>End 8</td>
<td>End 9</td>
</tr>
</tbody>
</table>

**TOPOGRAPHY:**

- **Acceptable (A):**
- **Unacceptable (U):**
- **No Response (NR):**

**Totals Across Ends:**

- Acceptable (A) __
- Unacceptable (U) __
- No Response (NR) __

**Responses (A)+(U) ____ Opportunities (A)+(U)+(NR) ____**

**Total # Criterion Trials:**

- (A)+(U) at 10 yds. ____
- (A)+(U) at 20 yds. ____

---

Figure 7. OTR & Criterion Trials Coding Sheet.
Nocking - One arrow laid across the arrow rest of the bow
- Bowstring held with top three fingers of dominant hand

Drawing - Bowarm extended fully toward target
- Bow held perpendicular to the ground
- String drawn back as directly as possible to anchor point

Anchoring - Drawing hand/fingers or string physically touches face

Aiming - Head oriented towards the target

Releasing - Relax drawing fingers with hand reacting rearward

Follow-through - Bowarm extended and stationary

After coding was completed, the totals across ends were tabulated for Acceptable (A), Unacceptable (U), and No Response (NR) categories. The number of responses were determined by totaling all (A)s and (U)s, and, the number of opportunities to respond, all (A)s, (U)s, and (NR)s. All totals were then transferred to a single tally sheet (Appendix G).

Number of Criterion Trials. Due to the nature of the teachers' lessons, number of criterion trials were coded simultaneously with OTR. Distances for each end were included on the coding sheet which then allowed it to serve a dual purpose (see Figure 7). To determine the number of criterion trials, all (A)s and (U)s at 10 yards and all (A)s and (U)s at 20 yards were totaled. All totals were then transferred to a single tally sheet (Appendix G).
Description and Training of Observers

Three individuals collected data for this study. All three were doctoral students in physical education, one was the investigator.

All three were female, and two had had previous experience in observational recording. The two observers who coded ALT-PE were already trained in the ALT-PE observation system.

The two observers who coded opportunity to respond and number of criterion trials adhered to the following steps during training:

1. Each observer was provided with written behavioral definitions of all categories and descriptions of shooting skill behaviors. In the opportunity to respond and number of criterion trials observation systems, observers were given one day to familiarize themselves with the definitions.

2. Observers were again provided with written behavioral definitions and descriptions of shooting skill behaviors. After each definition or description, observers were required to verbally indicate the name of each behavior category. Criterion for acceptance was 9 of 10 items correct (see Appendix B).

3. When each observer met the criterion for acceptance in #2 (both did so on the first attempt), training sessions were begun in the investigator's study. During the first session, both observers coded the same subject. The tape was stopped occasionally to clear up questions
regarding appropriate coding.

4. Once observers were comfortable with the format, each coded a different student on the videotape. The coding sheets were compared to that of the investigator.

Following training, both observers commenced coding videotapes at any and all convenient times, either independently or simultaneously. All coding sheets were dated and signed by the observer and placed in a file in the investigator's study.

Procedures for obtaining observer agreement/accuracy are discussed in the following section.

Observer Agreement/Accuracy

Much has been written in the literature concerning the reliability of data collected with interval recording systems (Johnston & Bolstad, 1974; Hawkins & Dotson, 1975), with the methods identified relying heavily upon interobserver agreement. Only recently has an alternative strategy been endorsed (Johnston & Pennypacker, 1980).

Johnston and Pennypacker (1980) define reliability as ..."a characteristic of the interaction between a single observer and a known part of the environment..." (p. 163). Since it is an intraindividual phenomenon, the use of a second observer to enhance accuracy by serving as a reliability check of the first observer is a superfluous addition.

Accuracy refers to the extent to which the observed data approximates the true value of the phenomenon. True value is a measure determined independently from which all possible bias and random measurement error have been removed.
Although the use of a second observer to evaluate accuracy is improper, a second observer can be used to improve the estimates of the true values of the data over the estimates available from a single observer (Johnston & Pennypacker, 1980). For purposes of this study, two independent observers observed videotapes and indicated each response occurrence on a coding sheet. The two coding sheets were compared and a response was accepted as having occurred only if both observers independently agreed so (scored intervals). Since a time coded coding sheet was available for ALT-PE and the ends were numbered on the OTR and number of criterion trials coding sheet, disagreements could be reviewed and a decision made as to the correct response occurrence. The resulting data seemed to improve the accuracy of the data. While the same procedure could have been accomplished by a single observer, two were used for purposes of time and believability of the resulting data.

The results of the observer agreement/accuracy measures are reported in Chapter IV.
Data Analysis

The tally sheets (Appendix G) upon which all coding data had been placed were used for input into a computer program. The Statistical Analysis System (SAS) was utilized to code and analyze the data.

Questions

1. What is the relationship among academic learning time-physical education, opportunity to respond, and number of criterion trials? To describe the relationships among the three process variables, Pearson product-moment correlations were utilized. An additional procedure of data analysis, graphic correlational analysis, was presented as a supplement to the Pearson product-moment correlations. While correlations indicate the magnitude and direction of the relationships numerically, graphs allow visual inspection. An N of 12 was used with the student as the unit of analysis, and an N of 4, with the class as the unit of analysis.

2. Which of the three process variables is most highly correlated with student achievement as measured by the A.A.H.P.E.R. Archery Skill Test, after accounting for initial ability? To answer this question, partial correlations were utilized (Van Dalen, 1979; Hopkins & Glass, 1978). Each process variable was correlated with the product variable, having controlled for the influence of initial ability by holding the pretest score on the skill test constant. Regression analysis was considered, but statisticians agreed that the same findings would result (Warmbrod, 1983; Ruland, 1983).
With the student as the unit of analysis, the data for the 12 target students was utilized. When the class was the unit of analysis, the data from all students in each class on the A.A.H.P.E.R. Archery Skill Test was averaged and represented that class's mean on that product variable, with the average of the three target students' data representing that class's mean on the process variable.

3. Which of the three process variables is most highly correlated with student achievement as measured by the Archery Knowledge Test, after accounting for initial ability? Partial correlations were utilized to answer this question. Each process variable was correlated with the product variable, having controlled for the influence of initial ability by holding the pretest score on the written test constant. Regression analysis was considered, but statisticians agreed that the same findings would result (Warmbrod, 1983; Ruland, 1983). With the student as the unit of analysis, the data for the 12 target students was utilized. When the class was the unit of analysis, the data from all students in each class on the Archery Knowledge Test was averaged and represented that class's mean on that product variable, with the average of the three target students' data representing that class's mean on the process variable.

4. If there are substantial interclass differences, which teacher and student process variables are the possible sources of those differences? One-way analysis of variance was calculated to determine interclass differences on all pretest and posttest scores. When substantial differences were noted, teacher and student process variables were analyzed as possible sources of those differences.
Summary

This chapter described the method of data collection involving machine observation and recording. Included was a description of the subjects and the setting in which those subjects were observed. Next, a discussion of the transduction process involving human observation and recording was presented. The observation systems for ALT-PE, and Opportunity to Respond and Number of Criterion Trials were outlined, including the behavioral definitions for each instrument. A short discussion of observer agreement/accuracy followed. The chapter concluded with a brief discussion of the methods of data analysis. Chapter IV will present the results and discussion of the data.
CHAPTER IV

ANALYSIS AND DISCUSSION OF DATA

This chapter presents the data gathered from observation of the videotapes. The data are summarized descriptively to answer each research question posed in Chapter 1. Relationships among variables are analyzed using correlation coefficients, and interclass differences are statistically analyzed and discussed. Graphic analysis is used where it is deemed appropriate.

Throughout the analysis and discussion of data, the following scale, suggested by Davis (1971), was used to describe the magnitude of relationship among variables for all correlations.

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>.70 or higher</td>
<td>very strong</td>
</tr>
<tr>
<td>.50 to .69</td>
<td>substantial</td>
</tr>
<tr>
<td>.30 to .49</td>
<td>moderate</td>
</tr>
<tr>
<td>.10 to .29</td>
<td>low</td>
</tr>
<tr>
<td>.01 to .09</td>
<td>negligible</td>
</tr>
</tbody>
</table>

Prior to analysis, steps were taken to determine the normality of the data. Scatterplots were constructed and examined for gross departures from linearity in the relationships among combinations of process and product variables, and none were observed. The Proc Univariate Procedure in the SAS package also failed to detect departure from normality. Therefore, the basic assumption for the
appropriate use of correlations was met.

The first section of this chapter presents a short dis-
cussion of the observer agreement/accuracy measures. It is
followed by a section on representativeness. The data pre-
sentation is made, followed by the discussion of data.

Observer Agreement/Accuracy

When observers are coding live or in the field, some
level of reliability or agreement between independent ob-
servers in training and in field settings seems justifiable
in deciding whether response class definitions are appro-
priate. However, when coding is from videotapes, which re-
present a permanent product of the true value of the
phenomenon, the focus should be accuracy of the data and not
merely reliability of independent observers.

As discussed in an earlier section, it was the intent of
the researcher to improve the accuracy of the data in this
study. Accuracy refers to the extent to which the observed
data approximates the true value of the phenomenon. True
value is a measure from which all possible bias and random
measurement error have been removed (Johnston & Pennypacker, 1980).

For this study, observer agreement/accuracy measures
were reported for the three process variables: ALT-PE, oppor-
tunity to respond, and number of criterion trials. The
procedure for obtaining observer agreement/accuracy measures
during the data collection phase was as follows:

ALT-PE

1. A cassette deck with a cuing tape was used so that
observers were coding the same intervals. The
cuing tape was adjusted so that it coincided with
the running time on the videotape. (Use of the
time coded coding sheet made this possible.)

2. After an entire lesson was observed and coded, the
two coding sheets were compared and ALT-PE agree­
ments (any interval in which motor appropriate was
chosen for the second level) noted. An agreement
was defined as an interval in which both observers
coded the same behavior as occurring.

3. Percent of observer agreement was obtained by using
the following formula:

\[
\text{observer agreement}(\%) = \frac{\text{no. of intervals in agreement}}{\text{no. of intervals in agreement} + \text{no. of intervals in dis-agreement}} \times 100
\]

4. All other intervals in which both observers were in
disagreement were reanalyzed and recoded. The
timed coded coding sheet allowed the intervals of
disagreement to be pinpointed on the videotape. Once
this was done, the cuing tape was adjusted to match
the elapsed time on the videotape. Both the video­
tape and cuing tape were started simultaneously, and
observers made decisions as to appropriate responses.

5. The coding sheet on which disagreements were recoded
served as the data sheet. It seemed to represent the
best estimate of the true value of intervals of
ALT-PE for this study.

**OTR & Number of Criterion Trials**

1. Each observer observed and coded an entire lesson.
The two coding sheets were compared and agreements
noted. An agreement was defined as a behavior category in which both observers coded the same response as occurring.

2. Percent of observer agreement was obtained by using the following formula:

\[
\text{observer agreement (\%) } = \frac{\text{no. behavior categories in agreement}}{\text{no. behavior categories in agreement} + \text{no. behavior categories in disagreement}} \times 100
\]

3. All other behavior categories in which both observers were in disagreement were reanalyzed and recoded. Since responses in archery occur in multiples of 6 (1 end = 6 arrows), pinpointing the end in which the discrepancy(s) occurred was an easy task. Once the end was located, the videotape was started and observers made decisions as to appropriate responses.

4. The coding sheet on which disagreements were recoded served as the data sheet. It seemed to represent the best estimate of the true value for opportunity to respond and number of criterion trials for this study.

Observer agreement/accuracy measures for ALT-PE were conducted on twelve of twenty-four lessons, and for opportunity to respond and number of criterion trials, fourteen of twenty-four lessons. Ideally, observer agreement/accuracy measures should have been conducted on all lessons, but due to time limitations, was only obtained on the lessons indicated.
All observer agreement/accuracy measures were .86 or above. The mean of all ALT-PE observer agreement/accuracy measures was .91 (Table 5) and the mean of all OTR/number of criterion trial measures was .96 (Table 6).

Table 5
Observer Agreement/Accuracy Measures
Coder 1 with Coder 2 on ALT-PE

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<thead>
<tr>
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<th>Lesson</th>
<th>ALT-PE</th>
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Table 6
Observer Agreement/Accuracy Measures
Coder 1 with Coder 3 on OTR/Number Criterion Trials

<table>
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<th>Lessons</th>
<th>OTR/Number Criterion Trials</th>
</tr>
</thead>
<tbody>
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<td>.98</td>
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<tr>
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<tr>
<td></td>
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<td>.97</td>
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</table>
Representativeness

Two sampling techniques were utilized in this study: the use of target students to represent the class on the process variables, and the use of an interval recording technique to represent continuous recording. Each sampling technique is addressed separately.

Target Students

In an attempt to determine the representativeness of the selected target students on the process variables, the following procedures were utilized: (1) two different classes and different lessons were selected; (2) process variables were coded for all students in each lesson; (3) the data for all students in each class was averaged and that average was compared to the average of the three target students' data. The data for the two classes are presented separately in Tables 7 and 8. A comparison of means indicated that the selected target students were representative.
Table 7
Mean Data for Class 1, Lesson 3
on Process Variables

<table>
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<tr>
<th>Variable</th>
<th>Target Students (N=3)</th>
<th>Class (N=10)</th>
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<td>Range</td>
</tr>
<tr>
<td>Intervals of ALT-PE</td>
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<td>15-18</td>
</tr>
<tr>
<td>Opportunity to Respond</td>
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</tr>
<tr>
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<td>21-33</td>
</tr>
<tr>
<td>unacceptable</td>
<td>7.3</td>
<td>2-14</td>
</tr>
<tr>
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<td>.7</td>
<td>0-1</td>
</tr>
<tr>
<td>total responses</td>
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<td>35-36</td>
</tr>
<tr>
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<td>36</td>
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<tr>
<td>Criterion Trials</td>
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</tr>
<tr>
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<td>35-36</td>
</tr>
<tr>
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</table>

Table 8
Mean Data for Class 3, Lesson 4
on Process Variables

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<th>Class (N=14)</th>
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</thead>
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<td>Range</td>
</tr>
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<td>12-15</td>
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<td>Criterion Trials</td>
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<td>31</td>
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<tr>
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Interval Recording

There are several options for measuring ALT-PE, including interval recording, group time sampling, and/or duration recording.

The interval recording observation technique is a sampling process, and its representativeness is dependent upon the number of samples collected and their distribution across the total time.

This study utilized a five-second observe, five-second record format. Since the intervals were short and spread evenly across the total time, they should produce representative data.

In an attempt to determine whether the data collected using the interval recording technique was representative of data collected continuously, the following procedures were followed: (1) one target student from each class was timed on ALT-PE using duration recording; (2) the ALT-PE calculated from interval recording was compared to the ALT-PE timed with duration recording. The results were presented in Table 9, and indicate that the interval recording sampling technique was representative of duration recording.

Table 9
Interval Recording vs. Duration Recording

<table>
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<th>Class</th>
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<th>Interval</th>
<th>Duration</th>
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<tr>
<td></td>
<td></td>
<td>Minutes</td>
<td>% Intervals</td>
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<tr>
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<td>3</td>
<td>7.5</td>
<td>20.3</td>
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</table>
Target Students

Table 10 presents the ALT-PE data on the twelve target students for the six outdoor lessons. The mean number of total intervals of ALT-PE for the twelve target students was 92.7, with a range of 77 to 106. The mean percentage of total intervals of ALT-PE was 18.7. Translating 92.7 intervals into minutes yielded 46.4 minutes of ALT-PE for the six lessons, or an average of 7.7 minutes per lesson. The mean number of total intervals of ALT-PE or 92.7 represented mean intervals of 67.2 from 10 yards, and 25.5 from 20 yards. The range of intervals from 10 yards was 56 to 78, and from 20 yards, 14 to 38. The mean percentage of total intervals of ALT-PE from 10 yards was 13.6 and, from 20 yards, 5.2. Target students had an average of 33.6 minutes of ALT-PE from 10 yards and 12.8 minutes from 20 yards.

Opportunity to respond data on the target students is presented in Table 11. The target students had a mean number of total opportunities to respond of 226.3. This mean represented a range of 187 to 252 opportunities. Target students had an average of 163.3 opportunities from 10 yards, ranging from 133 to 198, and 63.0 opportunities from 20 yards. Opportunities to respond from 20 yards ranged from 42 to 84. The mean number of total acceptable responses was 209.3, ranging from 161 to 252. Target students averaged 153.3 acceptable responses from 10 yards, and 56.0 from 20 yards. The range from 10 yards was 119 to 195 acceptable responses and, from 20 yards, 28 to 84 acceptable responses. The mean number of total unacceptable responses was 10.8, with a mean of 6.5 unacceptable responses occurring from 10 yards, and
### Table 10

**Number & Percentage of Intervals of ALT-PE by Target Students**

<table>
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<th>Class</th>
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**Note:** The table details the number of intervals (ALT-PE) for different classes and students across various lessons, with percentage calculations for each interval.
Table 11

Number of Opportunities to Respond by Target Students

<table>
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<tr>
<th>Class</th>
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</table>

Table 1 (continued)
4.3 from 20 yards. Total unacceptable responses ranged from 0 to 52. This represented ranges of 0 to 27 unacceptable responses from 10 yards and 0 to 25 from 20 yards. The mean number of total no responses was 6.2, ranging from 0 to 32. The mean number of no responses from 10 yards was 3.4, ranging from 0 to 24, and 2.8 no responses from 20 yards. No responses from 20 yards ranged from 0 to 23. The mean number of total student responses was 220.1. This mean represented a range of 161 to 252 responses. Target students had an average of 159.8 responses from 10 yards, and 60.3 responses from 20 yards. The range from 10 yards was 126 to 198 responses and, from 20 yards, 31 to 84.

The mean number of total criterion trials for the 12 target students was 220.5, with a range of 166 to 252. The mean number of criterion trials from 10 yards was 160.1, and from 20 yards, 60.4. These means represent ranges of 126 to 198 and 33 to 84, respectively. The data is presented in Table 12.

Table 13 presents the achievement scores on the target students. The mean pretest score on the Archery Knowledge Test was 20.3, with a standard deviation of 4.9. The mean total pretest score on the A.A.H.P.E.R. Archery Skill Test was 27.7. The standard deviation was 15.9. The mean pretest skill score from 10 yards was 20.8 and, from 20 yards, 6.8. The standard deviations were 13.7 and 7.4, respectively. The mean posttest score on the Archery Knowledge Test was 31.4, with a standard deviation of 4.1. The mean total posttest score on the A.A.H.P.E.R. Archery Skill Test was 83.3. The standard deviation was 26.6. The mean posttest skill score from 10 yards was 57.5 and, from 20 yards, 25.8. The standard deviations were 20.6 and 11.5, respectively. Achievement scores for all students were located in Appendix H.
<table>
<thead>
<tr>
<th>Class</th>
<th>Student</th>
<th>10 yds.</th>
<th>10 yds.</th>
<th>10 yds.</th>
<th>10 yds.</th>
<th>20 yds.</th>
<th>20 yds.</th>
<th>10 yds.</th>
<th>20 yds.</th>
<th>10/20 yds.</th>
<th>Total</th>
</tr>
</thead>
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<td>72</td>
<td>220</td>
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<td>35</td>
<td>32</td>
<td>0</td>
<td>26</td>
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<td>68</td>
<td>194</td>
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<td>42</td>
<td>36</td>
<td>46</td>
<td>0</td>
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<td>42</td>
<td>148</td>
<td>72</td>
<td>220</td>
</tr>
<tr>
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<td>1</td>
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<td>54</td>
<td>36</td>
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<td>0</td>
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<td>42</td>
<td>168</td>
<td>84</td>
<td>252</td>
</tr>
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<td>54</td>
<td>36</td>
<td>30</td>
<td>0</td>
<td>40</td>
<td>42</td>
<td>168</td>
<td>82</td>
<td>250</td>
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<td>36</td>
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Table 13
Achievement Scores on Target Students

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<th>Class</th>
<th>Student</th>
<th>Knowledge 10 yds.</th>
<th>Knowledge 20 yds.</th>
<th>Knowledge Total</th>
<th>Skill 10 yds.</th>
<th>Skill 20 yds.</th>
<th>Skill Total</th>
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<tbody>
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<td>35</td>
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<td>25</td>
<td>16</td>
<td>24</td>
<td>82</td>
<td>28</td>
<td>110</td>
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<tr>
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<td>2</td>
<td>25</td>
<td>16</td>
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<td>30</td>
<td>92</td>
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<td>20</td>
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</table>
Classes

The raw data on ALT-PE for the four classes is presented in Table 14. The mean number of total intervals of ALT-PE was 92.7, ranging from 88 in Class 1 to 101.7 in Class 2. The mean number of intervals of ALT-PE from 10 yards was 67.2 and, from 20 yards, 25.5. The ranges were 62.3 to 74.9 and 16.0 to 34.6, respectively.

Table 15 summarizes the opportunities to respond for each class during the six outdoor lessons. The average total number of opportunities to respond by class was 226.8, ranging from 193 in Class 3 to 252 in Class 2. The average number of opportunities to respond from 10 yards was 163.8 and, from 20 yards, 63.0. The ranges were 139 to 198 and 42 to 84, respectively.

The mean number of total criterion trials for the four classes was 220.5, ranging from 181.4 in Class 3 to 251.3 in Class 2. The mean number of criterion trials from 10 yards was 160.1 and, from 20 yards, 135.0 to 196.7 and 41.3 to 83.3, respectively (Table 16).

Table 17 presents the mean achievement scores for each class. The mean pretest score by classes on the Archery Knowledge Test was 20.0, with a standard deviation of 5.1. The mean total pretest score by class on the A.A.H.P.E.R. Archery Skill Test was 36.7. The standard deviation was 35.4. The mean pretest skill score from 10 yards was 27.1 and, from 20 yards, 9.6. The standard deviations were 25.5 and 12.2, respectively. The mean posttest score on the Archery Knowledge Test was 29.3, with a standard deviation of 4.1. The mean total posttest score on the skill test was 78.1. The standard deviation was 24.3. The mean posttest skill score from 10 yards was 56.4 and, from 20 yards, 21.7. The standard deviations were 16.8 and 12.9, respectively.
<table>
<thead>
<tr>
<th>Class</th>
<th>1 yds. No.</th>
<th>1 yds. %</th>
<th>2 yds. No.</th>
<th>2 yds. %</th>
<th>3 yds. No.</th>
<th>3 yds. %</th>
<th>4 yds. No.</th>
<th>4 yds. %</th>
<th>5 yds. No.</th>
<th>5 yds. %</th>
<th>6 yds. No.</th>
<th>6 yds. %</th>
<th>Total 10 yds. No.</th>
<th>Total 10 yds. %</th>
<th>Total 20 yds. No.</th>
<th>Total 20 yds. %</th>
<th>Total 16/20 yds. No.</th>
<th>Total 16/20 yds. %</th>
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<td>22.6</td>
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<td>19.0</td>
<td>18.0</td>
<td>0.0</td>
<td>11.0</td>
<td>13.1</td>
<td>14.7</td>
<td>17.5</td>
<td>62.3</td>
<td>19.1</td>
<td>25.7</td>
<td>15.3</td>
<td>88.0</td>
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<td>22.3</td>
<td>22.3</td>
<td>17.0</td>
<td>20.2</td>
<td>12.7</td>
<td>17.1</td>
<td>0.0</td>
<td>0.0</td>
<td>18.3</td>
<td>21.8</td>
<td>16.3</td>
<td>19.4</td>
<td>67.1</td>
<td>20.6</td>
<td>34.6</td>
<td>20.6</td>
<td>101.7</td>
</tr>
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<td>17.3</td>
<td>20.6</td>
<td>14.7</td>
<td>17.5</td>
<td>19.0</td>
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<td>13.3</td>
<td>18.0</td>
<td>0.0</td>
<td>11.3</td>
<td>13.5</td>
<td>14.3</td>
<td>17.0</td>
<td>64.3</td>
<td>19.7</td>
<td>25.6</td>
<td>15.2</td>
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<td>21.4</td>
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<td>17.0</td>
<td>14.0</td>
<td>16.7</td>
<td>16.3</td>
<td>22.1</td>
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<td>74.9</td>
<td>18.3</td>
<td>16.0</td>
<td>19.0</td>
<td>91.0</td>
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Table 15

Mean Number of Opportunities to Respond by Classes

<table>
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<th>4</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Class</td>
<td>10 yds.</td>
<td>15 yds.</td>
<td>20 yds.</td>
<td>25 yds.</td>
<td>10 yds.</td>
</tr>
<tr>
<td>1</td>
<td>24.0</td>
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<td>36.0</td>
<td>0</td>
<td>36.0</td>
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</tbody>
</table>

*aTarget student one served in a motor supporting role for one end and therefore, had six fewer opportunities to respond. However, all other students were given 42 opportunities to respond. Therefore, 42.0 was used as the class average instead of 40.0.

Table 16

Mean Number of Criterion Trials by Classes

<table>
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<th>4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
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<td>15 yds.</td>
<td>20 yds.</td>
<td>25 yds.</td>
<td>10 yds.</td>
</tr>
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<tr>
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<td>41.0</td>
<td>0</td>
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<td>42.0</td>
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</table>
Table 17
Mean Achievement Scores by Classes

<table>
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<th>Class</th>
<th>(p^a)</th>
<th>Knowledge Pretests</th>
<th>Skill Pretests</th>
<th>Total Pretests</th>
<th>Knowledge Posttests</th>
<th>Skill Posttests</th>
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</thead>
<tbody>
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<td>6.9</td>
<td>32.8</td>
<td>29.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 yds.</td>
<td>20 yds.</td>
<td>Total</td>
<td>10 yds.</td>
<td>20 yds.</td>
</tr>
<tr>
<td>2</td>
<td>18(18)</td>
<td>21.4</td>
<td>27.9</td>
<td>9.9</td>
<td>37.8</td>
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<tr>
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<td>20 yds.</td>
<td>Total</td>
<td>10 yds.</td>
<td>20 yds.</td>
</tr>
<tr>
<td>3</td>
<td>16(14)</td>
<td>19.9</td>
<td>23.5</td>
<td>3.5</td>
<td>27.0</td>
<td>30.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 yds.</td>
<td>20 yds.</td>
<td>Total</td>
<td>10 yds.</td>
<td>20 yds.</td>
</tr>
<tr>
<td>4</td>
<td>15(15)</td>
<td>20.4</td>
<td>30.9</td>
<td>17.5</td>
<td>48.5</td>
<td>27.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 yds.</td>
<td>20 yds.</td>
<td>Total</td>
<td>10 yds.</td>
<td>20 yds.</td>
</tr>
</tbody>
</table>

\(^a\)Numbers in parentheses indicate the number of students who completed all tests.
Results

The results for each research question are presented separately, first with the student as the unit of analysis, and then, with the class as the unit of analysis.

Questions

1. What is the relationship among academic learning time-physical education, opportunity to respond, and number of criterion trials? Correlation coefficients with the student as the unit of analysis, or an N of 12, are presented in Table 18. There was a very high positive relationship (.94) between total number of criterion trials and total opportunities to respond. There was a moderate positive relationship (.43) between total intervals of ALT-PE and total opportunities to respond, and there was a substantial positive relationship (.56) between total intervals of ALT-PE and total number of criterion trials.

The data collected from the videotapes on each target student was able to be subjected to graphic correlational analysis. In Figure 8, the target students in classes 1 and 2 are presented. Each target student's number of opportunities to respond and criterion trials, and percentage of ALT-PE intervals in outdoor sessions one to six have been plotted against each other in those sessions. Target students in classes 3 and 4 are presented in Figure 9. The graphic correlational analysis seemed to provide a more precise representation of the relationships among the three process variables than did the statistical correlations.

When the data on each of the three process variables was examined from distances of 10 and 20 yards separately, slightly different correlations resulted. When students
Table 18

Correlational Matrix Among Process Variables with the Student as the Unit of Analysis

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Intervals of ALT-PE</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervals ALT-PE at 10 yds</td>
<td>.46</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervals ALT-PE at 20 yds</td>
<td>.70</td>
<td>-.30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total OTR</td>
<td>.43</td>
<td>.40</td>
<td>.14</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OTR at 10 yds.</td>
<td>.15</td>
<td>.73</td>
<td>-.42</td>
<td>.75</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OTR at 20 yds.</td>
<td>.39</td>
<td>-.47</td>
<td>.80</td>
<td>.36</td>
<td>-.35</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Number Criterion Trials</td>
<td>.56</td>
<td>.49</td>
<td>.21</td>
<td>.94</td>
<td>.74</td>
<td>.30</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Criterion Trials at 10 yds</td>
<td>.25</td>
<td>.75</td>
<td>-.33</td>
<td>.73</td>
<td>.97</td>
<td>-.34</td>
<td>.78</td>
<td>1.00</td>
</tr>
</tbody>
</table>
| Criterion Trials at 20 yds | .53                       | -.28                     | .79                        | .48                  | -.20        | .95                                    | .48                       | -.18                     | 1.00


Figure 8. Graphic Correlational Analysis for Target Students in Classes 1 and 2.
Figure 9. Graphic Correlational Analysis for Target Students in Classes 3 and 4.
shot from a distance of 10 yards, there was a very high positive relationship (.73 to .97) among ALT-PE, opportunity to respond, and number of criterion trials. There was also a very high positive correlation (.79 to .95) among the three process variables when students shot from a distance of 20 yards.

Correlation coefficients with the class as the unit of analysis, or an N of 4, are presented in Table 19. There is a very high positive relationship (.99) between total opportunities to respond and total number of criterion trials, and between total intervals of ALT-PE and total number of criterion trials (.70). There was a substantial positive relationship (.66) between total opportunities to respond and total intervals of ALT-PE.

The data collected on the three target students from each class was averaged and that data was able to be subjected to graphic correlational analysis. In Figures 10 and 11, each class's mean number of opportunities to respond and criterion trials, and mean percentage of ALT-PE intervals in outdoor sessions one to six have been plotted against each other in those sessions. Again, the graphic correlational analysis seemed to provide a more precise and table representation of the relationships among the three process variables than did the statistical correlations.

Again, analyzing the data on each of the three process variables from distances of 10 and 20 yards separately yielded slightly different correlations (Table 19). There was a very high positive relationship among ALT-PE, opportunity to respond, and number of criterion trials when totals from each distance were analyzed separately.
Table 19

Correlational Matrix Among Process Variables with the Class as the Unit of Analysis

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Intervals of ALT-PE</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervals ALT-PE 10 yds.</td>
<td>.15</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervals ALT-PE 20 yds.</td>
<td>.69</td>
<td>-.61</td>
<td>1.00</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total OTR at 10 yds.</td>
<td>.66</td>
<td>.51</td>
<td>.16</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OTR at 20 yds.</td>
<td>.24</td>
<td>.93</td>
<td>.49</td>
<td>.75</td>
<td>.75</td>
<td></td>
<td>.99</td>
<td></td>
</tr>
<tr>
<td>Total Number Criterion Trials</td>
<td>.60</td>
<td>-.60</td>
<td>.92</td>
<td>.36</td>
<td>-.35</td>
<td></td>
<td>.99</td>
<td></td>
</tr>
<tr>
<td>Criterion Trials at 10 yds.</td>
<td>.70</td>
<td>.56</td>
<td>.15</td>
<td>.99</td>
<td>.78</td>
<td>.32</td>
<td>.99</td>
<td>.78</td>
</tr>
<tr>
<td>Criterion Trials at 20 yds.</td>
<td>.32</td>
<td>.95</td>
<td>-.44</td>
<td>.74</td>
<td>.99</td>
<td>-.35</td>
<td>.78</td>
<td></td>
</tr>
</tbody>
</table>
|                      | .62             | -.48                     | .86                      | .49                 | -.20         | .99                                       | .45                         | -.21                        | 1.00
Figure 10. Graphic Correlational Analysis for Classes 1 and 2.
Figure 11. Graphic Correlational Analysis for Classes 3 and 4.
Therefore, when the entire data set was examined with the student as the unit of analysis, the magnitude of the relationships among the three process variables varied. There was a very high relationship between total number of criterion trials and opportunities to respond. ALT-PE was moderately related to opportunities to respond, and substantially related to criterion trials. From distances of 10 and 20 yards, all three process variables were very highly correlated. When the entire data set was examined with the class as the unit of analysis, very high correlations resulted among the three process variables. The only exception was the relationship between total ALT-PE and opportunities to respond. They were substantially correlated.

2. Which of the three process variables is most highly correlated with student achievement as measured by the A.A.H.P.E.R. Archery Skill Test, after accounting for initial ability? With the student as the unit of analysis, several combinations of partial correlations were obtained (Table 20). When the total intervals of ALT-PE, opportunities to respond, and number of criterion trials were correlated with the total posttest score on the A.A.H.P.E.R. Archery Skill Test after partialing out the total pretest skill scores, the results ranged from no relationship to low positive relationships. The highest correlation (.24) was obtained between the total posttest skill scores and total number of criterion trials.

When the data on the three process variables was summarized from distances of 10 and 20 yards separately, and then correlated with the posttest scores on the A.A.H.P.E.R. Archery Skill Test from that distance, slightly higher correlations resulted. Both opportunities to respond and number of criterion trials from 10 yards had a moderate
Table 20
Partial Correlations of Process Variables with Postskill Scores with the Student as the Unit of Analysis

<table>
<thead>
<tr>
<th></th>
<th>Posttest Scores on A.A.H.P.E.R Archery Skill Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 yds.</td>
</tr>
<tr>
<td>Total Intervals of ALT-PE</td>
<td>0.14</td>
</tr>
<tr>
<td>Intervals of ALT-PE 10 yds.</td>
<td>0.03</td>
</tr>
<tr>
<td>Intervals of ALT-PE 20 yds.</td>
<td>0.13</td>
</tr>
<tr>
<td>Total OTR</td>
<td>0.36</td>
</tr>
<tr>
<td>OTR - 10 yds.</td>
<td>0.34</td>
</tr>
<tr>
<td>OTR - 20 yds.</td>
<td>0.03</td>
</tr>
<tr>
<td>Total Number Criterion Trials</td>
<td>0.40</td>
</tr>
<tr>
<td>Criterion Trials 10 yds.</td>
<td>0.36</td>
</tr>
<tr>
<td>Criterion Trials 20 yds.</td>
<td>0.12</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Partialed out pretest skill score from 10 yards
\textsuperscript{b}Partialed out pretest skill score from 20 yards
\textsuperscript{c}Partialed out total pretest skill score
positive correlation (.34 and .36) with the posttest skill scores from 10 yards after holding the pretest skill scores from that distance constant. Intervals of ALT-PE from 10 yards had a negligible positive relationship (.03). The number of criterion trials from 10 yards was the most highly correlated process variable with the posttest skill score from 10 yards, with an r of .36. All three process variables from 20 yards had negligible correlations with the posttest skill score from 20 yards, after partialing out the pretest skill score from 20 yards. Intervals of ALT-PE from 20 yards had the highest correlation with the posttest skill score from 20 yards with a r of -.04.

Several combinations of partial correlations with the class as the unit of analysis were also determined (Table 21). When totals for all three process variables were individually correlated with total posttest scores on the A.A.H.P.E.R. Archery Skill Test, holding total pretest skill scores constant, very high positive relationships resulted. The process variable which yielded the highest correlation (.99) with the total posttest skill score was the number of criterion trials.

Correlating data on the three process variables from distances of 10 and 20 yards separately with posttest skill scores from those distances, having accounted for pretest scores from those distances, yielded slightly different results. The most highly correlated process variable from 10 yards was opportunities to respond. Opportunities to respond from 10 yards had a very high negative relationship (-.70) with posttest skill scores from 10 yards. Intervals of ALT-PE from 10 yards had a substantial negative relationship (-.65), and criterion trials, a low negative relationship (-.27). From 20 yards, all three process variables had very high positive relationships with the posttest scores from...
Table 21
Partial Correlations of Process Variables
with Postskill Scores with the Class
as the Unit of Analysis

<table>
<thead>
<tr>
<th></th>
<th>Posttest Scores on A.A.H.P.E.R. Archery Skill Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 yds.  a                                      20 yds.  b</td>
</tr>
<tr>
<td>Total Intervals of ALT-PE</td>
<td>.87</td>
</tr>
<tr>
<td>Intervals of ALT-PE</td>
<td></td>
</tr>
<tr>
<td>10 yds.</td>
<td>-.65</td>
</tr>
<tr>
<td>Intervals of ALT-PE</td>
<td>.99</td>
</tr>
<tr>
<td>20 yds.</td>
<td></td>
</tr>
<tr>
<td>Total OTR</td>
<td>.99</td>
</tr>
<tr>
<td>OTR - 10 yds.</td>
<td>-.70</td>
</tr>
<tr>
<td>OTR - 20 yds.</td>
<td>.97</td>
</tr>
<tr>
<td>Total Number Criterion Trials</td>
<td>.99</td>
</tr>
<tr>
<td>Criterion Trials</td>
<td></td>
</tr>
<tr>
<td>10 yds.</td>
<td>-.27</td>
</tr>
<tr>
<td>Criterion Trials</td>
<td>.95</td>
</tr>
<tr>
<td>20 yds.</td>
<td></td>
</tr>
</tbody>
</table>

a Partialed out pretest skill score from 10 yards

b Partialed out pretest skill score from 20 yards

c Partialed out total pretest skill score
that distance, with intervals of ALT-PE yielding the highest r at .99.

3. Which of the three process variables is most highly correlated with student achievement as measured by the Archery Knowledge Test, after accounting for initial ability? Table 22 represents the partial correlations of the process variables with posttest scores on the Archery Knowledge Test with the student as the unit of analysis. All three process variables had substantial negative relationships with the knowledge test. Total intervals of ALT-PE, total opportunities to respond, and total number of criterion trials had coefficients of -.51, -.58, and -.62, respectively. With the student as the unit of analysis, the most highly correlated process variable with student achievement was number of criterion trials.

The partial correlations of the process variables with posttest scores on the Archery Knowledge Test with the class as the unit of analysis are presented in Table 23. Both total opportunities to respond and total number of criterion trials had very high negative relationships, with correlations of -.74 and -.76, respectively. Total intervals of ALT-PE had a negligible positive relationship (.07) with posttest knowledge scores. With the class as the unit of analysis, the most highly correlated process variable with student achievement was number of criterion trials.

4. If there are substantial interclass differences, which teacher and student process variables are the possible sources of those differences? One-way analysis of variance (ANOVA) was used to determine the equality of class means on all achievement scores separately. Alpha was set at the .05 level of significance.
Table 22
Partial Correlations of Process Variables with Post Knowledge with the Student as the Unit of Analysis

<table>
<thead>
<tr>
<th>Posttest Scores on Archery Knowledge Test&lt;sup&gt;a&lt;/sup&gt;</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Intervals of ALT-PE</td>
<td>-.51</td>
</tr>
<tr>
<td>Intervals of ALT-PE  10 yds.</td>
<td>-.37</td>
</tr>
<tr>
<td>Intervals of ALT-PE  20 yds.</td>
<td>-.25</td>
</tr>
<tr>
<td>Total OTR</td>
<td>-.58</td>
</tr>
<tr>
<td>OTR - 10 yds.</td>
<td>-.55</td>
</tr>
<tr>
<td>OTR - 20 yds.</td>
<td>-.04</td>
</tr>
<tr>
<td>Total Number Criterion Trials</td>
<td>-.62</td>
</tr>
<tr>
<td>Criterion Trials  10 yds.</td>
<td>-.59</td>
</tr>
<tr>
<td>Criterion Trials  20 yds.</td>
<td>-.14</td>
</tr>
</tbody>
</table>

<sup>a</sup>Partialed out pretest knowledge scores
Table 23
Partial Correlations of Process Variables with Post Knowledge with the Class as the Unit of Analysis

<table>
<thead>
<tr>
<th>Posttest Scores on Archery Knowledge Test a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Intervals of ALT-PE</td>
</tr>
<tr>
<td>Intervals of ALT-PE 10 yds.</td>
</tr>
<tr>
<td>Intervals of ALT-PE 20 yds.</td>
</tr>
<tr>
<td>Total OTR</td>
</tr>
<tr>
<td>OTR - 10 yds.</td>
</tr>
<tr>
<td>OTR - 20 yds.</td>
</tr>
<tr>
<td>Total Number Criterion Trials</td>
</tr>
<tr>
<td>Criterion Trials 10 yds.</td>
</tr>
<tr>
<td>Criterion Trials 20 yds.</td>
</tr>
</tbody>
</table>

a Partialled out pretest knowledge scores
No significant differences were noted on any of the posttest achievement scores. Table 24 indicates that there was no significant difference between class means on total posttest scores on the A.A.H.P.E.R. Archery Skill Test. There were also no significant differences on posttest skill scores from 10 yards (Table 25) and 20 yards (Table 26). The Archery Knowledge posttest scores (Table 27) yielded no significant difference.

All pretest achievement scores resulted in no significant differences (Table 28-31), except for pretest skill scores from 20 yards (Table 30). Pretest skill scores from 20 yards were significant at the .01 level.

An examination of Table 30 reveals that the means of Classes 1, 2, and 3 differ markedly from Class 4 (17.53). Class 3, with a mean of 3.50, represents the largest discrepancy.

Since it is obvious that pretest scores cannot be attributable to differences in process variables, no further analysis is necessary to answer this research question. However, since background data on all students were available (Appendix D), this became the possible source of those differences and was included.

Table 32 summarizes the background data for Classes 3 and 4. A perusal of the table reveals that the largest discrepancies exist in the sex and prior archery experience data. Class 3 had three times more females than males, while Class 4 had four times more males than females. Almost twice as many students in Class 4 as Class 3 had had one high school archery unit previously. Class 3 also had three more students with no prior archery experience. This data is provided as a possible source of the differences between Classes 3 and 4 on pretest scores for the A.A.H.P.E.R. Archery Skill Test.
**Table 24**

Summary Data and One-Way Analysis of Variance:
Total Posttest Scores on A.A.H.P.E.R.
Archery Skill Test

<table>
<thead>
<tr>
<th>Class</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>76.25</td>
<td>33.27</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>84.28</td>
<td>24.27</td>
</tr>
<tr>
<td>3</td>
<td>16</td>
<td>72.81</td>
<td>20.40</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>77.73</td>
<td>20.61</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>df</th>
<th>Sums of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>PR</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>3</td>
<td>1177.36</td>
<td>392.45</td>
<td>0.65</td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>57</td>
<td>34379.23</td>
<td>603.14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>35556.59</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 25**

Summary Data and One-Way Analysis of Variance:
Posttest Scores from 10 Yards
on A.A.H.P.E.R. Archery Skill Test

<table>
<thead>
<tr>
<th>Class</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>54.83</td>
<td>22.69</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>59.17</td>
<td>16.93</td>
</tr>
<tr>
<td>3</td>
<td>16</td>
<td>50.88</td>
<td>13.57</td>
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<tr>
<td>4</td>
<td>15</td>
<td>60.13</td>
<td>14.32</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>df</th>
<th>Sums of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>PR</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>3</td>
<td>854.68</td>
<td>288.23</td>
<td>1.02</td>
<td>0.39</td>
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<tr>
<td>Within</td>
<td>57</td>
<td>16165.65</td>
<td>283.61</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>17030.33</td>
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</tbody>
</table>
### Table 26
Summary Data and One-Way Analysis of Variance: Posttest Scores from 20 Yards on A.A.H.P.E.R. Archery Skill Test

<table>
<thead>
<tr>
<th>Class</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>12</td>
<td>18</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>Mean</td>
<td>21.42</td>
<td>25.11</td>
<td>21.94</td>
<td>17.60</td>
</tr>
<tr>
<td>SD</td>
<td>18.00</td>
<td>10.94</td>
<td>11.11</td>
<td>12.23</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>df</th>
<th>Sums of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>PR</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>3</td>
<td>463.64</td>
<td>154.49</td>
<td>0.92</td>
<td>0.44</td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>57</td>
<td>9547.23</td>
<td>167.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
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<td>10010.69</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 27
Summary Data and One-Way Analysis of Variance: Posttest Scores on Archery Knowledge Test

<table>
<thead>
<tr>
<th>Class</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>12</td>
<td>18</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>Mean</td>
<td>29.92</td>
<td>29.00</td>
<td>30.75</td>
<td>27.53</td>
</tr>
<tr>
<td>SD</td>
<td>3.55</td>
<td>3.31</td>
<td>3.30</td>
<td>5.44</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>df</th>
<th>Sums of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>PR</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>3</td>
<td>86.81</td>
<td>28.87</td>
<td>1.83</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>57</td>
<td>901.65</td>
<td>15.82</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>988.26</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 28
Summary Data and One-Way Analysis of Variance:
Total Pretest Scores on A.A.H.P.E.R. Archery Skill Test

<table>
<thead>
<tr>
<th>Class</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>11</td>
<td>18</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>Mean</td>
<td>32.82</td>
<td>27.78</td>
<td>27.00</td>
<td>48.47</td>
</tr>
<tr>
<td>SD</td>
<td>36.45</td>
<td>36.91</td>
<td>24.16</td>
<td>41.07</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>df</th>
<th>Sums of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>PR</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>3</td>
<td>3768.85</td>
<td>1256.28</td>
<td>1.00</td>
<td>0.40</td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>56</td>
<td>70324.48</td>
<td>1255.79</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>59</td>
<td>74093.33</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 29
Summary Data and One-Way Analysis of Variance:
Pretest Scores from 10 Yards on A.A.H.P.E.R. Archery Skill Test

<table>
<thead>
<tr>
<th>Class</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>11</td>
<td>18</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>Mean</td>
<td>25.91</td>
<td>27.89</td>
<td>23.50</td>
<td>30.93</td>
</tr>
<tr>
<td>SD</td>
<td>29.09</td>
<td>26.05</td>
<td>21.35</td>
<td>27.98</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>df</th>
<th>Sums of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>PR</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>3</td>
<td>454.56</td>
<td>151.52</td>
<td>0.22</td>
<td>0.88</td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>56</td>
<td>37799.62</td>
<td>674.99</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>59</td>
<td>38254.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 30
Summary Data and One-Way Analysis of Variance:
Pretest Scores from 20 Yards
on A.A.H.P.E.R. Archery Skill Test

<table>
<thead>
<tr>
<th>Class</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>11</td>
<td>18</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>Mean</td>
<td>6.90</td>
<td>9.89</td>
<td>3.50</td>
<td>17.53</td>
</tr>
<tr>
<td>SD</td>
<td>10.74</td>
<td>12.11</td>
<td>4.49</td>
<td>15.29</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>df</th>
<th>Sums of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>PR</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>3</td>
<td>1620.43</td>
<td>540.14</td>
<td>4.19</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>56</td>
<td>7222.42</td>
<td>128.97</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>59</td>
<td>8842.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 31
Summary Data and One-Way Analysis of Variance:
Pretest Scores on Archery Knowledge Test

<table>
<thead>
<tr>
<th>Class</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>10</td>
<td>18</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Mean</td>
<td>17.00</td>
<td>21.44</td>
<td>19.83</td>
<td>20.40</td>
</tr>
<tr>
<td>SD</td>
<td>3.97</td>
<td>4.38</td>
<td>4.45</td>
<td>6.51</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>df</th>
<th>Sums of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>PR</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>3</td>
<td>130.01</td>
<td>43.34</td>
<td>1.74</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>53</td>
<td>1318.97</td>
<td>24.89</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>56</td>
<td>1448.98</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 32

**Summary Background Data**

<table>
<thead>
<tr>
<th>Class</th>
<th>n</th>
<th>Mean Grade</th>
<th>Mean Age</th>
<th>Sex</th>
<th>Prior Archery Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>16</td>
<td>9.3</td>
<td>15.1</td>
<td>12F/4M</td>
<td>4 students/1 unit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10 students/none</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 students/backyard shooting</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>9.2</td>
<td>15.3</td>
<td>3F/12M</td>
<td>7 students/1 unit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7 students/none</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 student/summer camp</td>
</tr>
</tbody>
</table>
Discussion

This part of Chapter IV considers five factors of the data deserving special attention. Each is addressed separately.

Correlations

The first section of this discussion focuses on the apparent discrepancies between correlations obtained with the total ALT-PE, opportunity to respond, and criterion trial data and correlations obtained with the same variables, but with data from distances of 10 and 20 yards figured separately. Scatterplots with the class as the unit of analysis were developed for visual inspection.

In Figure 12, total intervals of ALT-PE, opportunity to respond, and criterion trials were correlated. The correlations ranged from .66 to .99. The relative positions of each class were consistent for each correlation.

Correlations among intervals of ALT-PE, opportunity to respond, and criterion trials from 10 yards (Figure 13) and 20 yards (Figure 14) yielded higher correlations. Again, the relative positions of the classes were consistent for each correlation from that distance. However, the positions of the classes when shooting from 10 yards and 20 yards have changed from the positions when total data on the variables were analyzed. By examining Figures 13 and 14, it is obvious that Class 4 has changed positions.

Class 4 shot from 10 yards for five days, instead of four days, as Classes 1, 2, and 3. Class 4 also shot from 20 yards on only one day, instead of two, as Classes 1, 2, and 3.
Figure 12. Scatterplots on Process Variables' Totals Calculated with the Class as the Unit of Analysis.
Figure 13. Scatterplots on Process Variables from 10 Yards Calculated with the Class as the Unit of Analysis.
Figure 14. Scatterplots on Process Variables from 20 Yards Calculated with the Class as the Unit of Analysis.
This change in the relative position of Class 4, which was attributable to the data for the extra day from 10 yards and one less day from 20 yards, was the source of the discrepancies.

Although not included within this discussion, scatterplots with the student as the unit of analysis were also developed and revealed the same finding.

The second section of the discussion on correlations addresses the seemingly illogical relationships obtained with the class as the unit of analysis between posttest scores on the A.A.H.P.E.R. Archery Skill Test and the process variables, particularly from a distance of 10 yards (see Table 21). After consultation with a statistician (Ruland, 1983) in which scatterplots were examined, it was suggested that the results are peculiar to these data. With only four observations, the results are unstable and should be interpreted cautiously.

Unit of Analysis

The second section of this discussion considers the differences between correlations obtained with the class as the unit of analysis and with the student as the unit of analysis. In all instances, correlations achieved with the class as the unit of analysis were higher.

When both units of analysis are used, it appears that greater insight into the structure of the data is revealed. The use of class means alone does not allow one to know what really occurred within classes or with individual students. Johnston and Pennypacker (1980) state that the class mean does not necessarily represent any individual student within the class. In this particular study, substantially different correlations were obtained with each unit of analysis.
OTR and Criterion Trials Data

The seemingly high correlations between opportunity to respond and number of criterion trials may be peculiar to the data in this study. Since students only shot from distances of 10 or 20 yards, every opportunity to respond was a "potential" criterion trial. The word potential is used because while a student may have been provided with the opportunity to make a learning response, no response may have been forthcoming, therefore, no criterion trial.

Student Teachers

The four student teachers from The Ohio State University who served as teachers for this study were not necessarily representative of the quality of the University's preservice teachers. One student teacher received an unsatisfactory grade, and three, satisfactory grades. Of the three that passed the student teaching experience, two were questionable up until the time that grades were due.

OTR Refinement

ALT-PE is a refinement of the gross measure of motor engaged time. Opportunity to respond is a gross measure of a learning response. Although not the purpose of this study, each opportunity to respond was categorically refined and coded as an acceptable response, an unacceptable response, and no response. (The analogy of ALT-PE to motor engaged time is similar to acceptable response to opportunity to respond.) Total acceptable responses were correlated with total intervals of ALT-PE, which resulted in an r of .86 (unit of analysis = class). As was previously discussed, when total opportunities to respond were correlated with total intervals of ALT-PE, the correlation coefficient calculated was .66. When both refinements (ALT-PE as motor
appropriate engaged time, and acceptable response as an
appropriate learning response) were correlated, a very
high positive relationship was noted.

Summary

The data on observer agreement/accuracy measures and
representativeness of the sampling techniques were presented. The results for each research question were also presented, followed by a short discussion on possible discrepancies in the data.

Chapter V will summarize the study, present conclusions drawn from the results, and suggest future research directions.
CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to investigate the relationships among academic learning time-physical education, opportunity to respond, and number of criterion trials as process variables and their relationships to two measures of student achievement in high school archery classes instructed by student teachers. More specifically, this study attempted to answer the following research questions:

1. What is the relationship among academic learning time-physical education, opportunity to respond, and number of criterion trials?

2. Which of the three process variables is most highly correlated with student achievement as measured by the A.A.H.P.E.R. Archery Skill Test, after accounting for initial ability?

3. Which of the three process variables is most highly correlated with student achievement as measured by the Archery Knowledge Test, after accounting for initial ability?

4. If there are substantial interclass differences, which teacher and student process variables are the possible sources of those differences?
The review of literature indicated that ETUs are viable alternatives to large scale, large sample process-product research designs. The review also showed that process variables, such as ALT-PE, opportunity to respond, and number of criterion trials, hold promise as measures of teacher effectiveness and student achievement. The importance of product measures, such as written tests and skill evaluations, of student achievement in physical education were noted.

The first phase of the study involved arranging machine observation and recording. Four archery classes in the physical education program at a public secondary school in the central Ohio area served as the setting for this study. Archery was selected as the task to be used in answering the questions posed in Chapter 1. The four teachers in the study were student teachers from The Ohio State University whose assignment for their student teaching experience was the public secondary school. Students enrolled in physical education archery classes during the Spring Quarter, 1983, were students enrolled at the public secondary school. Two weeks prior to the time that the archery unit was scheduled to begin, an orientation meeting was held. Copies of the Archery Experimental Teaching Unit were distributed to each teacher and thorough explanations of the components of the unit (i.e., 15, forty-two minute teaching session) were provided. Sequencing of sessions and pre and posttesting conditions were also discussed. Details peculiar to the videotaping were organized and relevant information presented to the teachers.

The second phase of the study involved arranging human observation and recording. Once videotapes had been obtained, the investigator and two colleagues observed the tapes and recorded specific process variables relevant to the study. Three students from each class, selected on a
multi-criterion system, were observed and coded. The process variables coded were ALT-PE, opportunity to respond, and criterion trials. Six of the fifteen sessions for each teacher were coded because they involved data relevant to this study. Prior to coding the tapes observers were trained in the use of the Opportunity to Respond and Criterion Trials observation instrument. Coders of ALT-PE were already familiar with the observation instrument and, therefore, no training was necessary. During coding, observer agreement/accuracy measures were obtained on 12 of 24 lessons for ALT-PE and 14 of 24 lessons for opportunity to respond and number of criterion trials.

Descriptive statistics were used to summarize and analyze the data. Relationships among variables were examined using Pearson correlation coefficients and partial correlations. One-way analysis of variance was used to determine interclass differences.

Conclusions

The conclusions of this study are presented to coincide with the four research questions.

Questions

1. What is the relationship among academic learning time-physical education, opportunity to respond, and number of criterion trials? With the student as the unit of analysis, the following conclusions can be supported:

1.1 There was a very high positive relationship (.94) between total opportunities to respond and total number of criterion trials.
1.2 There was a moderate positive relationship (.56) between total intervals of ALT-PE and total number of criterion trials.

1.3 There was a substantial positive relationship (.43) between total intervals of ALT-PE and total opportunities to respond.

1.4 From 10 yards, there was a very high relationship among intervals of ALT-PE and opportunity to respond (.73), intervals of ALT-PE and number of criterion trials (.75), and opportunity to respond and number of criterion trials (.97).

1.5 From 20 yards, there was a very high relationship among intervals of ALT-PE and opportunity to respond (.80), intervals of ALT-PE and number of criterion trials (.79), and opportunity to respond and number of criterion trials (.95).

In summary, with the student as the unit of analysis there were moderate to very high relationships among the three process variables. With this data set, the variables, opportunity to respond and criterion trials, were measuring the same phenomenon.

With the class as the unit of analysis, the following conclusions can be supported:

1.6 There was a very high positive relationship among total opportunities to respond and total number of criterion trials (.99),
and total intervals of ALT-PE and total number of criterion trials (.70).

1.7 There was a substantial positive relationship (.66) between total opportunities to respond and total intervals of ALT-PE.

1.8 From 10 yards, there was a very high relationship among intervals of ALT-PE and opportunity to respond (.93), intervals of ALT-PE and number of criterion trials (.95), and opportunity to respond and number of criterion trials (.99).

1.9 From 20 yards, there was a very high relationship among intervals of ALT-PE and opportunity to respond (.92), intervals of ALT-PE and number of criterion trials (.86), and opportunity to respond and number of criterion trials (.99).

In summary, with the class as the unit of analysis there were substantial to very high relationships among the three process variables. With this data set, it appears that all three process variables, ALT-PE, opportunity to respond, and criterion trials were measuring the same phenomenon. Visual analysis of the graphic correlations tends to strongly support that conclusion.

2. Which of the three process variables is most highly correlated with student achievement as measured by the A.A.H.P.E.R. Archery Skill Test, after accounting for initial ability? With the student as the unit of analysis, the following conclusions can be supported:
2.1 The highest correlation (.24) was obtained between the total posttest skill scores and total number of criterion trials.

2.2 From 10 yards, the highest correlation was between posttest skill scores and criterion trials (.36).

2.3 From 20 yards, the highest correlation (-.04) was between posttest skill scores and intervals of ALT-PE.

In summary, with the student as the unit of analysis, the most highly correlated process variable with student achievement as measured by the A.A.H.P.E.R. Archery Skill Test was criterion trials.

With the class as the unit of analysis, the following conclusions can be supported:

2.4 The highest correlation (.99) was obtained between the total posttest skill scores and the total number of criterion trials.

2.5 From 10 yards, the highest correlation (-.70) was between posttest skill scores and opportunity to respond.

2.6 From 20 yards, the highest correlation (.99) was between posttest skill scores and opportunity to respond.

In summary, with the class as the unit of analysis, the most highly correlated process variable with student achievement as measured by the A.A.H.P.E.R. Archery Skill Test was criterion trials. This seemed to be the fairest conclusion based on the data. The relationships from the separate
distances, especially 10 yards, seemed illogical and should be interpreted cautiously.

3. Which of the three process variables is most highly correlated with student achievement as measured by the Archery Knowledge Test, after accounting for initial ability? With the student as the unit of analysis, the following conclusions can be supported:

3.1 The highest correlation (-.62) was obtained between the Archery Knowledge Test and total number of criterion trials.

With the class as the unit of analysis, the following conclusions can be supported:

3.2 The highest correlation (-.76) was obtained between the Archery Knowledge Test and total number of criterion trials.

4. If there are substantial interclass differences, which teacher and student process variables are the possible sources of those differences?

4.1 No significant differences were noted on any of the following achievement scores: Total posttest scores on A.A.H.P.E.R. Archery Skill Test; posttest skill scores from 10 yards; posttest skill scores from 20 yards; posttest scores on the Archery Knowledge Test, total pretest scores on A.A.H.P.E.R. Archery Skill Test; pretest skill scores from 10 yards; and pretest scores on the Archery Knowledge Test.
4.2 There was a significant difference (0.01) between the classes on the pretest skill scores from 20 yards. Classes 1, 2, and 3 were significantly different from Class 4. The greatest difference existed between Class 3 (M = 3.50) and Class 4 (M = 17.53).

**Recommendations**

Based upon the results of this study, the investigator proposes the following recommendations:

1. Systematic replication of this study utilizing larger classes and/or different age groups (i.e., junior high, elementary).

2. Modification of this archery ETU by the addition of a third objective on daily scoring and recording. The result would be performance records available for correlation with process variables as they occur.

3. Systematic replication of this study (or archery ETU with modification) utilizing experienced teachers and student teachers.

4. The development of additional ETUs, especially with closed skills.

5. Development of other product measures of student achievement in physical education.
6. Utilizing ETUs as an intervention; Solomon Four Group Design.

7. Utilizing different subgroups as the unit of analysis (i.e., high, medium, and low skilled students).

8. Utilizing ETUs with the cooperating teacher serving as the intervention.

9. Systematic replication of this study with access to an indoor area in which shooting is allowed.

10. The development of ETUs as tools for evaluating preservice education: program evaluation (the extent to which students learn the materials and skills introduced in the program) and program validation (the extent to which program components lead to increased student learning in schools).

11. Future studies to investigate the relationship between ALT-PE and acceptable response, as a refinement of OTR.

While this study has investigated the relationships among ALT-PE, opportunity to respond, and criterion trials and their relationships to two measures of student achievement, it is really just the first of many steps needed to enrich our understanding of how teacher and student process variables affect student learning in physical education.

It is clear that in order to improve, students must have opportunities to respond. The teachers in this study provided that opportunity and the students did improve. The
question remains as to whether they might have improved more if more specific instruction and feedback had been provided.

The results of this study seem to support the suggestion by Duffy and McIntyre (Doyle, 1983) that merely providing opportunities for practice cannot be equated with teaching. Teaching involves providing explicit instruction in how to do academic tasks. The teachers in this study provided their students with opportunities to respond and their students improved initially. Further improvement or refinement of the motor skill task required specific instruction and feedback. It appears that the teachers in this study did not provide such instruction and feedback.

A replication of this study with the addition of daily performance measures seems to be the next logical step. The answer to the question as to whether merely providing more opportunities to respond, or opportunities plus instruction and feedback should be forthcoming.
The ALT-PE System

ALT-PE is currently conceptualized as a two level, hierarchical decision system. The first level of the system requires a decision on the context of the setting under observation. This context decision is made by observing the class or squad as a whole. For each observation sample a decision is made as to whether the class/squad is in general content or in subject matter content. General and subject matter content categories form a facet (Dunkin & Biddle, 1977) in that all activity has to be codable into a category that is either general content or subject matter content.

The subject matter content is further subdivided into two areas, knowledge content and motor content. These two subdivisions also form a facet, in that all physical education content has to be classifiable into a knowledge or motor category. The context level categories are schematically represented below.

<table>
<thead>
<tr>
<th>Context Level Categories - ALT-PE</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Content</td>
</tr>
<tr>
<td>transition</td>
</tr>
<tr>
<td>management</td>
</tr>
<tr>
<td>break</td>
</tr>
<tr>
<td>warm-up</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

This first level decision in the ALT-PE system provides information concerning the context within which specific individual student behavior is occurring.
The second level in the decision sequence involves observations of individual learner involvement. The learner involvement decision is made by observing individual students. While the first level context decision focused on the class as a whole, requiring only one judgment representing the entire group observed, the decision at the learner involvement level requires separate judgments for each student included within the observation sample. The learner involvement level has two sets of categories which form a facet, meaning that everything individual students are doing has to be classifiable into one of the categories. One set of categories is subsumed under the descriptor not motor engaged. A second set of categories is subsumed under the heading motor engaged. The term "motor" as used in the learner involvement level categories refers to motor involvement with subject matter activities related to the goals of the setting. Thus, the categories under the heading not motor engaged may include motor activity, but not subject matter oriented motor activity. This distinction will be made more clear in the sections dealing with definitions and examples. The learner involvement level categories are schematically represented below.

<table>
<thead>
<tr>
<th>Learner Involvement Categories - ALT-PE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Not Motor Engaged</strong></td>
</tr>
<tr>
<td>interim</td>
</tr>
<tr>
<td>waiting</td>
</tr>
<tr>
<td>off-task</td>
</tr>
<tr>
<td>on-task</td>
</tr>
<tr>
<td>cognitive</td>
</tr>
</tbody>
</table>

The coding conventions for this two level decision system are straightforward. If a general content or subject matter knowledge category is
chosen at the context level, then the second level decision is from categories in the not motor engaged group. If a subject matter content category is chosen at the context level, then the second level decision utilizes the entire learner involvement category system. Any observation sample in which motor appropriate is chosen for the second level decision becomes one unit of ALT-PE.

To review, the ALT-PE system involves a group-focused context decision and an individually focused learner involvement decision for each observation sample. Those observation samples in which a subject matter content motor category is chosen at the context level and motor appropriate is chosen at the learner involvement level are ALT-PE samples. The decision system is summarized below on a step-by-step basis.

Step 1 Context level decision.
What is the context of the class? What is the class as a whole doing?

<table>
<thead>
<tr>
<th>Choices: General content</th>
<th>Knowledge</th>
<th>Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>transition</td>
<td>technique</td>
<td>skill practice</td>
</tr>
<tr>
<td>management</td>
<td>strategy</td>
<td>scrimmage</td>
</tr>
<tr>
<td>break</td>
<td>rules</td>
<td>game</td>
</tr>
<tr>
<td>warm-up</td>
<td>social beh.</td>
<td>fitness</td>
</tr>
<tr>
<td></td>
<td>background</td>
<td>fitness</td>
</tr>
</tbody>
</table>

Step 2 Learner involvement decision.
What is the nature of the individual learner's engagement?
What is the individual student doing?

<table>
<thead>
<tr>
<th>Choices: Not Motor Engaged</th>
<th>Motor Engaged</th>
</tr>
</thead>
<tbody>
<tr>
<td>interim</td>
<td>motor appropriate</td>
</tr>
<tr>
<td>waiting</td>
<td>motor inappropriate</td>
</tr>
<tr>
<td>off-task</td>
<td>supporting</td>
</tr>
<tr>
<td>on-task</td>
<td></td>
</tr>
<tr>
<td>cognitive</td>
<td></td>
</tr>
</tbody>
</table>
ALT-PE Category Definitions

Context Level

The first level of decision making focuses on the class as a whole (or a subset of the class) and is designed to describe the context within which student behavior is occurring. There are three major subdivisions at the context level — general content, subject matter knowledge content, and subject matter motor content.

**General Content**

refers to class time when students are not intended to be involved in physical education activities.

**SM Knowledge Content**

refers to class time when the primary focus is on knowledge related to physical education content.

**SM Motor Content**

refers to class time when the primary focus is on motor involvement in physical education activities.

Each of the three main subdivisions at the context level has categories which describe more specifically the nature of the setting within which individual student behavior is occurring. These categories are defined as follows.

**General Content Categories**

**Transition (T)**

Time devoted to managerial and organizational activities related to instruction such as team selection, changing equipment, moving from one space to another, changing stations, teacher explanation of an organizational arrangement, and changing activities within a lesson.

**Management (M)**

Time devoted to class business that is unrelated to instructional activity such as taking attendance, discussing a field trip, lecturing about appropriate behavior in the gymnasium, or collecting money for the yearbook.
Break (B)

Time devoted to rest and/or discussion of nonsubject matter related issues such as getting a drink of water, talking about last night's ball game, telling jokes, celebrating the birthday of a class member, or discussing the results of a student election.

Warm Up (WU)

Time devoted to routine execution of physical activities whose purpose is to prepare the individual for engaging in further activity, but not designed to alter the state of the individual on a long term basis, such as a period of light exercises to begin a class, stretching exercises prior to a lesson, or a cooling down activity to terminate a lesson.

Subject Matter Knowledge Categories

Technique (TN)

Time devoted to transmitting information concerning the physical form (topography) of a motor skill such as listening to a lecture, watching a demonstration, or watching a film.

Strategy (ST)

Time devoted to transmitting information concerning plans of action for performing either individually or as a group such as explanation of a zone defense, demonstration of an individual move, or discussion of how best to move the ball down a field.

Rules (R)

Time devoted to transmitting information about regulations which govern activity related to the subject matter such as explanation of the rules of a game, demonstration of a specific rule violation, or viewing a film depicting the rules of volleyball (time devoted to transmitting information about rules governing general student behavior in physical education are coded management).

Social Behavior (SB)

Time devoted to transmitting information about appropriate and inappropriate ways of behaving within the context of the activity such as explanation of what constitutes sportsmanship in soccer, discussion of the ethics of reporting one's own violations in a game, or explanations of proper ways to respond to officials in a game.
Background (BK)

Time devoted to transmitting information about a subject matter activity such as its history, traditions, rituals, heroes, heroines, records, importance in later life, or relationship to fitness.

**Subject Matter Motor Categories**

Skill Practice (P)

Time devoted to practice of skills or chains of skills outside the applied context with the primary goal of skill development, such as a circle drill in passing a volleyball, one against one practice of dribbling a basketball, exploration of movement forms, practicing the Schottische step, or practicing a particular skill on a balance beam.

Scrimmage/routine (S)

Time devoted to refinement and extension of skills in an applied setting (in a setting which is like or simulates the setting in which the skill is actually used) and during which there is frequent instruction and feedback for the participants — such as, a half-court five on five basketball activity, the practice of a complete free exercise routine, six against six volleyball (all with instructions, suggestions, and feedback during the scrimmage).

Game (G)

Time devoted to the application of skills in a game or competitive setting when the participants perform without intervention from the instructor/coach — such as a volleyball game, a complete balance beam routine, the performance of a folk dance, or running a half-mile race.

Fitness (F)

Time devoted to activities whose major purpose is to alter the physical state of the individual in terms of strength, cardiovascular endurance, or flexibility such as aerobic dance, distance running, weight lifting, or agility training (the activities should be of sufficient intensity, frequency, and duration so as to alter the state of the individual).

Learner Involvement Level

The second level of decision making focuses on the individual learner(s) and is designed to describe the nature of the learner(s) involvement in a more specific way. There are two major subdivisions at the learner involvement
level -- not motor engaged and motor engaged.

Not Motor Engaged

refers to all involvement other than motor involvement with subject matter oriented motor activities.

Motor Engaged

refers to motor involvement with subject matter oriented motor activities.

Each of the two main subdivisions at the learner involvement level has categories which describe more specifically the nature of the learner's involvement. These categories are defined as follows.

Not Motor Engaged Categories

Interim (I)

The student is engaged in a non-instructional aspect of an ongoing activity such as retrieving balls, fixing equipment, retrieving arrows, or changing sides of a court in a tennis match.

Waiting (W)

Student has completed a task and is awaiting the next instructions or opportunity to respond such as waiting in line for a turn, having arrived at an assigned space waiting for the next teacher direction, standing on a sideline waiting to get in a game, or having organized into the appropriate formation waiting for an activity to begin.

Off-task (OF)

The student is either not engaged in an activity he/she should be engaged in or is engaged in activity other than the one he/she should be engaged in -- behavior disrupting, misbehavior, and general off-task behavior, such as talking when a teacher is explaining a skill, misusing equipment, fooling around, fighting, disrupting a drill through inappropriate behavior.

On-task (ON)

The student is appropriately engaged carrying out an assigned non-subject matter task (a management task, a transition task, a warm up task) such as moving into squads, helping to place equipment, counting off, doing warm up exercises, or moving from the gym to a playing field.
<table>
<thead>
<tr>
<th>Cognitive (C)</th>
<th>The student is appropriately involved in a cognitive task such as listening to a teacher describe a game, listening to verbal instructions about how to organize, watching a demonstration, participating in a discussion, or watching a film.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motor Engaged Categories</strong></td>
<td></td>
</tr>
<tr>
<td>Motor appropriate (MA)</td>
<td>The student is engaged in a subject matter motor activity in such a way as to produce a high degree of success.</td>
</tr>
<tr>
<td>Motor inappropriate (MI)</td>
<td>The student is engaged in a subject matter oriented motor activity but the activity-task is either too difficult for the individual's capabilities or the task is so easy that practicing it could not contribute to lesson goals.</td>
</tr>
<tr>
<td>Supporting (MS)</td>
<td>The student is engaged in subject matter motor activity the purpose of which is to assist others learn or perform the activity such as spotting in gymnastics, feeding balls to a hitter in a tennis lesson, throwing a volleyball to a partner who is practicing set up passing, or clapping a rhythm for a group of students who are practicing a movement pattern.</td>
</tr>
</tbody>
</table>
APPENDIX B

OTR & NUMBER CRITERION TRIALS
CODING MANUAL
Introduction

This is the training manual which you will use to prepare yourself to utilize the Opportunity to Respond and Number of Criterion Trials Observation System. The system is designed for the observation and coding of videotapes of the specified lessons of this study.

Four tasks have been prepared to teach you to accurately code with this system. The tasks are sequenced in a step-wise fashion. Once Task 4 has been completed, you will be ready to code videotapes either independently or simultaneously with the investigator.
Task 1

On the next page you will find a list of opportunity to respond and number of criterion trials behavioral definitions. Study this list carefully until you can identify each behavior category and the corresponding definition.
Topographical Definitions:

Acceptable (A) - Archery shooting skill is classified as acceptable when it is executed in accordance with the topographical specifications for that skill. The skill must be performed at the appropriate time.

Unacceptable (U) - Archery shooting skill is classified as unacceptable when it is not performed in accordance with the topographical specifications for that skill. The skill may be performed at an inappropriate time.

No Response (NR) - The flow of the lesson is such that the target student is placed in a position that requires a specific shooting skill response. Placed in this situation, the target student does not perform the skill response. The target student may exhibit avoidance behavior (not making any attempt to shoot an arrow), espact behavior (moving away from the shooting line to select a different bow and/or arrow(s)), or may be out of the class or position and unable to respond.

Topography of Archery Shooting Skill:

**Stance**
- Standing position
- Straddling shooting line

**Nocking**
- One arrow laid across the arrow rest of the bow
- Bowstring held with top three fingers of the dominant hand

**Drawing**
- Bowarm extended fully toward target
- Bow held perpendicular to the ground
- String drawn back as directly as possible to anchor point

**Ancoring**
- Drawing hand/fingers or string physically touches face

**Aiming**
- Head oriented toward the target

**Releasing**
- Relax drawing fingers with hand reacting rearward

**Follow-through**
- Bowarm extended and stationary
Task 2

In the left hand column, you will find the behavioral definitions and shooting skill descriptions as they appear on the list you have studied. Read each definition and verbally indicate to the investigator the corresponding behavior category that would correctly fill the right hand column.

The criterion level for this task is 9 out of 10 items answered correctly.
<table>
<thead>
<tr>
<th>Definition</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Archery shooting skill is not performed in accordance with the topographical specifications.</td>
<td></td>
</tr>
<tr>
<td>2. Student exhibits avoidance behavior such as not making an attempt to shoot an arrow.</td>
<td></td>
</tr>
<tr>
<td>3. Student performs the skill at an inappropriate time.</td>
<td></td>
</tr>
<tr>
<td>4. Archery shooting skill is executed in accordance with the topographical specifications.</td>
<td></td>
</tr>
<tr>
<td>5. The student is placed in a position that requires a specific shooting skill response, and does not perform the skill response.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Descriptions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Student lunges toward target while shooting.</td>
<td></td>
</tr>
<tr>
<td>7. Student stands two feet behind the shooting line while shooting.</td>
<td></td>
</tr>
<tr>
<td>8. Student releases the arrow with the bowarm extended.</td>
<td></td>
</tr>
<tr>
<td>9. Student's drawing hand physically touches the chest.</td>
<td></td>
</tr>
<tr>
<td>10. Student holds the bow perpendicular to the ground while shooting.</td>
<td></td>
</tr>
</tbody>
</table>
Task 3

You will view and code a pre-selected video training tape focusing on one student. After each end, your codes will be informally compared to what the investigator has coded. Any problems or questions will be examined at this time.
Using a selected videotape, you will observe and code one student for the duration of the lesson. Your coding sheeting will be compared to that of the investigator. Any discrepancies will be reviewed and discussed.
APPENDIX C

ACTIVITIES EXEMPT FROM REVIEW BY
OSU HUMAN SUBJECT REVIEW COMMITTEE
ACTIVITIES EXEMPT FROM REVIEW BY
OSU HUMAN SUBJECT REVIEW COMMITTEES

Research activities in which the only involvement of human subjects will be in one or more of the following categories are exempt from review by an OSU Human Subject Review Committee. These exemptions do not apply when deception of subjects may be an element of the research, when the activity might expose the subject to discomfort or harassment beyond levels encountered in daily life, or when individuals involuntarily confined or detained in penal institutions are subjects of the activity. A judgment that a particular activity falls within one of the categories exempted from review should be made with care, especially when children are subjects of the activity. Questions of interpretation may be directed to 422-9046, from which callers will be referred to the chairperson of the appropriate review committee.

1. Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as:
   a. research on regular and special education instructional strategies
   b. research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods

2. Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), if information taken from these sources is recorded in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

3. Research involving survey or interview procedures, except where responses are recorded in such a manner that the human subjects can be identified, directly or through identifiers linked to the subjects, and either:
   a. the subject's responses, if they became known outside the research, could reasonably place the subject at risk of criminal or civil liability or be damaging to the subject's financial standing or employability, or
   b. the research deals with sensitive aspects of the subject's own behavior, such as illegal conduct, drug use, sexual behavior, or use of alcohol.

All research involving survey or interview procedures is exempt, without exception, when the respondents are elected or appointed public officials or candidates for public office.

4. Research involving the observation (including the observation by participants) of public behavior, except where observations are recorded in such a manner that the human subjects can be identified, directly or through identifiers linked to the subjects, and either:
   a. the observations recorded about the individual, if they became known outside the research, could reasonably place the subject at risk of criminal or civil liability or be damaging to the subject's financial standing or employability, or
   b. the research deals with sensitive aspects of the subject's own behavior such as illegal conduct, drug use, sexual behavior, or use of alcohol.

5. Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

Exempting an activity from review does not absolve the investigator(s) of the activity from ensuring that the welfare of subjects in the activity is protected and that methods used, and information provided, to gain subject consent are appropriate to the activity.

Form HS-106
Rev. (5/83)
APPENDIX D

BACKGROUND DATA
Table A

Background Data for Students in Class #1

<table>
<thead>
<tr>
<th>Student</th>
<th>Grade</th>
<th>Age</th>
<th>Sex</th>
<th>Prior Archery Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>16</td>
<td>F</td>
<td>1 unit</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>15</td>
<td>F</td>
<td>none</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>15</td>
<td>F</td>
<td>none</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>15</td>
<td>F</td>
<td>none</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>15</td>
<td>M</td>
<td>1 unit</td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td>15</td>
<td>F</td>
<td>1 week-day camp-6th grade</td>
</tr>
<tr>
<td>7</td>
<td>10</td>
<td>15</td>
<td>M</td>
<td>1 unit</td>
</tr>
<tr>
<td>8</td>
<td>10</td>
<td>17</td>
<td>M</td>
<td>1 unit</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>15</td>
<td>F</td>
<td>none</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>15</td>
<td>F</td>
<td>none</td>
</tr>
<tr>
<td>11</td>
<td>10</td>
<td>16</td>
<td>F</td>
<td>none</td>
</tr>
<tr>
<td>12</td>
<td>9</td>
<td>16</td>
<td>M</td>
<td>none</td>
</tr>
</tbody>
</table>

\* Students 1, 2 and 3 are target students

\*1 unit = 3-week instructional unit at the high school level
Table B

Background Data for Students in Class #2

<table>
<thead>
<tr>
<th>Student</th>
<th>Grade</th>
<th>Age</th>
<th>Sex</th>
<th>Prior Archery Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
<td>15</td>
<td>M</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>15</td>
<td>M</td>
<td>Backyard shooting for fun</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>16</td>
<td>M</td>
<td>1 unit</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>14</td>
<td>F</td>
<td>None</td>
</tr>
<tr>
<td>5</td>
<td>9</td>
<td>15</td>
<td>F</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td>15</td>
<td>M</td>
<td>1 unit</td>
</tr>
<tr>
<td>7</td>
<td>9</td>
<td>14</td>
<td>F</td>
<td>None</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>14</td>
<td>F</td>
<td>Camp</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>15</td>
<td>F</td>
<td>None</td>
</tr>
<tr>
<td>10</td>
<td>9</td>
<td>16</td>
<td>M</td>
<td>Backyard shooting</td>
</tr>
<tr>
<td>11</td>
<td>10</td>
<td>16</td>
<td>F</td>
<td>1 unit</td>
</tr>
<tr>
<td>12</td>
<td>9</td>
<td>14</td>
<td>M</td>
<td>1 unit + 1 year experience</td>
</tr>
<tr>
<td>13</td>
<td>9</td>
<td>16</td>
<td>M</td>
<td>1 unit</td>
</tr>
<tr>
<td>14</td>
<td>9</td>
<td>18</td>
<td>M</td>
<td>None</td>
</tr>
<tr>
<td>15</td>
<td>9</td>
<td>15</td>
<td>M</td>
<td>None</td>
</tr>
<tr>
<td>16</td>
<td>10</td>
<td>15</td>
<td>M</td>
<td>None</td>
</tr>
<tr>
<td>17</td>
<td>9</td>
<td>15</td>
<td>F</td>
<td>Camp-6 yrs. old</td>
</tr>
<tr>
<td>18</td>
<td>9</td>
<td>15</td>
<td>F</td>
<td>None</td>
</tr>
</tbody>
</table>

a Students 1, 2 and 3 are target students

b 1 unit = 3-week instructional unit at the high school level
Table C
Background Data for Students in Class #3

<table>
<thead>
<tr>
<th>Student&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Grade</th>
<th>Age</th>
<th>Sex</th>
<th>Prior Archery Experience&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>15</td>
<td>F</td>
<td>1 unit</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>15</td>
<td>F</td>
<td>None</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>15</td>
<td>F</td>
<td>None</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>15</td>
<td>F</td>
<td>1 unit</td>
</tr>
<tr>
<td>5</td>
<td>9</td>
<td>15</td>
<td>M</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>9</td>
<td>15</td>
<td>F</td>
<td>None</td>
</tr>
<tr>
<td>7</td>
<td>10</td>
<td>16</td>
<td>F</td>
<td>None</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>15</td>
<td>F</td>
<td>Backyard shooting</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>15</td>
<td>M</td>
<td>None</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>15</td>
<td>F</td>
<td>1 unit</td>
</tr>
<tr>
<td>11</td>
<td>9</td>
<td>15</td>
<td>M</td>
<td>None</td>
</tr>
<tr>
<td>12</td>
<td>9</td>
<td>15</td>
<td>F</td>
<td>None</td>
</tr>
<tr>
<td>13</td>
<td>9</td>
<td>14</td>
<td>F</td>
<td>None</td>
</tr>
<tr>
<td>14</td>
<td>9</td>
<td>15</td>
<td>F</td>
<td>1 unit</td>
</tr>
<tr>
<td>15</td>
<td>9</td>
<td>14</td>
<td>F</td>
<td>None</td>
</tr>
<tr>
<td>16</td>
<td>10</td>
<td>17</td>
<td>M</td>
<td>Backyard shooting</td>
</tr>
</tbody>
</table>

<sup>a</sup>Students 1, 2, 3 are target students

<sup>b</sup>1 unit = 3-week instructional unit at the high school level
Table D
Background Data for Students in Class #4

<table>
<thead>
<tr>
<th>Student(^a)</th>
<th>Grade</th>
<th>Age</th>
<th>Sex</th>
<th>Prior Archery Experience(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
<td>15</td>
<td>M</td>
<td>1 unit</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>16</td>
<td>M</td>
<td>1 unit</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>14</td>
<td>M</td>
<td>Summer camp</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>16</td>
<td>F</td>
<td>None</td>
</tr>
<tr>
<td>5</td>
<td>9</td>
<td>16</td>
<td>F</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>9</td>
<td>15</td>
<td>F</td>
<td>None</td>
</tr>
<tr>
<td>7</td>
<td>9</td>
<td>16</td>
<td>M</td>
<td>None</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>15</td>
<td>M</td>
<td>1 unit</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>16</td>
<td>M</td>
<td>1 unit</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>16</td>
<td>M</td>
<td>1 unit</td>
</tr>
<tr>
<td>11</td>
<td>9</td>
<td>15</td>
<td>M</td>
<td>None</td>
</tr>
<tr>
<td>12</td>
<td>9</td>
<td>14</td>
<td>M</td>
<td>None</td>
</tr>
<tr>
<td>13</td>
<td>9</td>
<td>16</td>
<td>M</td>
<td>None</td>
</tr>
<tr>
<td>14</td>
<td>9</td>
<td>15</td>
<td>M</td>
<td>1 unit</td>
</tr>
<tr>
<td>15</td>
<td>9</td>
<td>15</td>
<td>M</td>
<td>1 unit</td>
</tr>
</tbody>
</table>

\(^a\) Students 1, 2 and 3 are target students

\(^b\) 1 unit = 3-week instructional unit at the high school level
APPENDIX E

ARCHERY EXPERIMENTAL TEACHING UNIT
ARCHERY

Experimental Teaching Unit

TEACHER'S GUIDE

PHYSICAL EDUCATION DEPARTMENT
THE OHIO STATE UNIVERSITY
COLUMBUS, OHIO 43210
SPRING, 1983
The following information is included in this packet:

1. a brief overview of the unit,

2. a list of performance objectives for the students,

3. a list of archery resources (available in the physical education office); you may use what is included, select some from other sources, or create your own,

4. guidelines for using the unit, and

5. sample test items from the Archery Knowledge Test and a copy of the A.A.H.P.E.R. Archery Skill Test and score sheet.
Overview

A team of graduate students and faculty members in the Physical Education Department at The Ohio State University is in the process of studying pre-service teachers of physical education. Essentially, we are attempting to determine some of the reasons that physical education teachers are successful. We want to thank you, your cooperating teacher, and your pupils for helping us with this project.

Briefly, we are asking you to teach this unit to a specified archery class to which you have been assigned. The objectives of the unit are explained below. The pupils will be tested before and after the unit to determine how much they improved.

The students enrolled in archery will be graded pass/fail. While this unit contains both cognitive and psychomotor objectives, the primary focus is skill development in archery. Student evaluation will be determined as follows: skill, 60%; knowledge, 20%; and miscellaneous, 20%.

We only provide guidelines for the unit. Your job is to teach the unit the best way possible in your judgement, so that the pupils learn the most they can in the designated time for the unit.
Performance Objectives

1. On a 40 item written test the student should be able to identify:
   a. archery terminology,
   b. types of materials from which arrows are made,
   c. types of materials from which bows are made,
   d. various designs of bows, including the most popular and common designs,
   e. archery accessories, including armguards, finger tabs, and quivers,
   f. parts of an arrow, straight limb bow, and a standard 48-inch target face,
   g. various methods for measuring the correct length of arrows,
   h. various methods of stringing the bow, including the safest and best technique,
   i. historical facts about the bow and arrow,
   j. statements of bow, arrow, technique, and/or range safety,
   k. scoring rules for target shooting,
   l. safe methods for retrieving arrows, and
   m. shooting steps and their correct order.

2. With the equipment specified in the unit the student should be able to:
   a. shoot for the best possible score at a 48-inch archery target from 10 yards, and
   b. shoot for the best possible score at a 48-inch archery target from 20 yards.
Archery Resources


Unit Guidelines

This section will provide you with the information you need to plan for the days you actually teach the unit. It is divided into the following sub-sections: preparing for the unit, testing, teaching, and miscellaneous information.

Preparing for the unit

Essentially, you will have three major responsibilities prior to actually teaching the unit:

(1) Prepare for teaching the unit. You should plan for 15 teaching days in the unit. The length of the class period is 42 minutes, from the tardy bell to the end-of-period bell. A unit block plan and the first three days' lesson plans should be written and presented to the cooperating teacher before actual teaching begins. Once the unit begins, written lesson plans should be available to the cooperating teacher daily.

(2) Check the assigned teaching space. It is necessary that your outdoor, grassy area, not exceed 50 x 75 yards. An indoor gymnasium, not exceeding 46 x 96 feet, is also available for bad weather purposes.

(3) Arrange for the use of equipment. It is necessary that you use only 20 twenty-pound straight limb bows, 192 twenty-eight inch cedar arrows, 32 finger tabs,
32 armguards, 32 ground quivers, 5 targets (48-inch diameter, 9.6-inch bullseye, 4.8-inch concentric circles).

Testing

Pretesting. On the first day that students are to report to you for the archery class, we will begin testing. With your help, the cooperating teacher's, and the university team's, it will take a maximum of two class periods to test students on both a written test and a skill test. Individual student scores on both tests will be provided for you.

Prior to testing the students, we will also want you to take the A.A.H.P.E.R. Archery Skill Test and the Archery Knowledge Test. This will be done before the testing of the students begins (time and date to be specified later).

Posttesting. After you finish teaching the archery unit we will test the students once again. The testing format will be the same as that used in pretesting.

After the testing is completed we will want to meet with you to get information from you on questions like: (1) What materials did you use (either from the packet or your own)?, (2) What materials/activities worked well and which were less effective?, (3) What was the reaction of the students to the unit?, and (4) What was your reaction to the unit? This packet, your block plan, all lesson plans, and any other materials that you used during your teaching should be brought with you to this meeting.
Teaching

You will have 15 lessons, 42 minutes in length, to teach the unit described above. Prior to teaching each lesson we will place a wireless microphone on you in order to clearly hear your verbal instructions to the students. We will also video-tape each lesson. Because of technical and time limitations, we will not be able to show you the video-tapes at the school. We will be happy, however, to make arrangements for you to see the video-tapes at O.S.U. after the unit is completed.

Miscellaneous Information

The video-tapes of the unit lessons will be viewed by a number of researchers over the next few years. In attempting to preserve confidentiality of teachers, schools, and students, each will be assigned a number and referred to in this manner. Teachers, students, and the school will not be identified by name, except during the natural course of the lesson (i.e. "Don't forget to anchor, John.").

It is also possible that some of the video-tapes may be utilized in the teacher preparation program at this or other universities to assist other individuals to become better teachers. Only positive examples of teaching will be used in these instances and teachers, schools, and students will not be identified by name.

Thank you for helping us to further our knowledge of success in teaching physical education.
Sample test items from the Archery Knowledge Test

(1) _______cast________ The distance that a bow is able to shoot.

(2) "Stance" refers to
   a. assuming a comfortable position with your feet about shoulder-width apart.
   b. head held erect and facing directly at the target.
   c. extending the bow arm with the bow toward the target.
   d. all of the above
   c. a and b only

(3) + = true Do not point a loaded bow at anyone.

(4) grip

--- 4
A.A.H.P.E.R. Archery Skill Test

Purpose: To measure accuracy in shooting with a bow and arrow at a standard 48-inch archery target from Distance A - 10 yards, and Distance B - 20 yards.

Equipment:
- 5 - Standard 48-inch archery targets
- 24 - 20 pound straight limb bows
- 144 - 28-inch cedar arrows
- 24 - armguards
- 24 - finger tabs
- 24 - quivers
- 1 - line marker
- 2 - stakes
- 1 - measuring tape (100 feet)
- 20 - score cards
- 5 - pencils

Procedure: Each archer will shoot two ends at each distance. Each archer will take four practice shots at Distance A. Each archer will then shoot one end and be scored on these, and will wait his/her turn to shoot the remaining end. The archer will withdraw the arrows and the recorder will record the score of each arrow on the score card. The archer will shoot the remaining end. The same procedure will follow. After each archer has shot 12 arrows the total score at the distance will be recorded.
After the archer has completed shooting two ends at Distance A, s/he will move back to the second Distance B, take four practice shots, and again shoot two ends as before. The archer will straddle the shooting line while shooting. The method of aiming allowed is point of aim or instinctive method. The archer may adjust his/her aim during practice shots or testing, but no additional practice shots will be allowed for this purpose.

**Rules:**

1. The archer must straddle the shooting line while shooting.

2. Four practice shots at each distance are allowed.

3. The archer may adjust the point of aim during practice shots or during testing, but no additional practice shots for this purpose will be allowed.

4. Each archer shoots one end at a time, and then waits his/her turn to shoot the other end.

**Scoring:** Arrows hitting the gold circle count 9 points; red area, 7 points; blue area, 5 points; black area, 3 points; and the white area, 1 point. Arrows striking two colors count the value of the higher scoring area. Arrows striking the target but falling to the ground count 7 points, regardless of where they strike.
The maximum score at each distance is 108 points, and the maximum score for both distances is 216 points.
<table>
<thead>
<tr>
<th>Name</th>
<th>Name</th>
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<th>Name</th>
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</thead>
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<td>Round</td>
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<td>Team Score</td>
<td>Score</td>
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</tr>
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</table>
APPENDIX F

ARCHERY KNOWLEDGE TEST
**ARCHERY KNOWLEDGE TEST**

**NAME**

**GRADE**

**AGE**

I. DIRECTIONS: Place in the blanks the correct term that corresponds to the definition on the right.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>finger tab</td>
<td>1. six arrows.</td>
</tr>
<tr>
<td>quiver</td>
<td>2. the material worn on the archer's wrist and forearm to protect it from the bowstring.</td>
</tr>
<tr>
<td>end</td>
<td>3. the specific number of arrows to be shot at designated distances.</td>
</tr>
<tr>
<td>round</td>
<td>4. a receptacle designed to hold or carry arrows.</td>
</tr>
<tr>
<td>tackle</td>
<td>5. when an arrow contacts the target for a score.</td>
</tr>
<tr>
<td></td>
<td>6. the archer straddles this while shooting.</td>
</tr>
<tr>
<td></td>
<td>7. the distance that a bow is able to shoot.</td>
</tr>
<tr>
<td></td>
<td>8. an individual who participates in archery.</td>
</tr>
<tr>
<td></td>
<td>9. archery equipment.</td>
</tr>
<tr>
<td></td>
<td>10. the odd colored feather.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>trajectory</td>
<td>strike</td>
</tr>
<tr>
<td>armguard</td>
<td>cock feather</td>
</tr>
<tr>
<td>bowman</td>
<td>hen feather</td>
</tr>
<tr>
<td>cast</td>
<td>hit</td>
</tr>
</tbody>
</table>
II. DIRECTIONS: Place in the blanks the correct term that corresponds to the part of the arrow, bow, and target face indicated.

<table>
<thead>
<tr>
<th>gold circle</th>
<th>shaft</th>
<th>arrow rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>cock feather</td>
<td>fletching</td>
<td>arrow plate</td>
</tr>
<tr>
<td>hen feather</td>
<td>back</td>
<td>pile</td>
</tr>
<tr>
<td>crest</td>
<td>serving area</td>
<td>petticoat</td>
</tr>
<tr>
<td>grip</td>
<td>face</td>
<td>black circle</td>
</tr>
<tr>
<td>string height</td>
<td></td>
<td>shield</td>
</tr>
</tbody>
</table>

11. __________________
12. __________________
13. __________________
14. __________________
15. __________________
16. __________________
17. __________________
18. __________________
19. __________________
20. __________________
21. __________________
22. __________________
III. DIRECTIONS: Place a "+" in the blank next to each true statement about archery safety; place an "o" in the blank next to each false statement about archery safety.

23. A bow drawn without an arrow should not be released. +

24. It is safer to shoot with an arrow that is too short than with one that is too long. o

25. Arrows should be carried by the feathered ends. +

26. An arrow should not be drawn beyond the body of the bow. +

27. Do not point a loaded bow at anyone. +

28. When finished shooting it is O.K. to go to the target to check the score. o

29. A bow should be limbered properly. +

30. Check the string height on the bow before each use. +

31. Do not shoot aimlessly into the air. +

32. When retrieving an arrow from the target face stand to the side of the target to avoid hitting oneself with the end of the arrow as it is removed. +

IV. DIRECTIONS: Read each item. Select the best answer and circle the letter next to it.

33. Arrows are made from the following material(s):
   a. wood
   b. plastic
   c. fiberglass
   d. aluminum
   e. a, c, and d only

34. The most popular bow design is:
   a. straight limb
   b. working recurve
   c. stabilizer
   d. all of the above
   e. none of the above
35. Historically, the bow was
   a. man's first attempt at conserving energy
   b. an invention of survival
   c. an invention for recreational use
   d. all of the above
   e. a and b only

36. An arrow counts seven points if it
   a. hits the red circle on the target face
   b. rebounds off after hitting the scoring surface, if witnessed
   c. passes through the scoring face, if witnessed
   d. all of the above
   e. a and b only

37. The safest and best method(s) of stringing the bow is
   a. using a bracing instrument
   b. the step-through method
   c. the push-pull method
   d. all of the above
   e. b and c only

38. Choose the correct step-by-step shooting order:
   a. stance, nock, draw, anchor, aim, release, and follow-through
   b. stance, nock, aim, anchor, draw, release, and follow-through
   c. nock, stance, draw, anchor, aim, release, and follow-through
   d. nock, stance, aim, anchor, draw, release, and follow-through
   e. stance, nock, draw, aim, anchor, release, and follow-through

39. "Stance" refers to
   a. assuming a comfortable position with your feet about shoulder-width apart
   b. head held erect and facing directly at the target
   c. extending the bowarm with the bow toward the target
   d. all of the above
   e. a and b only
40. The correct length of arrows can be determined by using the following method(s)
   a. the arm spread measurement: extend the arms at shoulder height and measure from finger tips to finger tips; then follow the chart to find the length of arrow
   b. stretch the arms in front of the body with palms together: place a yardstick at the breastbone and measure from the chest to the finger tips; where the finger tips touch the yardstick indicates the length of the arrow
   c. take your shoe size and double it: that number indicates the length of the arrow
   d. draw a measuring arrow (marked in inches) in your bow: at full draw, your correct arrow length is measured at the front of the arrow shelf
   e. a, b, and d only
APPENDIX G

TALLY SHEETS
# ALT-PE Tally Sheet

## Class 

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157
### OTR & Criterion Trials Tally Sheet

**CLASS # ___**

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- **ACCEPTABLE**
- **UNACCEPTABLE**
- **NO RESPONSE**

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APPENDIX H

ACHIEVEMENT SCORES

FOR ALL STUDENTS
Table E
Achievement Scores For Class #1 On The Archery Knowledge Tests
And The A.A.H.P.E.R. Archery Skill Tests

<table>
<thead>
<tr>
<th>Student</th>
<th>Pretests Knowledge</th>
<th>Pretests Skill</th>
<th>Posttests Knowledge</th>
<th>Posttests Skill</th>
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<td></td>
<td>10 yds. 20 yds. Total</td>
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<td>1</td>
<td>22 35 0 35</td>
<td>36</td>
<td>78 44 122</td>
<td></td>
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<tr>
<td>2</td>
<td>15 0 0 0</td>
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<td>44 21 65</td>
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<td>3</td>
<td>9 12 0 12</td>
<td>29</td>
<td>16 20 36</td>
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Table F
Achievement Scores For Class #2 On The Archery Knowledge Tests
And The A.A.H.P.E.R. Archery Skill Tests

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Table G
Achievement Scores For Class #3 On The Archery Knowledge Tests
And The A.A.H.P.E.R. Archery Skill Tests

| Student | Pretests | | Posttests | | |
|---------|----------| |----------| | |
|         | Knowledge| Skill | Knowledge| Skill | |
|         | 10 yds.  | 20 yds. | Total | 10 yds. | 20 yds. | Total |
| 1       | 24       | 27     | 12    | 39      | 34      | 56     | 29     | 85     |
| 2       | 24       | 12     | 1     | 13      | 34      | 59      | 19     | 78     |
| 3       | 19       | 35     | 1     | 36      | 35      | 39      | 28     | 67     |
| 4       | 23       | 33     | 8     | 41      | 30      | 57      | 18     | 75     |
| 5       | 8        | 6      | 14    | 17      | 37      | 51      | 28     | 79     |
| 6       | 22       | 11     | 1     | 12      | 29      | 28      | 7      | 35     |
| 7       | 18       | 3      | 0     | 3       | 30      | 53      | 0      | 53     |
| 8       | 17       | 11     | 0     | 11      | 31      | 49      | 13     | 62     |
| 9       | 19       | 54     | 1     | 55      | 29      | 84      | 31     | 115    |
| 10      | 24       | 44     | 2     | 46      | 32      | 51      | 18     | 69     |
| 11      | 27       | 23     | 5     | 28      | 30      | 47      | 29     | 76     |
| 12      | 11       | 0      | 0     | 0       | 29      | 26      | 25     | 51     |
| 13      | 15       | 0      | 0     | 0       | 32      | 53      | 32     | 85     |
| 14      | 15       | 48     | 5     | 53      | 29      | 44      | 5      | 49     |
| 15      | 21       | 0      | 0     | 0       | 28      | 64      | 40     | 104    |
| 16      | 67       | 14     | 81    | 23      | 53      | 29     | 82     |
Table H
Achievement Scores For Class #4 On The Archery Knowledge Tests
And The A.A.H.P.E.R. Archery Skill Tests

<table>
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