EFFECTS OF THREE PRESENTATION FORMATS IN A PSI COLLEGE LEVEL BOWLING COURSE

by

Ronald N. Cregger

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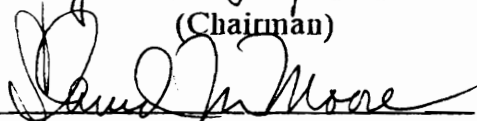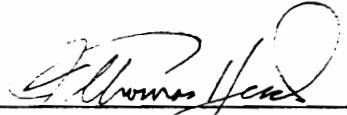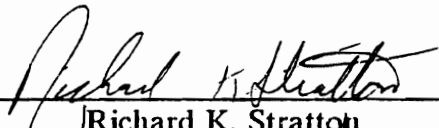in partial fulfillment of the requirements for the degree of

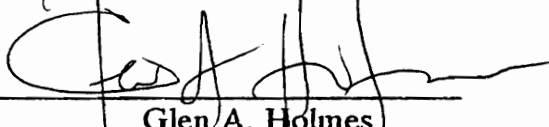## DOCTOR OF PHILOSOPHY

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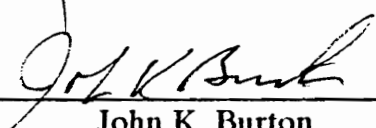**Curriculum and Instruction:
Physical Education Pedagogy**

APPROVED:

_____
Michael W. Metzler
(Chairman)

_____
David M. Moore

_____
Thomas J. Head

_____
Richard K. Stratton

_____
Glen A. Holmes

_____
John K. Burton

July, 1994
Blacksburg, Virginia

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Committee Chairman: Michael W. Metzler
Curriculum and Instruction: Physical Education Pedagogy

(ABSTRACT)

The purpose of this study was to examine differences in psychomotor learning using three different presentation formats for providing information and facilitating feedback applied in Keller's Personalized System of Instruction (PSI) in a college level bowing course. The course was taught as part of the Basic Instruction Program (BIP) at a large, Southeastern university.

Utilizing the principles of Russell's (1980) Novice Spare Conversion System specific sources of data were analyzed to determine significant differences which existed among and within three forms of presentation formats used for providing information related to converting common spares during the spare conversion unit of a beginning level bowling course. Based on results attained from comparisons of specific formats' unit skills tests and student perceptions, the study determined the effects of each presentation format as a means of presenting information as part of a PSI design in the psychomotor domain. The three presentation formats were: (a)

text (T), (b) text and static graphics (TG), and (c) text, static graphics, and animation (TGA).

The findings from this investigation focused on the examination of the effects of three forms of presentation formats applied in a specific course in the psychomotor domain. The effects of each format were examined by analyzing data of significant differences among presentation groups in ten comparisons related to their use for providing skill-related information and the facilitation of feedback in a spare conversion unit as a part of a PSI designed bowling course. Based on information gained from the ten comparisons eight were shown to display no significant difference among presentation formats.

Acknowledgements

Finally, I owe a special thanks to my parents, Bill and Glenda, who have provided me with support throughout my education. They have tolerated me during times when no one else would (or should have) and have always been there when I really needed someone.

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Chapter I

Introduction

The United States is witnessing a growth in the demand for physical activity. Higher education addresses this growth through Basic Instructional Programs (BIP) which provide students with exposure to the physical education curriculum (Trimble & Hensley, 1984). While no solid empirical evidence exists, the most common form of instruction in the BIP probably involves a single, conventional style of instruction. In discussing effective teaching strategies in K-12 physical education Siedentop (1991) refers to this conventional style of instruction as a "whole-class method" (p. 19).

Whole-class instruction is most commonly associated with Mosston and Ashworth's (1994) practice style of teaching. This instructional strategy is based on the teacher providing the whole class with skill related information and expecting all students to perform at the same level, without considering individual differences. However, meeting students' individual needs and interests should be uppermost if the acquisition of motor skills is to be a successful and enjoyable experience (Singer & Dick, 1974). If individual instruction cannot be realized, traditional methods of teaching must be reevaluated and alternative instructional approaches must be examined.

During a discussion on educational trends, a group of educational psychologists, Azzi, Bori, Sherman, and Keller, determined that "current teaching methods were sadly out of date" (Keller & Sherman, 1974, p. 7). Alternative methods of providing instruction are more likely to come from the Instructional Systems Development (ISD) model. McCombs (1986) describes ISD as offering a "process for achieving the goal of more effective and efficient instruction" (p. 67). One such alternative is Keller's Personalized System of Instruction (PSI) (Cregger & Metzler, 1991).

Learning tasks in PSI are designed as highly individualized activities within the class. PSI provides individualized instruction, allowing each student the opportunity to learn at his/her own rate, largely independent from the teacher. The teacher provides motivation through the use of several "key strategies" (Siedentop, 1991, p. 91). One of these key strategies is the use of the written word (text) to provide a form of personalized, immediate information and performance feedback.

Current teaching methods in most physical education programs require that large portions of class time are spent providing verbal information, reducing opportunities to engage in more active psychomotor learning (Siedentop, 1991). In PSI success is developed through many opportunities for practice trials with the instructor available for providing skill

information (cues) and feedback on the task being attempted. These cues and feedback are offered in the place of lecture/demonstration.

Keller's original PSI design emphasized the use of the written word to increase task performance by allowing teachers to concentrate on providing skill related information (Keller & Sherman, 1974). In a study of PSI in a college physical education course, Cregger and Metzler (1992) identify four design features which emphasizes use of the written word. One of these features is a low amount of lecture/demonstration time. By providing the students with general and managerial instructions in forms other than live lecture/demonstration, the teacher's time is freed to provide a greater amount of task related information. This information is based on individual needs and differences.

Text delivery in PSI appears to allow more efficient use of class time when compared to verbal instruction (Metzler, 1986, 1988). However, recent developments suggest the need to examine the effectiveness of PSI when information is provided in alternative presentation formats in the psychomotor domain (Cregger & Metzler, 1992).

Introduced in the early 1960s, PSI is based on five defining characteristics: (a) self-pacing, (b) mastery learning, (c) teacher acting as a motivator, (d) emphasis on the written word, and (e) student proctors (Keller & Sherman,

1974, p. 24). PSI does seem to offer potential as an effective alternative form of instruction (Cregger & Metzler, 1992). Regardless of PSI's potential very little research currently exists on its use in sport skill instruction. The value of PSI in promoting individualized instruction appears to show promise in university BIPs.

A reemergence of PSI has been demonstrated in several university physical activity courses (Cregger, 1991; Cregger & Metzler, 1992; Metzler, 1986, 1988). PSI appears to be well suited to address the differing abilities and interests of students enrolled in physical education. Tousignant (1983) describes the potential of PSI in physical education to address those differences, by using a "...go-at-your-own-pace system that permits the students to move through a course at a speed commensurate with their own abilities..." (p. 33). The features of sequenced learning, tasks leading to mastery criteria, increased attention to slower students, individual progression within and through units, and performance as the main focus, would seem to be advantageous for motor skill acquisition in physical education settings (Metzler, 1986).

Several forms of content presentation have been adapted for use in Keller's PSI in physical education BIPs. However, research on the differences among the attributes of various media in the psychomotor domain appear limited at best (Metzler, Eddleman, Treanor, & Cregger, 1989). In examining 81

physical education classes Fishman and Tobey (1978) suggested that gross movement skills offered a "unique opportunity" (p. 55) to use visual information. In order to promote performance as the main focus of PSI Metzler (1986, 1988) added graphic representations of tasks as an extra dimension to text task instruction. Cregger's (1991) PSI design of a college level volleyball course used diagrams to demonstrate common errors which may occur during performance.

The use of static diagrams of task components offers the learner the opportunity to use pictures as examples of the key movements involved in a skill. Markland and Martinek (1988) suggest that some form of visual component is important in providing information for beginners' acquisition of a motor skill. Furthermore, the use of pictures promotes self-pacing by accurately representing each movement so learners are not required to wait for the instructor's demonstration of the movement before progressing.

A second alternative form of presentation combines text and a form of animation. Often animation is provided through the use of recorded graphics and text (i.e. video tape and video discs) when providing instruction as a form of motor learning. Brooks and Koop (1991) describe the combination of videocassette recorders (VCRs), computer graphics, and computerized networks as an alternative to current methods of teaching and learning interactions. In a study of computer-

based instruction, Herrmann (1982) suggested the use of an interactive video program to provide course information as an alternative to proctors in a PSI designed introductory psychology course.

The idea of using graphic representations of a skill as a means of presenting instructional information is not new. May and Lumsdaine (1958) discuss the use of pictures in motor performance for military training. They further discuss the possible use of graphics (especially movies) and their potential as an alterative form of learning in the late 1950s. However, research is limited on graphics (especially animated graphics) as part of a PSI structured psychomotor unit.

Keller and Sherman (1974) justify use of the written word for presentation of information by describing text's ability to provide information in a clear, sequenced form. Current research suggests that instructional technology can be utilized to produce similar results in the distribution of information in the educational setting (Brooks & Koop, 1991).

With the advancement of educational technology the use of video tapes combined with graphic representations of movement skills has become a viable alternative for providing information. For psychomotor learning Cregger and Metzler (1992) suggest that graphics, especially animated graphics produced through videotapes and videodiscs, could be produced to present all the information now offered in other forms.

This study will look at instituting three types of presentation formats providing instruction in a PSI designed bowling course. As an "alternative to long-term, large sample process-product research design" (Graham, Soares, & Harrington, 1983, p. 3) the study focuses on implementation in a spare conversion unit as part of a PSI beginning bowling course. The purpose was to examine the differences in psychomotor learning effects among each of the three presentation formats and their various attributes when implemented in a college level PSI physical education course.

Purpose Statement

The purpose of this study was to examine differences in psychomotor learning using three different presentation formats as components of PSI. Each type of presentation format provided different attributes used as a part of the PSI design for giving learners information and a frame of reference for feedback on appropriate skill performance in converting common bowling spare combinations. These differences were determined by comparing the attributes of each presentation format within a PSI college level bowling course. The study utilized the principles of the Novice Spare Conversion System (NSCS) (Russell, 1980, p. 90) as the basis for providing instruction and determining feedback during the spare conversion unit of the course.

Research Question

Does a significant difference exist in psychomotor learning, as measured by mean percent of spares converted, among three different presentation formats applied in a spare conversion unit as part of a PSI college level bowling course?

Research Hypothesis

In the second chapter literature on the use of various forms of presentation is examined. The literature suggests that each presentation format offers different (and similar) attributes which may aid the student in understanding information related to task success.

Based on this review of literature, it is assumed that by combining several of these presentation formats an accumulation of attributes offer the learner an increased opportunity to develop the skills necessary to perform the task appropriately. Furthermore, it is assumed that the combination of text, static graphics, and animation represent a greater accumulation of media attributes, related to learning than do other presentation formats and/or format combinations (i.e. text and/or text and static graphics). This assumption leads to the hypothesis that:

Greater learning gains will occur when text, static graphics, and animation are combined as the presentation format during a spare conversion unit in a PSI designed college level bowling course.

Significance of the Study

Many studies have been completed on PSI in classroom settings. However, little research exists on PSI in physical education (Hymel, 1987). Keller (1974) identifies the use of the written word (text) as the appropriate method for providing individualized information in PSI. However, since the introduction of PSI instructional technology has made dramatic changes in the presentation of information and the attributes available to the designer. Clark (1975) states that media researchers have "...ignored the subtleties of individual differences." (p. 202).

In order to meet the individual differences (including learning styles) present in college level BIP's, the use of alternative forms of information presentation need to be addressed. This study examined the influences of changes in technology and focuses on alternatives to the written word in the presentation of skill-related information and the facilitation of feedback in PSI, specifically in a college level bowling course.

Student Limitations

The study was limited to 49 students enrolled in two beginning sections of bowling within a college level basic instructional program.

Teaching Limitations

1. Eight lanes were available for class use.

2.   One on-site computer (located at the bowling lanes) was available for the CAI part of the course.

3.   One teacher instructed both sections with one course proctor available during the spare conversion unit of the course.

Basic Assumptions

1.   These classes were typical of others in the Basic Instructional Program at this university and others.

2.   Student and teacher behaviors were representative of those behaviors when not being observed.

3.   The researcher-as-teacher did not bias the implementation of the PSI course.

4.   Students were familiar with the processes of PSI from prior units of the course.

5.   The students entered the course with various levels of bowling experience.

6.   All students received the same class instruction in the basic skills of bowling, prior to the spare conversion unit.

Summary

In summary, larger enrollments with less individualized instruction has become a trademark of the university Basic Instructional Programs (Miller, Dowell, & Pender, 1989). The problem of decreased individualized instruction has become evident in many of the activity courses offered in the basic instructional program, including beginning level bowling.

With the inability of conventional teaching methods to provide individualized instruction, alternative instructional designs need to be examined (Cregger & Metzler, 1992). One such alternative is Keller's Personalized System of Instruction. Evidence from earlier research (Cregger & Metzler, 1992; Metzler, 1986, 1988) suggests that PSI can provide several keys to learning in the psychomotor domain. There remain design features, however, which need further development if PSI is truly to be a viable alternative in psychomotor instruction.

One of the most promising avenues of inquiry appears to be the use of alternative forms of presentation formats for providing information. Keller (1974) describes the use of the written word (text) to provide students with individualized instructional information in promoting performance success. However, today's technology has led to several changes allowing for alternative means of presenting information for student learning.

One of the main features of PSI is the ability to free the instructor from routine managerial tasks, allowing for increased time to provide individualized information (Metzler, 1986). This study examined differences in psychomotor learning using attributes of three presentation formats in a spare conversion unit as part of Keller's PSI design in a college level bowling course.

Chapter II

Review of Literature

Current instructional designs may be failing to meet the educational needs of today's learners. Design research suggests that many students feel instruction has become boring and a well designed program appears necessary if instruction is to regain students' interest (Tinning & Fitzclarence, 1992). Literature on teaching proposes that if the learner is to regain an interest in learning an alternative method of instructional design and information delivery should be implemented (Keller & Sherman, 1974).

The purpose of this chapter was to review the literature related to an alternative instructional systems design, specifically Keller's Personalized System of Instruction, and the application of three presentation formats for delivering information as part of the design. Literature was reviewed from four areas: (a) Keller's Personalized System of Instruction, including its development, characteristics, and use in the psychomotor domain; (b) the use of written text as a presentation format in the education setting; (c) the use of static graphics and pictorial representations as a presentation format in the educational setting; and (d) the use of animation as a presentation format in the education setting.

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Information will be divided into three major categories:

      1) Instructional design

      2) Keller's Personalized System of Instruction

      3) Presentation formats

Instructional Design

"Instructional design is a prescriptive science because its primary purpose is to prescribe optimal methods of instruction" (Reigeluth, 1983, p. 21). To date, most research and development of such instructional systems has focused on teaching and learning outcomes in the cognitive domain, with relatively little work in the motor domain (Hymel, 1987). Very few design-based instructional systems have been developed for motor skills commonly taught in school physical education or sport programs (Reigeluth & Curtis, 1987). However, the literature on teaching indicates the need for alternative instructional system designs (Keller, 1974). The development of a "linking science" between theory and the actual practice of education should provide a body of knowledge related to learning. This information would serve as a guide to learning if instruction is to be effective. Many students feel that instruction has become boring, and, as a result, they form a poor image of their own learning ability as they fail to learn what is being taught (Tyler, 1978). A well designed program is necessary if instruction is to become interesting to the teacher and the learner. In Instructional-

Design Theories and Models: An Overview of the Current
Status, Reigeluth (1983) referred to instructional design as
this "linking science" needed in education.

Instructional systems design begins with many base
decisions concerning the learner and how to provide
information in the most effective manner. These decisions
involve converting the subject matter to related patterns of
teaching and learning activities for a specific unit content
(Metzler, 1989). Gagne, Briggs, and Wager, co-authors of
Principles Of Instructional Design (1988), describe
instructional systems as a step-by-step process beginning with
a base of information that reflects identified goals
(Reigeluth, 1983). Research on instructional systems show
that these goals can be viewed in five major areas: (a)
design, (b) development, (c) implementation, (d) management,
and (e) evaluation.

Reigeluth (1983) defines instructional design as a
discipline that is concerned with understanding, improving,
and applying methods of instruction through the process of
deciding what methods are best for promoting desired results
in specific student populations. The purpose of any design
activity is to devise means for reaching the desired
educational outcomes of instruction in an optimal fashion.
Therefore, instructional design's relation to instructional
systems is to promote effective processes of instruction,

development, implementation, management, and evaluation (McCombs, 1986).

Keller's Personalized System of Instruction

Reiser's <u>Instructional Technology: A History</u> (1987) presents an overview of many instructional systems now in use for various domains of learning, including psychomotor and cognitive. One of these is Keller's Personalized System of Instruction (PSI), designed in the early 1960s.

Following a discussion of B.F. Skinner's principle of Analysis of Behavior (Holland & Skinner, 1961) and looking toward an introductory psychology program at the University of Brazil, Keller and his associates concluded that "traditional teaching methods were sadly out of date" (Keller & Sherman, 1974, p. 7). Keller, a psychology professor at Columbia University, suggested that if education was to improve, instructional design systems would need to be developed to improve and update methods of providing instructional information. Before introducing the course at the University of Brazil, Keller searched for a way in which instruction could follow a methodical pattern. The pattern should use previous success to reinforce the student to progress in a systematic manner toward a specified outcome. Keller developed such a system, called Personalized System of Instruction (PSI).

PSI was first used as an instructional system for a college level introductory psychology course. PSI can be described as an interlocking system of instruction, consisting of sequentially, progressive tasks designed as highly individualized learning activities. In this design students determine their own rate and amount of learning, as they progress through a series of instructional tasks. PSI has five defining characteristics: (a) use of proctors, (b) mastery learning, (c) self-pacing, (d) teacher as motivator, and (e) use of the written word. These characteristics determine decisions made within the design (Keller & Sherman, 1974).

PSI shares some of the same characteristics common to Bloom's Learning For Mastery (LFM) model (Siedentop, Mand, & Taggart, 1986). Each task must be performed to a criterion established prior to the beginning of the course. Upon completion of each task, students have the option of moving to the next task or staying at that same task. Eventually the student must advance to the next task (Reiser, 1987).

Learning tasks are designed as highly individualized activities within the class. Students work at their own rate, largely independent from the teacher. The teacher usually provides motivation only through the use of cues and feedback on course content as students progress through the unit (Metzler, Eddleman, Treanor, & Cregger, 1989).

One of the strongest advantages of PSI is the freedom it provides for the instructor. The instructor is no longer responsible for many of the day-to-day aspects of providing managerial and content information and modeling demonstrations. This enables students to have more time to practice the skills in the unit. The instructor's main roles in PSI are: (a) designing the overall plan for the unit, (b) implementing the design, (c) managing the resources necessary for the class, and (d) conducting systematic analysis of instructional processes and learning outcomes (Metzler, 1989).

Keller first experimented with PSI using just two high school seniors and one college freshman. At the completion of the course all three students expressed a desire to be instructed under PSI over traditional designs (Keller & Sherman, 1974). Their only complaint was the lack of opportunity for discussion. PSI was used as a course design for the first time at the University of Brazil in a course entitled, "An Introduction to Reinforcement Theory." At the end of the course, students viewed PSI as a desirable alternative and would take other classes in that manner if given an option (Keller, 1968). Due to a "university crisis" in Brazil, the course was dropped and the professors went different directions. In 1965, adding proctors to aid in class discussions, Sherman and Keller put the program into practice at Arizona State University as an instructional system design.

PSI in Education

Research on PSI in the classroom setting has been extensive (Hymel, 1987). Often it has been limited to comparisons with designs using conventional strategies. It has been demonstrated that PSI and similar mastery-based instruction can be extremely effective in producing significant gains in student achievement. Therefore, the largest part of the available research centers around PSI as a mastery-based system and its comparisons to other systems which share common characteristics. Due to these limitations of existing research, PSI in education will be examined through comparisons with other systems in education and systems with common characteristics which have been employed as cognitive learning strategies.

Often PSI research focuses on comparisons to Bloom's Learning For Mastery (LFM) (Bloom, 1971). LFM and PSI share a few characteristics (Metzler, Eddleman, Treanor, & Cregger, 1989), among these are the use of mastery learning, increased teacher freedom, and increased student skill practice time. In both systems, each task must be performed to a criterion determined prior to the beginning of the course.

Reiser (1987) points to the similarity between LFM and PSI in the method of student progression through the systems. Upon completion of each task, the student is given the choice of advancing or continuing work within that unit. However,

whereas PSI allows the student to continue working on the same task until mastery is reached, LFM recommends a "looping-back" to a previous lesson and proceeding forward from that point (Bloom, 1971).

This similarity extends to PSI's use of providing information to the learner in small chunks, or tasks, with frequent assessment of these smaller learning units (Siedentop, Mand, & Taggart, 1986). These chunks are built on simple tasks, to allow the learner success before advancing to more complex tasks. As in PSI, success is developed through many opportunities for practice trials with the instructor providing cues and feedback on the task being attempted. These cues and feedback are offered in the place of lectures and demonstrations. Though Bloom's LFM approach shares many similarities with Keller's design, PSI actually extends the concept of mastery to include attention to the individual student as he/she progresses through the sequence of learning tasks (Reiser, 1987).

Another system used in the educational classroom setting, which bears similarities to PSI, is the Audio-Tutorial approach, developed for teaching Botany (Postlewait & Novack, 1967). As in PSI, Postlewait's Audio-Tutorial approach places emphasis on independent study in which students carry out individual work assignments at their own pace by the extensive use of tapes and films. These materials were developed as

motivational tools. Postlewait saw a dramatic improvement in grades and a decrease in the number of failures when using this independent progression (Postlewait & Novack, 1967). In comparing Postlewait's approach to his own PSI, Keller points to increased interest and greatly improved performance in classrooms where this technique was employed (Keller, 1968).

Comparative studies of instructional designs (or systems) have pointed to the positive effects produced by a personalized system of instruction in the classroom setting. Willett, Yamashita, and Anderson (1983) compared various instructional systems used in teaching science in grades kindergarten through twelve in a meta-analysis of instructional systems. The study addressed the question, "What are the effects of different instructional systems used in science teaching?" (Willett, Yamashita, & Anderson, 1983, p. 405). In this study instructional systems were defined as "...a general plan for conducting a course over an extended period of time. The plan is general in that it encompasses many aspects of a course (e.g. presentation of content, testing, size of study groups)" (Willett, Yamashita, & Anderson, 1983, p. 406).

In an extensive review of literature related to the study of science in education from 1950 to 1983, twelve systems of instruction were examined. Each system was coded under eleven sections, including some outcome characteristics and effect size calculations. Broad conclusions were drawn from this

study. PSI and it's characteristic mastery-based learning was identified as the most innovative and successful system for cognitive and overall achievement. Also, PSI's property of self-paced instruction appears to use time more efficiently and effectively (Willett, Yamashita, & Anderson, 1983). In examining these results, the analysis substantiated its claims by pointing to work done by Kulik and Kulik (1979) which identified PSI as being useful at the college level and that the key characteristics of a successful instructional system were frequent testing and immediate feedback. From the research completed on the use of PSI as an instructional system in the cognitive domain, it appears that PSI is a viable alternative to many instructional design systems currently employed in the classroom setting.

PSI in Physical Education

Singer and Dick (1974) point to the varying needs of students and suggested that individualized instructional opportunities must be provided in order to meet these needs. Very little research has been completed on the acquisition of motor skills in physical education and related activities using mastery-based learning designs (Hymel, 1987). Metzler (1988), points out that, "Regardless of claims made for or against the effectiveness of Mastery-based learning, the arena for the debate has been almost exclusively based in the cognitive domain..." (p. 3). Furthermore, Reigeluth and

Curtis (1987) noted that instructional systems development (ISD) in the motor domain has been centered on skills related to industrial and military applications, with very few instructional systems being applied to physical education. However, Singer and Dick's position that individualized instructional opportunities are necessary in education has led to the examination of PSI as a design form which can meet student needs through independent learning progressions.

Students have varying abilities and interest in physical education. Tousignant (1983) describes the potential of PSI in physical education to address those differences, by using a "...go-at-your-own-pace system that permits the students to move through a course at a speed commensurate with their own abilities..." (p. 33). The features of sequenced learning, tasks leading to mastery criteria, increased attention to slower students, individual progression within and through units, and performance as the main focus, would seem to be advantageous for motor skill acquisition in physical education settings (Metzler, 1986).

Metzler (1986) examined the effectiveness of PSI by comparing a group of 64 college students enrolled in basic tennis classes. Students were divided into two course sections, one taught with PSI, the other taught with a Demonstration-Group Practice style. The results showed no significant difference in the amount of student-paced instruction. PSI students had a higher amount of PE content

allocation (96.7%) than the traditional students (90.5%). However, the nature of content engagement did favor PSI. Due to the individually-paced content practiced in PSI, those students had significantly higher gain scores (51.7% to 41.3%) than the traditional groups. Metzler (1986) concluded that the results indicated the potential of PSI in physical education to: "...1) attend to individual student skill progression, 2) foster better use of allocated time, 3) allow students more practice time on motor play skills, and 4) promote greater success when practicing those motor play skills." (p. 7)

To expand the research base on PSI in the motor domain Metzler (1988) continued his research by looking at student process and achievement in a basic college tennis course. Sixteen sections were included (8 "conventional" and 8 PSI) between 1984 to 1987. One group had PSI, consisting of 33 criterion tasks covering forehand, backhand, rules, and some match play. Another group received their instruction under a strategy in which a designated number of meetings (between 2 to 4) were allocated for each stroke or course unit. This group was labeled as "conventional." The results indicated that the PSI classes had significantly more student-paced instruction, instructional content, total engagement, motor appropriate trials, and successful motor trials. It was also evident that PSI students received more tasks with explicit

directions and criteria, whereas the conventional instruction students often practiced on their own. PSI students had a higher motor trial success rate (86.4% to 65.7%), scored significantly higher in three of four dependent achievement measures, indicating the effectiveness of PSI in that motor skill setting. Metzler (1988) concluded that PSI resulted in a more efficacious pattern of class time involvement than did the "conventional" strategy.

The few completed physical education studies suggest that PSI allows students to be more motivated and to increase their in-class participation (Tousignant, 1983). PSI appears to increase interest in the content and achieves greater results than other systems in the motor skills domain. However, as stated earlier, the purpose of examining various methods of instructional design is to produce knowledge about optimal "blueprints" for diverse methods of instruction, combinations of methods, and situations in which each of those models are most useful (Metzler, 1989). Tousignant (1983) has pointed out the variation that exists within each physical education class and activity. If PSI can promote better results across many activities and domains. it must be examined in a variety of content and grade levels. Since allocated time in physical education class is usually limited, it is necessary to monitor the use of PSI as an instructional strategy in physical education (Metzler, Eddleman, Treanor, & Cregger, 1989).

The majority of research in physical education learning has focused on the instructor who implements the design, rather than the instructional design itself. However, research using the characteristics present in the system does exist (Keller & Sherman, 1974). The results of the characteristics of PSI implemented in a physical activity were available and have been examined. These results were separated into two categories - psychomotor and cognitive domains.

Psychomotor Domain. Literature comparing PSI to conventional teaching strategies demonstrates a decidedly higher success rate established for PSI students when implemented in the psychomotor domain (Metzler, 1989). Competency-based instruction offers similarities to PSI, and has been used to examine the effectiveness of established criteria and individually paced progression in physical activities in physical education.

Viera and Ferguson (1986) demonstrated the use of competency based instruction in a skills class designed for college physical education majors. PSI and competency based instruction have many similar design characteristics. These include: (a) students are made aware of criteria for passing tasks, (b) pacing was based on ability level and time was allowed to reach goals according to individual abilities, and (c) students begin work at entry level skills and progressed toward the desired level of performance as the course

dictates. As with PSI, competency is determined through mastery and students work toward a terminal criterion goal by going through a series of progressive tasks. Viera and Ferguson (1986) pointed out advantages of the qualities present in PSI that will influence psychomotor performance outcomes using a competency based model. Among these, students work on their own immediately upon entering the gymnasium, without having to wait for teacher directions. This reduces time spent in management, allowing students to receive a greater amount of practice on the activity tasks needed to achieve mastery.

Also, Viera and Ferguson (1986) found that when prescribed goals were presented, students worked conscientiously toward these goals and took advantage of all available class time to practice their skills. They also use out-of-class time to perfect these skills to enable criteria to be reached faster.

Cognitive Domain. Keller (1954) points out the importance of the cognitive domain in physical activities by saying, "...it is not probable that skills involve a form of purely motor learning" (p. 27). He further suggests that cognitive processing must be involved in order for a physical task to be mastered (Sahakian, 1976). Keller's experimentation at the University of Brazil and Columbia University offered evidence that cognitive outcomes could be developed using PSI as an instructional design. However,

little of the research on these cognitive outcomes focus on the use of the cognitive strategies in physical activities (Hymel, 1974). Too often the importance of the cognitive domain in learning physical activities has been ignored.

The research that does exist often refers only to rules and scoring content, rather than cognitive processes related to movement patterns which need to be developed to successfully achieve psychomotor skills in the course. Vickers (1990) points out that the cognitive aspects of any instructional design for the psychomotor domain should also focus on moves during a skill and how to put that skill into an organized form of action. Knowledge structures identify the skills and movement strategies in any activity, including psychomotor activities. Sport pedagogy has shown how concepts in the cognitive domain can aid skill performance (Vickers, 1990). In order for PSI to be viable as an instructional design in physical education, the cognitive aspects of the course must be included in the course design.

Media Presentation Formats

Much of the research on technology has emphasized its capabilities to provide information in a form which will increase student performance and "...bring about more effective instruction" (Ellington & Harris, 1986, p. 56.). Media in educational technology refers to the form in which the information is delivered to students in the learning

situation. Seels and Glasgow (1990) define media as, "...the means by which information is presented and experiences shared." (p. 181). Clark (1983) identifies media as the key component in providing delivery of information in different forms and to a diverse group of audiences.

Media researchers have long experimented with various forms of teaching aids which promote increased learning. Although many studies have claimed to illustrate performance increases with various forms of media, researchers have ignored students' needs based on individual differences (Clark, 1975). Siedentop (1991) states that instruction needs to be "..sensitive to the characteristics of the learners" (p. 227). However, despite this increasing awareness of the importance of individual differences, and instructional design's ability to address these differences, reviews of research on presentation methods generally conclude that very little usable empirical information has been generated (Kozma, 1991).

Clark and Snow (1975) concluded that past design research focuses on a traditional method of instruction as the predominant method of design, rather than examining alternate methods of presentation within the design. Much of the information is presented in verbal or auditory form. In a study comparing occurrences of prescriptive information during physical activity classes the predominant presentation format

was verbal or auditory (Pieron, 1984). In order to meet these individual differences Clark (1975) suggests media research begins to look at the use of alternative methods of presentation of instruction and the possible benefits alternative formats may offer.

Since the inception of PSI in the 1960s technological advancements have provided an opportunity to explore alternatives in the way information is presented. This section examines the use of three alternative presentation formats in the delivery of information and the attributes of each in education and PSI. These three presentation formats are: (a) text, (b) graphics and pictures, and (c) animation.

Text

Kozma (1991) begins his discussion on the value of text by stating, "The most common medium encountered in school learning is the book" (p. 182). Kozma (1991) describes the medium as the process or device through which information is delivered or presented. Books as a medium provide the majority of information in the educational setting and much of the instructional content of books appears in that form (Kozma, 1991).

Text provides several attributes which make it a valuable learning tool when implemented as part of instructional design in education. According to Kozma (1991) text is presented in a stable, unchanging format. Based on the stability of text

Kintsch (1988) identified two interrelated ways in which the learner uses text to produce appropriate mental representations. Each of these ways (understanding and reexamining skill component operations and identify information deemed most valuable) acts as an attribute when text is used as the presentation format.

In text, stability provides the basis for two positive attributes in its use as a format for the presentation of information. The first of these attributes is allowing the learner to develop an understanding of the operations of the various components within a skill and allowing the learner the opportunity to review and reexamine the information and progress at a rate commensurate with the difficulty (or simplicity) of the information being presented (dependent upon the existing knowledge-base of the learner). As with other presentation formats, text provides the learner with information which is designed to produce a mental representation of the components' relationship within the task or skill described. By understanding and reviewing this relationship the learner is often able to construct a mental picture of the complete skill. Text presentation allows the mental picture to be reexamined as many times as necessary in order to understand the relationship of the elements, thereby producing an understanding of the total concept.

The second attribute based on the stability of text allows the learner to begin to understand the parts of the action and focus on the information which the learner deems most valuable in the overall meaning of the information (Kozma, 1991). In a study observing the reading patterns of seven physicists Bazerman (1985) indicated that when reading informational text related to their field, they were able to be selective in the information on which they focused. According to Bazerman (1985) each member of the group focused on the material they deemed most valuable for their individual needs. Each learner reported spending less time on information they were more familiar with and reviewed information that was unfamiliar (or deemed less valuable).

A study conducted by Kuntz, Drewniak, and Schott (1989) indicated that when comparing a group of university students receiving text information with or without graphic representations or diagrams students with a greater domain knowledge appeared to rely more on the text presentation. Students with a greater domain knowledge of the task based responses on their own mental representations dependent upon their experiences and the text information. Conversely, those with a lower level of prior knowledge required the use of pictures and/or diagrams to perform the tasks (Kuntz, Drewniak, & Schott, 1989).

Kozma (1991) suggests that text is valuable as a presentation format, however the rate at which information is

acquired is often dependent upon the knowledge-base the learner brings to the presentation. Current media research recommends that when designing instruction using text, the material should be presented in a way which supports and facilitates learning based on the prior domain knowledge students bring to the course (Kozma, 1991).

Text in PSI. The PSI characteristic of emphasis on the written word promotes several positive features. These features are: (a) reduced amount of lecture/demonstration, promoting increased amount of time in skill practice; and (b) increased individualized instruction resulting in more efficient use of allocated class time by the students (Cregger, 1991).

Originally PSI was designed to increase individualized instruction by allowing the instructor (or proctor) to work with students on an individual basis rather than spending time conducting whole-class managerial tasks (Cregger & Metzler, 1992). Keller's design emphasizes the written word (text) in order to free the teacher and meet the goals of increased individualized instruction (Keller & Sherman, 1974).

Emphasis on the written word in PSI suggests the use of text information rather than a verbal presentation (Keller & Sherman, 1974). Students are responsible for following instructions provided on task sheets, and learning task sequences and policy guides, rather than waiting for the instructor's verbal instructions. The teacher is available to

elaborate on the information provided in the written materials and to motivate learners' performance.

Metzler, Eddleman, Treanor, and Cregger (1989) used written material in PSI as the major source of information when implementing PSI in a college level tennis course. Studies of PSI in the motor domain have demonstrated that PSI written materials in text form allows for more efficient use of class time and increased student motor engagement (Cregger & Metzler, 1992; Metzler, 1988, 1986).

In summary, it appears that the major strengths (attributes) of text in PSI are based on the stability text provides in presenting the appropriate information. Keller (1974) validates the value of text by using the written word as one of the defining characteristics of PSI.

Static Graphics

Several instructional strategies and designs currently exist in education for teaching psychomotor skills (Harrison & Blakemore, 1992). Each of these offer an opportunity to employ various types of media to promote effective learning. Clark and Snow (1975) described media's function in the presentation as delivery of information to the learner. One method of media used for presenting instructional information is the use of pictorial/graphic representations (visual aids).

In discussing the value of visual aids Pieron and Delmelle (1984) described pictorial graphics as, "...helpful

to provide learners with a model to reformulate their motor plan." (p. 195). However, a limited amount of research exists on the use of static graphics presenting information in a PSI design in the psychomotor domain. Much of the use of visual representations as part of information presentation in education has been limited to learning in the cognitive domain. Although experiments in the cognitive domain appear to dominate the literature many of the same characteristics and principles (i.e. modeling, sequential movement patterns, spacial relationships) appear to exist in the delivery of information in physical education.

The first attribute of static graphic presentations is its contribution to the development of conceptual maps. Winn (1983) identifies educational literature concerned with the effects of graphic materials related to cognitive processing. Winn (1983) describes this cognitive processing in education as the development of conceptual maps of what is being learned. Kozma (1991) suggests that the use of pictures can aid in the learner's understanding of unfamiliar information. The student's ability to understand the basic concepts can be developed by examining pictorial representations of the task.

The second attribute is the ability of graphics to provide the learner with an outline of the task/skill to be performed. Kozma (1991) describe the use of graphics as offering an opportunity to provide an outline to aid the

learner's understanding of new information as it fits into their existing knowledge base.

The third attribute of static graphics is the ability to facilitate the storage of information which the learner deems most beneficial when dealing with new or unfamiliar skills or knowledge (Kozma, 1991). Much of the earlier studies on the use of graphics focused on its value in conjunction with text and especially in the areas of reading comprehension and the physical sciences (Winn, 1983; Rieber, 1989; Juaire & Pargman, 1990).

Another attribute of graphics is its ability to provide the learner with a visual model of the performance or task being attempted. Rieber (1989) suggests that graphics can be used to aid students in making mental visualizations, whereas, text requires the student to reconstruct mental images based on past experiences alone. Studies in education identify graphic's ability to provide the learner with an understanding of spacial relationships and semantic differences (Rieber, 1989). Rieber (1989) suggests that the relationship to distances is more readily understood by the learner if placed in a graphics context. As in the acquisition of movement skills, the learner often is unable to determine relationships due to an inadequate or misunderstanding of verbal or text descriptions. Less interpretation of meanings is required when students are provided with a visual example. Juaire and

Pargman (1990) promote the benefits of pictures in aiding understanding by referring to pictures as requiring less "mental gymnastics" (p. 201) and providing a simpler and more stable frame of reference.

In a review of fifteen years of research, Winn (1983) identified three properties of graphics impacting on learning. Each of these properties (attributes) are concerned with the use of graphics representations to define relationships among elements of learning. Winn (1983) identified these three attributes as: (a) distance among elements, (b) sequencing, and (c) orientation. Each of these properties provides demonstrations of graphics' use in the teaching-learning process.

The first of these, distance, refers to the learner's ability to understand the similarities and differences between two elements which make up a single piece of information (Winn, 1983). These decisions are based on the learner's ability to make judgments concerning the type of information being presented when comparing the concepts of each element. By comparing the various elements in a single piece of information the appropriate progression can be determined. Studies conducted by Winn (1983) demonstrated the use of graphic representation in improving the learner's ability to organize information following viewing the various elements of a single piece of information.

The second property, sequencing, allows graphic representations to provide the learner with a pattern which can be used to understand various information. In order for graphic materials to provide their greatest influence they must be presented at a level the learner can use and understand (Winn, 1983). By determining the sequencing of information the learner must develop a learning pattern which will lead them through the various elements contained in the information. By examining graphic materials and visual images the learner can begin to recognize a pattern which identifies a sequenced order and various elements contained in each piece of information. Graphic materials and images provide an example of a strategy which learners can use. Once this strategy is understood the learners can determine how the information is best processed and stored for later retrieval (Winn, 1983).

The final property, orientation, describes the position of various elements' relationship when developing the entire skill. Researchers have shown that visual display of elements in information can provide meaning and effect in learning (Winn, 1983). The use of graphics provides a model of the appropriate relationship of the elements within the completed shape of the task.

Graphics in feedback. Winn, Plattor, and Loosmore (1985) suggested that graphics can be used to illustrate and provide

a number of types of information, one of these can be described as feedback. In PSI the instructor is free to offer individualized instruction in the form of increased feedback (Cregger & Metzler, 1992). By providing feedback the student can focus on the psychomotor skills and concentrate on aspects of the activity which will produce success.

Graphic representations offer an alternative form of feedback designed to provide the learner with a realistic picture of the movement necessary for success. Pieron and Delmelle (1984) state that in order for instructors to be efficient they must have, "...an instantaneous capacity to analyze skill, to compare to the pupil's actual performance with an ideal model of the skill..." (p. 193). This ideal model can be provided through the use of feedback based on a visual representation of the skill. Braden (1982) suggested that graphics have the potential to provide clear, concise cues through visual representations leading to appropriate performance. Furthermore, Winn, Plattor, and Loosmore (1985) state that when graphics are used as an illustration "...it is their purpose to show as accurately as possible what something looks like." (p. 6).

In a study on the use of various forms of augmented feedback by high school volleyball coaches, Markland and Martinek (1988) illustrated the potential of visual feedback by observing that starting players received significantly more

audiovisual feedback than did non-starting players. If feedback is related to prescriptive information based on comparing previous performance to correct performance, then graphics can provide a visual comparison.

Graphics In Instructional Design. Any new acquisition of skills requires, in part, a form of presentation to understand the movements involved. Often the learner has no memory representation of the appropriate type of movement pattern required. In the acquisition of new skills graphics can act to enhance the learning process (Juaire & Pargman, 1990). Graphics offer information which can provide the learner with visual representations of these appropriate processes (movements). These representations provide a visual reference for skill performance. Juaire and Pargman (1990) suggests that pictures aid an individual's learning efforts in recognition and recall when teaching procedural tasks. Pictures can be used to present images of recognizable actions and can be compared to previous knowledge (Kozma, 1991). These comparisons often lead to the development of new representations of appropriate movement patterns.

Self-paced instruction often uses written instructions combined with pictorial representations to provide learners with task information. Graphics used to represent each stage in a task is a common strategy for sequential learning in instructional design. A review of graphic's use in education

suggests that early learning will probably be most effective when pictures are used to display the key movements involved in a skill (Kozma, 1991).

Juaire and Pargman (1990) describe pictures as being "user friendly" (p. 201). Pictures promote the self-pacing feature of several designs and can accurately represent each movement so the learners are not required to wait for instructor demonstration before progressing. As in text, graphics allow the learner to refer to any part of the movement when unsure of appropriate performance (Kozma, 1991).

Graphics in Keller's PSI. Keller's Personalized System of Instruction (PSI) can be described as an interlocking system of instruction. PSI is composed of sequentially progressive tasks, designed as highly individualized learning activities (Cregger, 1991). In this design students determine their own rate of learning by following a series of instructional tasks. In designing a PSI tennis course Metzler (1986, 1988) incorporated graphic representations with written instructions to describe task performance. The use of graphics is represented in three of Keller's (1974) five defining characteristics of PSI: mastery learning, self-pacing, and use of the written word.

PSI learning tasks are designed as individualized activities based on course content. In some PSI designs students are provided with instructional materials, among

these are task sheets. Keller (1974) initially designed task sheets with information presented in the written word. Metzler (1986, 1988) combined graphic presentations of task performance and task location as additional information in the performance of each task. In designing a PSI volleyball course Cregger (1991) provided prescriptive feedback by including a separate picture of possible errors and methods to correct there errors.

Pieron and Delmelle (1981) state that prescriptive feedback concerning the correctness of a performance is necessary if the learner is to improve. Pictorial error correction sheets can provide the learner with information to identify the reason for an unsuccessful attempt and make the corrections needed to attain mastery. By following the pictorial images the learner can identify the requirements needed to meet mastery and correct any "common" error in performance which exists.

PSI allows students to progress through tasks by following information on class materials. Graphic representations of tasks, combined with written task sheets, promotes self-pacing. The learners may advance without waiting for lecture/demonstrations by the instructor. A PSI used in a volleyball course taught at a large southeastern university demonstrated the use of graphics facilitating an increase in the amount of practice time and individualized instruction available during the course (Cregger, 1991).

Singer (1980) refers to the use of self-pacing in the early stages of instruction. PSI incorporates the use of self-pacing by providing the learner with graphics in the form of pictures. The learners were able to advance by referring to diagrams as needed. PSI's use of pictorial images promotes effective use of time in the teaching-learning process.

In summary, the literature reviewed suggests that the major attributes of graphics presentations are: (a) development of conceptual maps, (b) providing an outline of performance, (c) storage of valued information, (d) providing mental visualization, (e) providing spacial visualization, and (f) providing an understanding of relationships among task elements (includes distance, sequencing, and orientation). In PSI each of these characteristics is displayed through one or all of Keller's (1974) defining characteristics.

Animation

Animation is defined as, "...creation of an illusion of movement in a visual display by use of special effects." (Ellington & Harris, 1986, p. 6). Early research on the use of animated information began with the military's use of films as a form of indoctrination and training aids (May & Lumsdaine, 1958). As the value of visual aids in training became apparent, education began to take an interest in animation's use as a teaching tool. In 1946 Yale Motion Picture Research Project was given a grant from the Motion

Picture Association of American for the purpose of
"...evaluating certain pilot teaching films that were produced
under the sponsorship of that organization (May & Lumsdaine,
1958, p. v). Information from this project promoted research
into the use of animated pictures and graphics as a form of
educational presentation.

Educational technology literature related to animation
revolves around a six category taxonomy of motives for
incorporating animation in visuals. Five of these impact on
the effectiveness of information presentation: (a) attention-
gaining, (b) motivation/reinforcement, (c) conceptualization,
(d) presentation(animation simulating the "action"), and (e)
interactive dynamics (Rieber, 1989, p. 3).

Rieber (1989) looked at studies which investigated the
instructional effectiveness in undergraduate college courses.
Students receiving a verbal presentation were compared to
students receiving a pictorial presentation. Higher scores
were recorded by the pictorial presentation group. The study
did not discriminate between effects of still graphics and
animation. In a similar study King (1975) compared three
different modes of presentation: (a) no graphics, (b) text
plus visuals, and (c) text plus animated visuals. Results
showed no significant differences between any of the groups.
Other similar studies were conducted in which groups using
animation were compared to those without (Rieber, 1989).

These studies show that no significant differences were indicated by any of the groups. However, children appeared to respond to animation features more than adults (Rieber, 1989).

The popularity of computers in education has increased the use of animation in computer-based instruction. A review of education software packages demonstrates the increasing use of animation as an instructional presentation format (Rieber, 1989). Levin and Lesgold (1978) state that abundant evidence exists to document the value of pictures as an instructional tool (Levin & Lesgold, 1978). However, empirical data which might determine the effectiveness of animation in enhancing instructional materials is inconsistent. This could be attributed to general flaws in animation studies and lack of generality of results (Rieber, 1989). Although most attempts at studying animation have shown no effects on learning or instructional materials, this inconsistency could be due to comparisons to other instructional aids, rather than the effectiveness of animation as a means of presentation. Before any sound conclusions can be drawn more research is required and empirical evidence must be derived.

In summary, the literature reviewed suggests that the major attributes of animated graphics presentations are: (a) gaining the learner's attention, (b) providing motivation (or reinforcement) for performance, (c) explaining concepts within the performance (by simulating the action), and (d)

providing demonstration of the movement. Each of these attributes is based on Rieber's (1989) six category taxonomy.

Summary

Current design in the college level BIP commonly employs a form of "whole class" instruction (Siedentop, 1991, p.19). This style of teaching can be described as the teacher providing information to the whole class with little regard for individual student needs. Singer and Dick (1974) identified the need for individualized instruction if the learning experience in physical education is to be successful and enjoyable. One alternative design to meet student individual needs is Keller's Personalized System of Instruction.

A review of literature on the use of PSI points to several examples where PSI in the psychomotor domain has led to higher rates of learning when compared to current "conventional" (or, whole class) instructional strategies (Metzler, 1986). By implementing the use of text, PSI releases the instructor from many of the daily managerial duties to concentrate on the varying needs of each student as they progress through a series of sequential learning tasks.

Keller's original design emphasized the use of text in presenting information. However, present day technology offers a variety of presentation formats and options for providing task-related information. In discussing future considerations for PSI in the motor domain Cregger and Metzler

(1992) identify the need for examining alternative methods of information presentation.

Despite the increased awareness of the importance of individual differences, reviews of research on media attributes generally conclude that very little information has been produced on the effects of alternative presentation formats and their relationship to providing instructional information. Clark (1975) describes much of the research on media and presentation formats in instructional design as focusing on attributes relationship to student's aptitudes rather than how these attributes can be applied to the design for increasing learning.

Clark and Snow (1975) point out that a lack of design research focusing on different presentation formats as a component of alternative designs currently exists. Much of existing design research is based on examining processes that occur in the traditional (whole-class) design (Clark & Snow, 1975).

Literature on PSI demonstrated that Keller originally developed the design to emphasize the written word (Keller & Sherman, 1974). However, The Keller Plan Handbook (Keller & Sherman, 1974) suggests the possibility of incorporating alternative formats for presentation was mentioned as part of the future research and development of PSI. Recent technology advancements offers diverse forms of presentation formats

available for today's use in PSI. In a meta-analysis of media research Kulik, Kulik, and Cohen (1980) determined that when media provided information through forms other than text, college level students demonstrated increased performance in a variety of courses.

Research on the effects of introducing various presentation formats in the psychomotor domain appears to be extremely limited. Furthermore, a literature search of research on PSI demonstrates the lack of information existing on the effects of alternative forms of providing instruction.

In summary, research suggests that advancements in educational technology have produced a number of changes in the availability of alternative presentation formats. However, research on alternative presentation formats in a PSI psychomotor setting are limited (Cregger & Metzler, 1992). Gindele and Gindele (1983) recommend that educators should explore opportunities to utilize technological advancements in an attempt to present information in alternate forms which will be most beneficial to the learner.

Media literature provides positive attributes for the use of each form of presentation format (text, static graphics, and animation) in the cognitive domain, use in the psychomotor setting is limited at best. In this chapter a complete review of literature indicates that the use of text has a certain number of attributes, text and static graphics has several

more, and text,static graphics, and animation have even more. Although, Kozma (1991) suggests that at a point the use of various attributes in the presentation of information may cause confusion for lower skilled learners when introducing a new skill, he fails to make a determination at what point this negative effect may occur.

Information contained in this review of literature identifies various attributes contained in text, static graphics, and animation. Based on the information contained in this review of literature the assumption is made that by combining theses attributes the greater the likelihood of learning occurring. This assumption acknowledges that a ceiling effect will likely occur at an unknown point when additional attributes might even prove detrimental to the learner.

Chapter III

Methods

This chapter provides an overview of the study design, data collection, and methods of analysis used in an examination of three presentation formats providing information and facilitating feedback in a PSI spare conversion unit. This chapter will be divided into five sections:

1) Study Design
2) Data Collection
3) Presentation Formats and Operations
4) Methods of Analysis
5) Pilot Study

Study Design

Keller's PSI is structured around the concept that students require individualized instruction in order to improve educational performance. To provide this individualized instruction Keller devised a system which allows students to advance at their own pace by following information provided in text materials, freeing the teacher to provide students with information related to individual performance. However, as instructional technology has advanced, alternative methods of information presentation are available for PSI. This section describes the course structure, contextual factors, and materials used throughout the course as a part of the PSI design.

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Course Structure

The BIP bowling course was designed to provide basic instruction in the fundamentals of bowling by utilizing Keller's Personalized System of Instruction (PSI). PSI allows students to progress at their own pace as they move through a sequenced group of learning drills and mastery task trials. Students were not be held back or penalized by other students, or forced to proceed before they were ready. How fast the course is completed depended on each student's learning rate. Figure 1 shows the flow of content as students moved through the course.

PSI Course Units. Following completion of a pre-test students began to move through a series of units listed on a criterion summary sheet at the front of each course manual. Each unit consisted of a list of drills and tasks of fundamental psychomotor and cognitive skills required to participate in the game of bowling. The course presented several units sequenced in numerical order. Each unit was divided into a series of drills and learning tasks with criteria for demonstrating development of the skills used in the game of bowling.

Following a PSI design each student progressed through each unit at his/her own rate. Entry into each unit was based on achieving task mastery, rather than time restrictions. The time entering the unit or the amount of time needed to
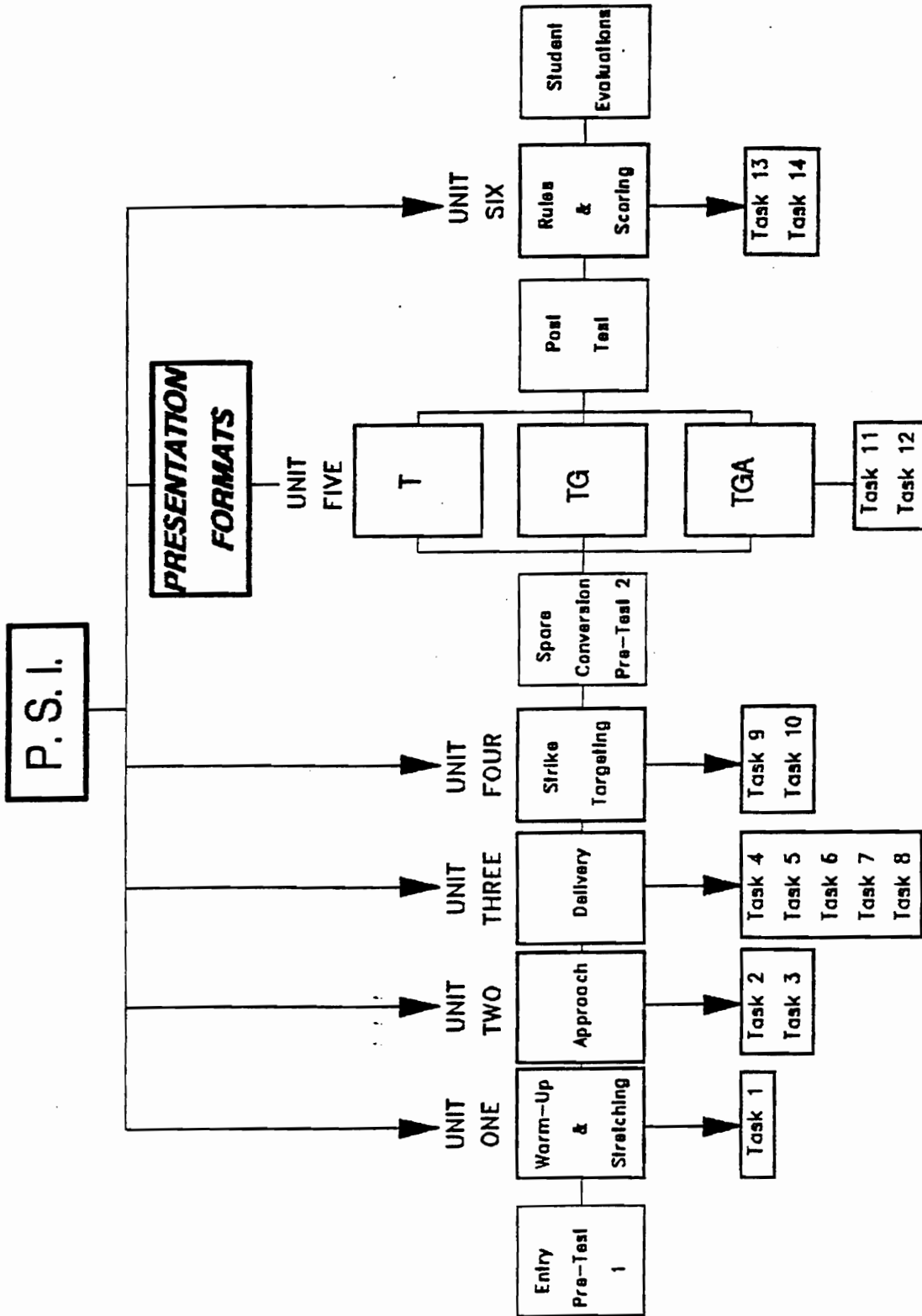
FIGURE 1. COURSE FLOW CHART

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complete the tasks within a unit varied dependent upon each student and did not impact on the student's grade or performance evaluation.

Spare conversion unit. Prior to entering the spare conversion unit each student was administered a second pre-test (first pre-test administered upon course entry). Students entered the unit at various times based on time required to complete the previous tasks. Once this pre-test was completed students were given a unit manual and began to work on the designated drills. The type of information each student received was dependent upon which media group they were assigned to. This information was determined prior to beginning the course.

Each student performed each drill and task until mastery criterion had been reached (tasks are based on trials rather than time). Upon exiting the spare conversion unit each student was required to take a post test. The percentage of spares converted were recorded as the post test score. Once the students had completed the post test they proceeded to the next unit in the PSI sequence.

Contextual Factors

Two bowling courses were conducted at a large Southeastern university as part of the Basic Instructional Program, comprised of a variety of beginning level physical education activity courses. These courses are designed to

contribute to all phases of student development, and are structured around outcomes of: (a) knowledge, (b) motor skills, (c) physical fitness, and (d) attitudes (Sebolt, 1989). Students enroll for one semester hour credit, based on a pass-fail grading system.

The bowling courses were scheduled at the bowling lanes at the university student center. Eight regulation size lanes were available for class use. Each course was scheduled for 45 class periods, each lasting 40 minutes. Classes included four days for pre and post testing and three days for the spare conversion unit introduction. The spare conversion unit consisted of a total of approximately 18 classes, including periods for pre and post testing. (Based on the PSI design students entered the unit at various times throughout the course.)

Students enrolled on a self-selected basis, by course section. These selections were made without prior knowledge of the design being used or the course instructor. Participants in the study consisted of 48 undergraduate and one graduate students of various ages, with 16 females and 33 males. Student academic level varied with 1 graduate level, 38 seniors, 4 juniors, 6 sophomores, and 1 freshmen.

Prior experience in bowling was determined by questions on the pre-test scoring sheets (see Appendix B). Entry ability levels were based on a skills pre-test consisting of 100 possible points, described later in this chapter.

Design Materials

In order to understand the study design it will be necessary to examine the materials used throughout the course and their implementation in PSI. Each of the four types of materials will be described: (a) course policy guides, (b) criterion summary sheets, (c) learning tasks sheets (not including the spare conversion unit), and (d) inning scoring sheets. These materials will be examined by describing the information provided in each, its purpose, and implementation in the course.

Course policy guides. The first material contained in the course manual was the course policy guide (see Appendix C). This guide described the course and its operations. Each policy guide contained information on the course description, the course sequence of units, course goals, established performance objectives, participant responsibilities, grading criteria, and a listing of all material distributed during the course.

The policy guide also contained information on how each student should proceed through the course and how materials were to be used to aid in his/her progress. The policy guide was developed to allow students to move through the course without the teacher providing verbal instructions (i.e. management, skill description, task description and requirements) in order to increase skill practice time. Each

student was allowed to keep one copy of the policy guide contained in the course manual.

On the first day following pre-testing each student received a copy of the course manual. Each manual contained the policy guide and was provided time to read it. At the end of this time students were shown copies of the materials described in the policy guides and allowed to ask questions concerning any information contained in the guides. Once all questions had been answered each student was told to take his/her guide home and read it again.

The first part of the next class was spent answering any further questions. After this point any questions which arose during the course were referred to the students' policy guides.

Criterion summary sheets. The second item contained in the students' course manual was a criterion summary sheet (see Appendix D). This sheet outlined each unit within the course and the sequence in which the units appeared.

Each criterion summary sheet provided the student with the number of each unit, topic of the unit, the tasks within each unit, and space to record the beginning and completion date for each task and unit. A space at the top was provided for the student's name.

In order to ensure that all students were using the same skills in ball delivery several tasks were marked with an asterisk. Each asterisk was used to indicate that task

mastery was achieved and that tasks were being performed correctly. Each task marked with an asterisk required the instructor's initials before the student was allowed to progress.

Criterion summary sheets were designed to provide each student with an overview of units within the course, tasks required in each unit, and an indication of which drill or task the student should be working on. Furthermore, the sheets provided the teacher and the student with a record of the number of tasks completed, the date each task was completed, and the length of time required to reach mastery criterion in each task.

Once the student entered class he/she immediately began to work on the current task outlined on the criterion summary sheet. When a task labeled with an asterisk was reached the student notified the instructor to observe all or part of the task to ensure performance was satisfactory. These procedures were followed for each unit within the course.

Learning task sheets. Once the students had reviewed the policy guide, the criterion summary sheet, and had entered the unit, they turned to the learning task sheets (see Appendix E). After purchasing and reading the related section of the manuals students began working on the drills in the unit. Each learning task sheet contained three sections of information related to task performance: (a) drills to

practice task performance prior to attempting criterion; (b)
written description of how the drills and tasks should be
performed; and (c) the performance criterion for each.
Spaces at the bottom of each sheet were provided for student
partner's (or course proctor/instructor's) signature on
mastery task completion and the date of completing each task.

Innings scoring sheets. The fourth material used
throughout the course was innings scoring sheets (see Appendix
F). The sheets were used in place of regulation scoring
sheets (except during the rules and scoring unit).
Information recorded on these sheets were used to record
performance during pre and post tests and success during all
drills and task trials. Information from inning scoring
sheets covered five areas of task performance: (a) number of
pins knocked down on each of two balls, (b) the specific pins
knocked down with first ball, (c) type of spares remaining,
(d) percent of spares converted, and (e) total number of pins
knocked down during ten innings.

The term "innings" was used in place of frames. An
inning is compromised of two balls unless the first ball is a
strike. The object focused on a series of two ball scores
rather than total scores. By focusing on single innings
rather than total score students were able to concentrate on
spare conversions rather than overall outcome.

Each sheet consisted of two sets of ten innings. Each
inning was represented by a square. In each square a diagram

of ten circles was used to represent the ten pins on a bowling lane. The observer (partner) recorded the first of two balls by marking in the circles to demonstrate which pins were knocked down by the first ball (this allowed identification of the pins remaining which define the spare produced). The number of pins knocked down by the first ball was recorded in the upper left corner of the inning square.

In the upper right corner a box was positioned inside the square. This box was used to record the total number of pins knocked down during the inning. This procedure was followed for all task trials bowled.

Data Collection

This study was designed to determine differences in psychomotor learning based on effects of the strengths (attributes) of three different presentation formats in skill performance in a PSI college level bowling course. In order to determine differences in the types of presentation formats, it was necessary to collect data related to students' ability to convert various types of spares using an adaptation of the "Novice Spare Conversion System" (Russell, 1980, p. 90). This study looked at and described the attributes of each format for presenting skill information and facilitating feedback. Presentation attributes were presented in three forms of delivery media: (a) with text only (T), (b) with text and static graphics (TG), and (c) with text, static graphics, and

animation (TGA). The purpose of this section is to outline the conditions affecting data collection and to describe the attributes of each presentation format which data collection will occur.

Instructional Context

Each of three types of presentation formats was examined to determine ability of students to convert "common spare leaves" (Russell, 1980, p. 97) in the context of a PSI bowling course. With the differences of each type of presentation attributes as the main focus, data were collected using two components present throughout the course design: (a) Novice Spare Conversion System and (b) standardized unit conditions.

Novice Spare Conversion System (NSCS). The NSCS is based on the path of the ball moving along three positions on the lane. These were: (a) the approach starting point, (b) the lane dart, and (c) the key pin position (see Appendix G).

Each position identifies a target that the ball should cross or contact when attempting to convert a given spare. The NSCS is based on the strategy that only the angle of the ball should be adjusted, with the approach remaining unchanged (Russell, 1980). Each form of information presentation provided a description using text, static graphic pictorial, or animation representation identifying each of the positions for all common spare leaves.

<u>Standardized Unit Conditions</u>. Several standardized conditions affecting data collection in PSI were established prior to the beginning of the spare conversion unit of the course. These conditions were similar across all subject groups in the study: (a) pre and post tests were administered to all students, (b) students were divided into pairs, acting as partners, and (c) each student received a spare conversion booklet.

At the start of the course students in each group were paired with a partner so that one acted as an observer to record information on the inning scoring sheets for all pre/post tests, drills, and task trials. Prior to beginning the spare conversion unit all students were required to take a second pre-test consisting of ten innings of bowling (a preliminary pre-test was administered upon entry into the course.)

The pre and post tests were scored as one series of ten innings with a possibility of 100 points and 100 percent spares converted. Partners acted as scorers, recording each inning's score and the spares attempted and converted. The course instructor was responsible for totaling and recording the mean percent of spares converted for each of the three presentation groups. Group mean percentages of spares converted from the second pre-test and the post test were the unit of measurement for comparing differences within groups on spare conversion.

Following completion of the second pre-test each student received a spare conversion booklet which outlined the type and use of the presentation format they would be using. Each booklet contained all learning task sheets, drills, mastery task information, class readings and diagrams (where applicable), presentation information, unit guidelines, innings scoring sheets, and spare conversion attempt record sheets for each drill and mastery task attempt in the spare conversion unit. Students were randomly selected for one of three groups using a random number table. Each group was assigned a treatment based on the form of presentation format introduced into each group: (a) text only (T) composed of 17 students; (b) text and static graphics (TG) composed of 18 students; and (c) text, static graphics, and animation combined (TGA) composed of 14 students.

Training for Observation Accuracy

During the spare conversion unit students were paired in order to receive feedback concerning the path of their ball during spare conversion attempts. In order to ensure that all students were able to correctly identify the path of the ball in relation to the target points necessary for promoting improved spare conversion a list of observational procedures were developed (see Appendix H).

Prior to beginning the spare conversion unit each student was provided with a list of procedures to be followed when

observing their partner's spare conversion attempts. These procedures for observations were divided into two parts. Part A involved describing and defining the following information: (a) location, (b) stance, (c) setting, (d) information focus, (e) frame of reference, and (f) target point identification.

Part B was observer testing to determine observation reliability. After receiving a list of observation procedures and a class lecture related to appropriate observation practice each student was given time to study and familiarize themselves with the observation procedures. Prior to beginning the observation text each student was allowed time to ask questions. Once all questions were answered students were asked to record the location of ten balls rolled down a bowling lane. Each ball's position was recorded in relation to three target points identified as vital in spare conversion based on Russell's (1980) Novice Spare Conversion System (NSCS): (a) the approach starting position, (b) the lane darts, and (c) key pin contact position.

Each ball was videotaped in order to record the ball's position. Each videotape was analyzed and coded to determined the appropriate ball position for each of the three target positions for the ten balls rolled. Due to limitations in the study the instructor acted as coder. To determine observer accuracy each student's answers were compared to the videotaped information (Metzler, 1990). An accuracy

percentage of at least 80% was established as the acceptable criterion.

Presentation Formats and Operations

The study was designed to examine the effects of three different forms of presentation formats providing information and facilitating feedback in a PSI designed college level bowling course. In order to examine the implementation of alternative types of presentation formats in PSI it was necessary to collect data related to the various attributes of each form of presentation during the spare conversion unit.

Each of the forms of presentation contained several attributes which determined how spare conversion information was provided to each group of students. The specific form determines the attributes used to present information, facilitate feedback, and promote learning of spare conversion skills.

Each of the following sections contains a description of how the presentation formats influenced the presentation of information related to content and feedback in each form. Each presentation format will be followed with a description of how the variables were used during the unit operation.

Text Only (T)

Information providing content and facilitating feedback was presented as text only information contained in a spare conversion unit booklet. This booklet provided students with

a text description on the correct path of each ball to convert common spare leaves. The description of common spare conversions was presented in the form of a text listing of the target points necessary to convert various types of commonly produced spares (Russell, 1980). This information was contained in a spare conversion list (see Appendix I). The spare conversion list described each point of the ball's movement from the approach starting position, across the appropriate dart, to the crossing or contacting the correct key pin position for converting a list of common spares. This information was provided for right and left hand preference (identified in the unit booklets and course manual as right or left hand dominance).

Information in the unit booklet included text instructions on how to use the booklet and the Novice Spare Conversion System prior to attempting all spare conversion trials (see Appendix J). All information was delivered in the form of written text only. Students were unable to participate in the unit until the spare conversion unit booklet had been purchased or received from the instructor.

Unit operation. Once entering the spare conversion unit, each student was provided with a T spare conversion booklet for progression through the unit. Each spare conversion booklet contained eight sections: (a) unit introduction (preface), (b) unit guidelines, (c) spare conversion unit

learning tasks (including drills and mastery tasks), (d) class readings, (e) description and use of the NSCS, (f) spare conversion list, (g) spare attempt conversion record, and (h) a description of the use and application of the inning scoring sheets.

The first section of the booklet provided the student with an introduction to the spare conversion unit of the course. This introduction began by discussing the use of information provided in the booklet and how this information would aid in the student's progression through the spare conversion unit. The introduction described the booklet's contents, student's movement through the unit, means of recording information in the booklet (this included information on the partner's responsibility for using inning scoring sheets for recording information on mastery task performance), and the use of the spare conversion attempt record.

The second section of the booklet contained a list of five guidelines which the student was expected to follow throughout the unit. Unit guidelines pertained to receiving information from other students, limiting outside practice, and use of questions supplied in the spare attempt conversion record (see Appendix K). Each guideline included an explanation of its role in the unit and why the student was expected to follow each.

After reading the guidelines the students used the booklet to examine the criteria described in the learning tasks sheets used in the unit. These sheets outlined the drills and mastery performance of each task (see Appendix L). Furthermore, the learning task sheets provided a written (text) description of how an where to perform each drill and mastery task and the criterion for each.

Also, the spare learning task sheets provided information about the task by designating the related class readings (see Appendix M). Based on information provided on the learning task sheets students turned to pages identified as class readings contained in the booklet. These class readings contained information on: (a) basic information about why the skill is important; (b) strategy related to the skill; and (c) description of the process for performing the skill. All class readings were based on information from Strickland's (1989) <u>Bowling: Steps to Success</u> and Russell's (1980) <u>Bowling Now</u>.

Prior to rolling one ball to produce a spare each student was instructed to complete all class readings and review the learning task sheets. Readings were done before entering class and the student was allowed an opportunity to review any pertinent skill-related information before going to the course proctor or instructor. Use of the recommended class readings allowed the students to be better prepared to reach mastery

task criterion at a faster pace and to be better informed about strategies related to the activity.

The student was then instructed to review information in the booklet which described use of the Novice Spare Conversion System which outlined how the system would be used to improve performance and act as a frame of reference for evaluating performance. This section identified each of the key target points and their role in converting common spares.

After reviewing the learning task sheet information, class readings, and the NSCS, the student was ready to move to the first task in the unit. In this task each student was expected to pass a quiz on information and the spare conversion presentation format they would be using during the unit (see Appendix N). (Passing the quiz required the student to achieve a 90% score.) The quiz was indicated as the mastery performance task for the first task in the unit (Task 11).

After meeting the designated criterion the student began the second task by rolling one ball to establish a spare leave. Once a spare leave had been established the student refereed to the spare conversion list contained in the unit booklet. Based on the spare produced the student located their spare in the list and answered the three questions contained in Part A of the spare attempt conversion record (see Appendix O). These questions asked the student to

indicate the correct approach starting point, the correct dart, and the correct key pin position of the spare leave. All answers were based on information provided in the spare conversion list.

Based on information about using the NSCS to convert a spare and the spare conversion list the student attempted to convert the spare. After the spare conversion attempt the student recorded his/her success and answered three questions about the path of their ball compared to the correct path identified in the spare conversion list. Responses were recorded in Part B of the spare attempt conversion record (see Appendix P).

Once all drills were completed the student began the mastery performance tasks. In performing these tasks students followed the same procedure for the designated criteria as were used in the drills. This pattern was repeated until the mastery criterion had been reached and the course proctor or instructor had initialed the booklet and signed the inning scoring sheet.

The final section in the unit booklet described the use of the innings scoring sheet. These sheets were used during the mastery task to record information on the student's performance. The student's partner was responsible for recording all information concerning the student's attempts at converting spares.

Text and Static Graphics (TG)

Information providing content and facilitating feedback in this group was presented as text information combined with a static graphic representation of the appropriate path of each ball to convert common spare leaves. The text and graphic diagrams of each common spare were contained in a TG spare conversion unit booklet similar to the text only group.

Each piece of information concerning spare conversion contained a text description and a graphic representation of the target points necessary to convert various spares. A text list of target points combined with a graphic diagram identified the position of the appropriate target points as they appeared on the lane. A list of common spares for right and left hand preference was provided.

All information contained in this booklet was presented in the form of a text description combined with a static graphic representation. Students were unable to participate in the unit until the TG spare conversion unit booklet had been purchased or received from the instructor.

Unit operation. Other than the use of static pictures the unit operation was the same as in the T group. Learning tasks sheets and class readings provided students with instruction and information about spare conversion. Accompanying the text description of common spare target points in the spare conversion list was a static graphic

showing the correct path the ball should take from the start to the key pin position for each common spare.

Learning task sheets contained diagrams of the drill and mastery task performance (where appropriate). Each of these materials were contained in the TG spare conversion unit booklet. Each student was required to pass a quiz (90% correct) on the presentation format before attempting spare conversion (see Appendix N).

Text, Static Graphics, and Animation (TGA)

This presentation group received content information and feedback by interacting with text, static graphics, and animation combined. Unlike the TG group, students were able to determined the correctness of their spare conversion attempt by viewing an animated representation of the correct path.

Content information and feedback was presented in several forms. Presentation of information about the correct ball path in spare conversion was produced by comparing an animated graphic representation provided on a computer monitor. This group was provided with text and static graphic representations which contained information about the correctness of student understanding of ball positioning in order to convert various spares. Information on right and left hand preference was provided.

As in the T and TG groups students were provided a spare conversion unit booklet. This booklet contained six sections of information: (a) unit introduction (preface), (b) unit guidelines, (c) spare conversion unit learning tasks (including drills and mastery tasks), (d) description and use of the NSCS, (e) spare attempt conversion record, and (f) a description of the use and application of the inning scoring sheets. Students were unable to participate in the unit until the booklet had been purchased or received from the instructor.

Along with the booklets students were provided information by viewing computer screens (see Appendix Q). These screens contained information on use of the system, when to attempt to convert the spare, use of the Novice Spare Conversion System (NSCS) prior to attempting the skill, and use of the NSCS after completing each skill trial. All spare conversion information and perceptions of feedback in this group were delivered through the use of text, static graphics, and animated graphics.

Unit operation. In this group attributes were presented through computer-assisted instruction (CAI) combined with unit booklets (containing text and graphics). Once the students had received the unit booklet they were provided with several opportunities to familiarize themselves with the system by reading the booklets and walking through each phase of the CAI applications.

After reviewing information contained in the TGA spare conversion unit booklet and viewing the first six computer screens students began the first task in the unit. This task required the student to pass a quiz on the use of the media (see Appendix N), with a score of 90% correct.

The introduction instructed the student on the use of the mouse to respond to information presented on the computer screen. As the student moved through each screen during the introduction instructions were provided on when to attempt to convert the spare and when to return to the computer screen.

Once information on how to move about in the computing environment was understood students were provided with information on use of the NSCS to improve spare conversion performance. Since the course was based on a PSI designed students required access to spare conversion information at various times throughout the course. In order to provide this information according to student need a description of the use of the information in the system, use of the Novice Spare Conversion System, and how to begin and move through the system was contained in the unit booklet (see Appendix J).

Using Authorware 3.1 students were able to access information containing text and diagrams which indicated how the NSCS is used to determine ball positioning, path, and target points in spare conversion. Access to this information was available throughout the course by recalling NSCS

information in the booklet and on a computer located at the bowling lanes. Also, additional instruction on using the system was available in a computer lab located across the university campus. (Practice was dependent upon prior scheduling arrangements made with the instructor and availability of the computer lab and facilities.)

After completing the first task in the unit the student moved to the computer and began the system. Once the first six screens had been reviewed the student moved from the computer to the lane and rolled one ball to produce a spare leave. Once the spare leave had been analyzed the student returned to the computer and, using the mouse, responded to several questions about hand preference and the pins left standing in the spare leave.

Once the student had determined the pins left standing in the spare he/she turned to Part A of the spare attempt conversion record. In Part A the student was presented with three questions related to the ball path needed in order to convert the spare. Based on any prior knowledge the student indicated his/her answer by placing a tally mark by each response. After answering a single question on the spare attempt conversion record each answer was entered on the computer. This continued until the appropriate answer was given as indicated by the computer (the student was not able to advance to the next question until the correct response was provided). As each question was answered correctly the

student was provided with a static graphic of the identified target point locations along the spare conversion ball path. Once the student had viewed the correct positioning and path of the ball the student moved to the lane and attempted to convert the spare.

After completing the attempt the student returned to the screen and used the mouse to respond to three questions concerning spare conversion success and ball positioning compared to the correct ball path. At each question the student had an opportunity to view an animation of the appropriate ball path. Based on the information provided by the comparison between the animated ball path and the student's spare attempt ball path each question in Part B of the spare attempt conversion record was answered.

Once all drills were completed the student moved to the designated mastery task and followed the same procedure for each attempt. This pattern was repeated until mastery criteria had been reached. (Mastery criterion was verified by the course instructor or course proctor.) Verification was identified by the course proctor's or instructor's initials placed in the task booklet and their signature placed on the innings scoring sheet.

TGA Equipment. Equipment needed in computer-assisted instruction included an IBM-compatible 486 computer with five megabytes of random access memory (RAM) and a compatible

monitor for the information and feedback presentation during the spare conversion section of the unit. Furthermore, one VHS Panasonic videotape recorder was used in order to determine observer accuracy. To keep a record of student observation reliability several blank, VHS tapes were necessary. Also, a mouse and a mouse pad were needed to allow students to move through the program by clicking on the appropriate buttons.

The authoring package for all computer generated graphics was Authorware 3.1. All programs were stored on hard drive to facilitate recall of the appropriate program for the spare conversion being attempted. All programs were interactive, allowing students to select appropriate type of information dependent upon spare combination and hand preference without needing instructor assistance.

In summary, each group followed the PSI self-pacing feature by entering the units at various rates throughout the course. Students performed strike attempts while waiting for the computer. During this unit two lanes were identified as task lanes for the third group (TGA) due to the limited access of the computer. Once the student had completed the first task and the drills as described in the second learning task sheet he/she moved to the mastery task lanes identified and performed the appropriate number of trials identified by the mastery criteria (40 trials).

Pilot Study

A pilot study was conducted prior to beginning the course. It involved six undergraduate students majoring in physical education. Each participated in the spare conversion system, with each group of three receiving computer-assisted instruction (TGA) and one of the other forms of treatment (T or TG). One doctoral candidate from the university physical education department acted as the course proctor and assisted in the pilot study operation. The purpose of this pilot study was to examine any contextual constraints that may exist. Also, operation of the technology was tested to ensure that the system worked as it was designed. Furthermore, the pilot study allowed the investigator and the course proctor to become familiar with equipment and procedures used in the system.

Results from this pilot study determined that four changes were necessary: (a) development of observation procedures guidelines, (b) need to set aside several lanes for the TGA group, (c) need to assign fixed position for the computer at the lanes, and (d) need to develop a psychomotor quiz for all students un the course.

Methods of Analyses

Three groups were examined to determine significant difference in psychomotor learning when using three presentation formats during a PSI spare conversion unit. Data

were examined using four analyses conducted among and within the three presentation formats.

This section will discuss the methods of data analysis employed to determine if significant differences existed in mean percent of spares converted and student perceptions of PSI and specific unit presentation formats within and among the three presentation groups.

Prior to entering the spare conversion unit each student completed a test to determine if differences existed between the types of ball delivery used during the spare conversion unit. Data were analyzed using two sources of data: (a) spare conversion skills tests and (b) student evaluations. Under each source of data several analyses were conducted to determine differences or similarities within and/or among three presentation formats providing information and facilitating feedback in this study.

Spare Conversion Skills Tests

The first source of data, spare conversion skills tests, was analyzed under two separate analyses: (a) learning effects during spare conversion unit and (b) presentation format adjusted mean gain scores. Results for each analysis were based on a series of comparisons conducted within presentation groups.

The first set of analyses determined differences (or lack of differences) which existed within presentation groups.

Comparisons within presentation groups were conducted in three areas: (a) least square means within groups, (b) least square mean across time, and (c) least square means within groups across time.

To determine if significant statistical differences existed within presentation formats a two way repeated measures analysis of variance (ANOVA) was performed. All groups were compared from pre-test two to unit post test, as measured by mean percent of spares converted.

The second analysis, presentation format gains, were based on a single comparison. This comparison examined the statistical differences by comparing adjusted gain scores within presentation formats. To determine if significant statistical differences exist among formats a Kruskal-Wallace one way ANOVA on ranks was performed. All groups were compared from pre-test two to unit post test, measured by mean percent of spares converted.

Student Evaluations

The second source of data, student evaluations, were analyzed under two sperate analyses: (a) student perceptions of PSI and (b) student perceptions of specific spare conversion formats. Results for each analysis were based on comparisons among presentation groups. In order to determine differences (or lack of differences) which existed among presentation groups six statistical analyses were performed.

The first analysis, student perceptions of PSI, was based on three interrelated comparisons. Each of the three comparisons examined the statistical differences among presentation groups by comparing mean student ratings of: (a) PSI's ability to promote increased skill, (b) PSI's ability to promote increased knowledge, and (c) PSI's effectiveness as a design for teaching college level bowling. To determine if significant statistical differences existed among each format a Kruskal-Wallace one way ANOVA on ranks was performed to determine differences on mean gain scores of percent of spares converted among presentation groups. Dunn's Method all pairwise multiple comparison procedures were used to examine all significant differences that existed among groups. All groups were compared based on student ratings from course evaluations completed at the end of the course.

The second analysis, student perceptions of specific spare conversion presentation formats, was based on three interrelated comparisons among presentation formats in specific spare conversion units. Each of the three comparisons examined the statistical differences among presentation groups by comparing mean student ratings of: (a) unit presentation format's ability to promote increased skill in converting spares, (b) unit presentation format's ability to promote increased knowledge concerning spare conversion, and (c) unit presentation format's effectiveness providing

information for improving spare conversion. To determine if significant statistical differences exist among formats a Kruskal-Wallace one way ANOVA on ranks was performed to determine differences on mean gain scores among presentation groups. Dunn's Method all pairwise multiple comparison procedures were used to examine significant differences that existed among groups. All groups were compared based on student ratings from course evaluations completed at the end of the course.

Summary

In summary, the purpose of this chapter was to introduce the methods of producing and collecting data during this study and to determine how this data was analyzed. Contextual factors were introduced to aid in explaining situations specific to this course.

A pilot study was used to determine any unforeseen occurrences which could occur as a result of using technology in an "out-of-house" setting. As a result of the pilot study conducted several changes were made in the set-up of the technology and the amount of training provided to the students in order to deliver the spare conversion information necessary. The next chapter will present and describe the results obtained from the various analyses.

Chapter IV

Data Analysis

The purpose of this study was to determine the effectiveness of using three different presentation formats in a spare conversion unit as part of a PSI designed college level bowling course. Data analyses were completed to test for differences among the three presentation groups (formats) when providing information and facilitating feedback in spare conversion attempts. Two data sources were analyzed: (a) spare conversion skills tests and (b) student evaluations.

This chapter will describe and analyze the types of data, results, and comparisons based on interrelated records kept throughout the course. Data analysis will be separated into three categories:

1) Observer Accuracy

2) Spare Conversion Skills Tests

3) Analyses of Student Perceptions

Observer Accuracy

Students were assigned partners as a function of the spare conversion unit. Each partner was responsible for aiding performers (other students) in recording information related to spare conversion attempts. One of these responsibilities was to provide feedback on the performer's ball path during the conversion attempt.

To ensure that this information was accurate each student

was trained in the appropriate procedures for identifying the key target points necessary for successful spare conversion. This training included a written list of observational guidelines and definitions (see Appendix H), a lecture provided by the instructor to supplement the written guidelines, and an opportunity to practice the observation process.

Following training the instructor entertained questions related to making and recording observations. Once all questions were answered each student was tested on the observation procedures by viewing the path of ten balls rolled on a regulation bowling lane. For each ball the observer was asked to correctly identify: (a) the approach starting point, (b) the dart position, and (c) the key contact pin position.

In order to test for observer accuracy a videotape recording of each ball path was used to record the correct target points crossed during the ball's path. Observer accuracy was designed to ensure that information on student performance during spare conversion remained consistent and correct throughout the unit. Accuracy was determined by comparing the videotaped recording of each ball path to the student's record of that ball path over ten observations. The accuracy for each observation was based on the identification of three target points (30 possible correct responses). The percent of accuracy was determined by comparing recordings to

three correct positions identified on the videotape. A criterion of 80% correct responses was determined appropriate to demonstrate observer accuracy before students were allowed to collect data (Metzler, 1990).

Results are divided among each of the three presentation groups in the study: (a) text (T), (b) text and static graphics (TG), and (c) text, static graphics, and animation (TGA). Table 1 presents a summary of each group's mean percent of accuracy for each target position over all observations. Analysis of raw data determined that all students reached the criterion level of 80% accuracy on all three components (see Appendix R).

Spare Conversion Skills Tests

The following statistical data analyses were intended to address the major research question developed within the study: Does a difference exist in learning, measured by mean percent of spares converted, among three presentation formats applied in a spare conversion unit as part of a PSI college level bowling course?

This section will report resulting differences among the three presentation groups by analyzing two types of results: (a) learning effects occurring during the spare conversion unit among presentation formats and (b) group adjusted mean gain scores among presentation formats. Results will be presented on several related comparisons to examine differences existing among the three presentation formats.

Table 1

Mean Percent of Accuracy for Each Target Position Within Presentation Groups

Presentation Formats	Mean % of student accuracy identification		
	Approach Position	Dart	Contact Pin
T	96.5%	94.7%	90.0%
TG	91.7%	92.8%	93.9%
TGA	86.4%	85.0%	88.6%
All	91.8%	91.2%	91.0%

Statistical analyses for these comparisons are presented in the following section.

Learning Effects During Spare Conversion Unit

The first data analysis determined whether differences occurred on mean percent of spares converted among presentation format groups. Three comparisons were made on the percent of spares converted in the second pre-test and the post test (given at the completion of the spare conversion unit): (a) comparison of means among presentation groups (format), (b) comparison of means among presentation groups (formats) across time (pre and post tests), and (c) comparisons of means of interaction among groups across time (pre and post tests). Table 2 presents the mean percent of spares converted among presentation formats based on each comparison.

Statistical analyses of percent of spares converted within formats were performed using a two way repeated measures analysis of variance (ANOVA) on all comparisons. The ANOVA revealed that differences among groups were not due to random sampling variability, therefore, no significant differences among presentation groups were found to exist (groups, subjects); (2,46) $F = .950$, $p = .39$. There was also no significant difference from pre-test to post test (across time) among presentation groups; (1, 46) $F = .528$, $p = .47$. Application of the same ANOVA on interaction of groups across time (groups x time) revealed no significant difference among

Table 2

Mean Percent of Spares Converted From Pre to Post Tests Among

Presentation Formats

Presentation Format	Mean percent spares(group, time, group x time)	
	Pre-Test	Post Test
T	39.4%	40.1%
TG	36.3%	35.1%
TGA	29.0%	37.9%
All Groups	34.9%	37.7%

formats; (2,46) F = .612, *p* = . 55. An alpha level of (*p* < .05) was used to determine statistical significant difference for all ANOVAs in the study.

Pre-test to post test comparisons. Mean scores among presentation groups ranged from a pre-test low of 29.0% (TGA) to a post test high of 40.1% (T). The ANOVA results suggest that no significant statistical difference was observed among groups based on the percent of spares converted on the post test.

Mean scores among all presentation groups across time ranged from 34.9% in pre-test 2 to 37.7% in the post test. The ANOVA results suggest that no significant difference was seen to exist among groups based on the percent of spares converted on pre-test two and on the post test.

Mean scores for the third comparison, interaction among presentation groups across time, ranged from a low of 29.0% (TGA) to a high of 39.4% (T) in the pre-test and a low of 35.1% (TG) to a high of 40.1% (T) in the post test. The ANOVA results suggests that no significant difference was shown to exist among groups interacting across time.

In summary, mean score pre-test differences appeared to exist between the TGA and T groups when comparing interaction among groups across time. The group mean scores for pre-tests demonstrated a difference in spares converted (TGA = 29.0% to T = 39.4%).

Using a two way repeated measures ANOVA three comparisons were examined to detect differences in spare conversion on pre and post test scores among presentation formats. Each presentation group was compared among groups, across time, and interaction among groups across time. Based on statistical analyses no significant differences were shown to exist among the three presentation formats. Table 3 presents the results of the ANOVA of the three comparisons among presentation formats.

Presentation Format Gains

Analysis of presentation format gains determined the existence of differences in pre to post tests percent of spares converted among presentation format groups. A single comparison was made on the mean gain scores of percent of spares converted from the second pre-test to the post test (given at the completion of the spare conversion unit). Table 4 presents the mean gain scores based on the percent of spares converted among presentation formats. Statistical analysis of percent of spare conversion gains within format were performed using a one way Kruskal-Wallace ANOVA on ranks. The ANOVA revealed that differences among groups were not due to random sampling variability, therefore, no significant differences among presentation groups were found to exist; $(2,46)$ F = .612, p = .55. An alpha level of ($p < .05$) was used to determine statistical significant difference for all ANOVAs in the study.

Table 3

Two Way Repeated Measures ANOVA on Mean Percent of Spare

Conversion Among Presentation Formats

Response Variables: **Group, Time, and Group x Time**

Source	DF	SS	MS	F	P
Group	2	651.3	325.6	0.950	N.S.
Group (Subject)	46	15774.0	342.9		
Time	1	187.2	187.2	0.528	N.S.
Group x Time	2	434.2	217.1	0.612	N.S.
Residual	46	16314.2	354.7		
Total	97	33306.2	343.4		

Table 4

Mean Gain Scores of Percent of Spares Converted From Pre to

Post Tests Among Presentation Formats

	Presentation formats			
	T	TG	TGA	All
Mean Gain	0.7%	-1.2%	8.9%	2.8%

Mean gain scores of percent of spares converted among groups ranged from a low of -1.22% (TG) to a high of 8.86% (TGA). The ANOVA results suggest that no significant difference was seen to exist among group mean gain scores based on the percent of spares converted from pre-test two to the post test.

In summary, visual examination appeared to demonstrate mean gain score differences existing between the TGA and TG groups when comparing interaction among groups across time. The TGA group demonstrated a positive change in spares converted (8.86). However, the TG mean gain score indicated a reduction in change of spares converted from pre to post tests (-1.22).

A Kruskal-Wallace one way ANOVA on ranks was performed to detect differences in spare conversion mean gain scores from pre to post tests. Despite the visual appearance of differences in mean scores among groups, the ANOVA determined that no significant statistical differences existed among the three presentation formats. Table 5 presents the results of the ANOVA on the mean gain scores among presentation formats.

Analyses of Student Perceptions

A second set of analyses was based on data from student evaluations of the PSI course and each of the three unit presentation formats. At the completion of the course each student responded to several questions related to the use of

Table 5

Gain Scores Among Presentation Formats

Presentation Formats	Mean percent spares converted		
	Pre-Test 2	Post Test	Gain Scores
T	39.4	40.1	0.70
TG	36.3	35.1	−1.22
TGA	29.0	37.9	8.86

PSI and the specific form of presentation used with his/her group. A total of 18 questions was given, with responses based on a 5-point Likert scale (1 = "poor"; 5 = "excellent"). This produced a group mean rating for each question (see Appendix S). Of the 18 questions, six were determined to indicate the possible existence of significant differences among groups. Therefore, analyses were conducted only among presentation groups' mean perceptions on those six questions.

Questionnaires consisted of two parts. Questions on the first part asked for student perceptions of PSI, independent of presentation format. The second was based on the effectiveness of the specific spare conversion format used with their group (T, TG, TGA). Two sets of results were produced. Results were based on analyses of mean ratings among the three presentation groups.

Each of the two sets of results were divided into several related comparisons to examine differences among presentation formats. The analysis for each comparison is presented in the following sections. A Kruskal-Wallace ANOVA on ranks was performed to detect differences in presentation groups' mean perceptions of PSI. Each presentation group was compared on PSI's ability to promote increased skill, increased knowledge, and PSI's effectiveness as a course design

PSI Course Evaluations

An analysis was conducted to examine student perceptions concerning the use of PSI among presentation groups. Mean group scores were determined for student perceptions of: (a) PSI's ability to promote increased skill, (b) PSI's ability to promote increased knowledge, and (c) PSI's effectiveness as a design for teaching a college level bowling course. Each score was determined based on student mean rating within each presentation group.

A one way Kruskal-Wallace ANOVA on ranks was used to test for differences among groups. An alpha level of ($p > .05$) was used to determine significant differences. Significant differences appearing among presentation formats received application of Dunn's Method of multiple comparison procedures to isolate a group or groups that differ from the others.

PSI's ability to promote increased skill. Mean scores of student ratings of PSI's ability to promote increased skill were compared among groups. Table 6 presents the means of student ratings among the three presentation groups.

Mean ratings ranged from a low of 2.88 (T) to a high of 3.79 (TGA). Statistical analysis suggests that the TGA group displayed a difference greater than would be expected by chance when compared to the other two presentation groups ($p = .01$).

PSI's ability to promote increased knowledge. Mean scores of student ratings of PSI's ability to promote increased knowledge were compared among groups. Based on

Table 6

Mean Perceptions of PSI's Ability to Promote Increased Skill

	PSI evaluations (promote skill)	
Presentation Formats	Mean	Standard Error
T	2.88	0.17
TG	3.28	0.19
TGA	3.79	0.11

student ratings Table 7 presents the means of student perceptions among the three presentation groups.

Mean ratings ranged from a low of 2.94 (T) to a high of 3.79 (TGA). Statistical analysis suggests that the TGA group displayed a difference greater than would be expected by chance when compared to the other two presentation groups (p = .01).

PSI's effectiveness as a design for teaching a college level bowling course. Mean scores of student ratings of PSI's effectiveness as a course design were compared among groups. Table 8 presents the means of student ratings among the three presentation groups.

Mean ratings ranged from a low of 2.94 (T) to a high of 3.64 (TGA). Statistical analysis of suggests that no significant difference is shown to exist (p = .91).

In summary, statistical analysis of comparisons of PSI's effectiveness as a course design determined that no difference existed among presentation formats. However, when comparing PSI's ability to promote increased skill and knowledge a significant difference among presentation groups was observed between the TGA and T groups. Table 9 presents the results of Dunn's Method comparing PSI's ability to promote skill and knowledge among presentation formats.

Spare Conversion Unit Evaluations

Students' perceptions about the specific spare conversion unit format among presentation groups was the second set of analyses conducted. Information from these evaluations

Table 7

Mean Perceptions of PSI's Ability to Promote Increased
Knowledge

| Presentation Formats | PSI evaluations (promote knowledge) | |
	Mean	Standard Error
T	2.94	0.18
TG	3.39	0.20
TGA	3.79	0.19

Table 8

Mean Perceptions of PSI's Effectiveness as a Design for
Teaching a College Level Bowling Course

Presentation Formats	PSI evaluations (course effectiveness)	
	Mean	Standard Error
T	2.94	0.22
TG	3.39	0.28
TGA	3.64	0.26

Table 9

Dunn's Method All Pairwise Multiple Comparison Procedures on

Mean Perceptions of PSI

Response Variable: **PSI Promoting Increased Skill**

Comparison	Diff. of Ranks	P	Q	P < .05
TGA vs T	15.26	3	3.24	p < .01
TGA vs TG	8.72	2	1.88	N.S.
TG vs T	6.54	2	1.48	N.S.

Response Variable: **PSI Promoting Increased Knowledge**

Comparison	Diff. of Ranks	P	Q	P < .05
TGA vs T	14.80	3	3.09	p < .01
TGA vs TG	7.41	2	1.57	N.S.
TG vs T	7.39	2	1.65	N.S.

provided mean scores on their perceptions of unit presentation format's: (a) ability to promote increased skill in converting spares, (b) ability to promote increased knowledge concerning spare conversion, and (c) effectiveness of the format as a means to provide information for improving spare conversion. A Kruskal-Wallace one way ANOVA on ranks was performed to detect differences among presentation groups mean perceptions of specific spare conversion unit formats. Presentation groups' mean values of specific spare conversion unit formats were compared promoting increased skill, promoting increased knowledge, and effectiveness providing information concerning spare conversion. Statistical analyses observed no significant differences existed among groups.

Unit presentation format's ability to promote increased skill in converting spares. Analysis of unit presentation format's ability to promote increased skill in converting spares compared the mean scores of student ratings of unit presentation format's ability to promote increased skill among the three presentation groups. Table 10 presents the means of student ratings among the three presentation groups.

Mean ratings among each presentation group ranged from low of 3.06 (T) to high of 3.28 (TG). Statistical analysis of data suggests that no significant difference exists among presentation groups ($p = .98$).

Table 10

Mean Perceptions of Specific Spare Conversion Unit Format's
Ability to Promote Increased Skill

| Presentation Formats | Unit evaluations (promote skill) | |
	Mean	Standard Error
T	3.06	0.24
TG	3.28	0.21
TGA	3.21	0.21

Unit presentation format's ability to promote increased knowledge in converting spares. Analysis of unit presentation format's ability to promote increased knowledge in converting spares compared the mean scores of student ratings of unit presentation format's ability to promote increased knowledge. Table 11 presents the means of student ratings among the three presentation groups.

Mean ratings among each presentation group ranged from a low of 3.24 (T) to a high of 3.39 (TG). Statistical analysis of data suggests that the mean values among presentation groups showed no significant difference (p = .99).

Unit presentation format's effectiveness as a means to provide information for improving spare conversion. Analysis of each unit presentation format's effectiveness as a means to provide information for improving spare conversion compared the mean scores of student ratings of unit presentation format's effectiveness as a means to provide information for improving spare conversion. Table 12 presents the means of student ratings among the three presentation groups.

Mean ratings among each presentation group ranged from a low of 3.0 (TGA) to a high of 3.29 (T). Statistical analysis of data suggests that the diversity in the mean values among presentation groups showed no significant difference (p = .86).

Table 11

Mean Perceptions of Specific Spare Conversion Unit Format's Ability to Promote Increased Knowledge

Presentation Formats	Unit evaluations (promote knowledge)	
	Mean	Standard Error
T	3.24	0.22
TG	3.39	0.27
TGA	3.36	0.31

Table 12

Mean Perceptions of Specific Spare Conversion Unit Format's

Effectiveness Providing Information for Improving Spare

Conversion

Presentation Formats	Unit evaluations (effectiveness)	
	Mean	Standard Error
T	3.29	0.21
TG	3.22	0.11
TGA	3.00	0.28

In summary, comparison of students perceptions of specific spare conversion formats were analyzed. Based on a Kruskal-Wallace one way ANOVA on ranks, mean scores of group perceptions suggested that no significant differences were found to exist among the three presentation groups.

Summary

In summary, data from ten comparisons of three presentation formats were analyzed to determine significant statistical differences existing among each. Although visual examination appeared to display differences in several mean scores, statistical analyses indicated that only the students' mean perception of PSI promoting increased skill and knowledge displayed significant statistical differences.

Results from this chapter indicated that little to no significant difference existing in learning, as measured by mean percent of spares converted, among the three presentation formats applied in a spare conversion unit as part of a PSI college level bowling course. The next chapter will discuss some possible reasons and discuss this lack of difference and suggest conclusions that can be drawn from the results of the analyses and how the data might relate to these conclusions.

Chapter V

Summary and Conclusions

The purpose of this study was to examine three presentation formats delivering information in a PSI college level bowling course. Two sources of data were analyzed to develop comparisons of formats: (a) spare conversion skills test and (b) student evaluations. Each source of data was analyzed to produce four sets of results.

Kozma (1991) suggests that the use of a different form of presentation may impact upon the learners' ability when compared to another form of presentation providing information. This chapter was designed to examine the results of comparing three presentation formats used for providing information and how they influenced students' performance and perceptions when applied in a spare conversion unit as a part of a PSI designed college level bowling course. This information will be divided into four sections:

1) Review of the Study

2) Course Design

3) Discussion

4) Conclusions

Review of the Study

The United States is witnessing a growth in the demand for physical activity. Higher education addresses this growth through Basic Instructional Programs (BIP) which provide

students with exposure to the physical education curriculum
(Trimble & Hensley, 1984). While no solid empirical evidence
exists, the most common form of instruction in the BIP appears
to be "whole class" instruction (Siedentop, 1991, p. 19).

Whole-class instruction is most commonly associated with
Mosston and Ashworth's (1994) practice style of teaching.
This instructional strategy is based on the teacher providing
the whole class with skill related information with little to
no consideration of individual differences. Meeting students'
individual needs and interests should be uppermost if the
acquisition of motor skills is to be a successful and
enjoyable experience (Singer & Dick, 1974). If individual
instruction cannot be realized, traditional methods of
teaching must be reevaluated and alternative instructional
approaches must be examined. One such alternative is Keller's
Personalized System of Instruction (PSI) (Cregger & Metzler,
1991).

PSI provides individualized instruction, allowing each
student the opportunity to learn at his/her own rate, largely
independent from the teacher. Keller's original PSI design
emphasized the use of the written word to increase task
performance by allowing teachers to concentrate on providing
skill related information (Keller & Sherman, 1974).

Text delivery in PSI appears to allow more efficient use
of class time when compared to verbal instruction (Metzler,

1986, 1988). However, recent developments suggest the need to examine the effectiveness of PSI when information is provided in alternative presentation formats in the psychomotor domain (Cregger & Metzler, 1991).

Several forms of content presentation have been adapted for use in Keller's PSI in physical education BIPs. These adaptations include text combined with graphics and use of video taped animation (Cregger & Metzler, 1992). However, research on the differences among the attributes of various media in the psychomotor domain appear limited at best (Metzler, Eddleman, Treanor, & Cregger, 1989).

With the advancement of educational technology the use of alternative presentation formats offers a viable alternative for promoting psychomotor learning. This study will look at instituting three types of presentation formats (text, text and static graphics, and text, static graphics, and animation) providing instruction in a PSI designed bowling course. Differences in presentation formats were determined by comparing the attributes of each presentation format in a spare conversion unit as a part of a PSI designed college level bowling course.

Course Design

The findings in this study indicated that of the ten comparisons, only two displayed a significant statistical difference within or among presentation groups. Those

displaying significant differences were based on student perceptions of the use of PSI. The following section identifies areas of the course design needing further development. A lack of significant learning gains suggests that the TGA design may not be significantly effective and perhaps needs further development.

The first area requiring further development is the number of trials used during the pre and post tests. Each pre and post test consisted of a total of ten trials in which students recorded the results of two balls during each trial. Each student's unit entry and exit skill level was based on percent of spare conversion in ten innings.

By limiting the number of test trials to ten students' skill in converting spares may not have been tested validly, and actual differences between pre and post test results may not have emerged. The low number of test trials may have caused a limitation in consistency producing little to no significant differences within or among any of the three presentation format groups. Baumgartner and Jackson (1987) supported this position be suggesting that the degree of consistency of a test increases with the number of trials within the test.

The second area of course design requiring further development was the amount of time used to conduct the pre and post tests. Each student was administered the pre-test prior

to entering the spare conversion unit. One day was allowed for pre-test completion. Once completing the pre-test the student began the first task in the unit. Following completion of the unit tasks each student was allowed one day to complete the post test.

Determining students' ability on pre and post tests conducted over a single day (one class period for each) can often provide a misleading account of students' true level of ability. By basing performance on a specific day, rather than actual ability level a false impression of average performance can occur. Performance can change from day to day. These changes in performance often fail to indicate a true change in ability level. Baumgartner and Jackson (1987) support the inaccuracy of daily variations in performance by suggesting that all performers have "good days" and "bad days" (p. 71).

One suggestion for indicating students' true ability level would be to lengthen the period over which the tests are administered to examine the mean percent of spares converted over an extended period of time. Bergman (1981) described lengthening the time over which the test is administered as the simplest way of increasing test score consistency.

Developing any instructional system design requires a large amount of "up-front" time to construct materials and procedural goals needed to achieve the desired course objectives (Cregger, 1991). Often the processes used during the system operations require revisions. These areas of

revision and further development are part of the research and development (R & D) process of an educational product in instructional designed courses (Cregger, 1991). One such revision may include the course assessment procedures. By increasing the number of trials and the period of time during both pre and post tests the opportunity of determining truer, consistent scores and learning differences within and among presentation formats may have emerged.

Discussion

This study looked at the differences among presentation formats introduced into a spare conversion unit. Analyses of data collected during the spare conversion unit of the PSI bowling course produced four sets of results: (a) learning effects during the spare conversion unit, (b) presentation format gains, (c) PSI course evaluations, and (d) spare conversion unit evaluations. Each set of results was analyzed based on a total of ten format comparisons. This section will examine and discuss the results of the data analyses conducted on each format comparison.

Learning Effects During the Spare Conversion Unit

The first set of results analyzed learning effects occurring among presentation formats applied during the spare conversion unit. In order to determine format differences data from three comparisons were analyzed: (a) mean percent of spares converted on post test scores within groups, (b)

mean percent of spares converted on pre and post tests within all groups across time, and (c) mean percent of spares converted within groups interacting with time.

In order for students to successfully perform any new skill it is necessary that a mental representation of the components in the skill are produced (Juaire & Pargman, 1991). In a pilot study on the use of PSI Keller and Sherman (1974) reported that in order for information to be most beneficial it is necessary that students be familiar with the form in which it is provided within the design. Kozma (1991) proposes that much of the information students receive is in the form of text provided through books, the most common presentation form encountered in educational settings. By providing the majority of information in the form of books students are often most familiar with the use of text.

Although, statistical analyses of results within this study failed to indicate familiarity of text providing significantly different performance. Although, the use of text as a presentation format demonstrated a higher mean percent of pre and post test spare conversion success, no significant differences existed among presentation groups (formats) in any of the three comparisons. Examination of mean spare conversion results indicated that the use of text as a presentation format was not significantly beneficial in increasing mean percent of spares converted among groups, across time, and among groups interacting with time.

Presentation Format Gains

The second set of results analyzed presentation format mean gains occurring from pre to post tests during the spare conversion unit. Differences within presentation formats were based on a single analysis: (a) mean gain scores on percent of spares converted from pre to post test.

As stated earlier, in order for students to understand the skills contained in a task they must develop a conceptual picture of the task. Often this picture enhances understanding of the components within a skill and the relationship of each in producing successful performance.

Resnick (1987) suggests that an important part of learning any skill is the understanding of the relationship between symbols and their use in a realistic performance and that the use of animation may enable the learner to understand the application of the information when attempting spare conversion. However, in an analysis of several animation studies Rieber (1989) concluded that when comparing groups using animation to those without, significant differences were not found among groups.

A statistical analyses of data revealed that there was no significant difference among presentation formats examined in this study. Although, a visual examination of the three groups indicated that the TGA group showed a higher positive change in the percent of spare converted from pre to post test, no

significant change in outcome was recording when the TGA group was compared among presentation groups without animation. Findings in this study suggest that the use of animation in presenting information provided no significant difference when compared with other presentation formats examined in this study.

PSI Course Evaluations

The next set of results analyzed student perceptions of PSI as the design implemented in a college level bowling course. PSI analyses were conducted on differences existing among presentation formats based on student evaluations. In order to determine differences among formats mean perceptions were analyzed using three comparisons: (a) mean student ratings of PSI's ability to promote increased skill, (b) mean student ratings of PSI's ability to promote increased knowledge, and (c) mean student ratings of PSI's effectiveness as a design for teaching college level bowing.

Analyses of data indicated significant differences were found to exist in PSI's ability to promote increased skill and knowledge. This difference may be attributed to introduction of computers providing information.

The use of a different form of presentation can often influence students' perception of the value of the information being presented. Rieber (1989) described this "novelty effect" (p. 9) as disguising the true value of introducing a new or alternative system as part of a course design.

Often when a new technology is introduced, students presume that it will improve their learning. In a study examining the effects of animated instruction and levels of practice in a computer-based lesson Rieber (1989) suggested that, "...new technologies have historically been prone to the misconception that they are innately superior to traditional approaches." (p. 2). Differences identified in the skill and knowledge comparisons among groups may be related to a misconception of the media rather than students' perception of the presentation format.

Despite the significant differences among students' perception of PSI increasing skill and knowledge, no difference was found among perceptions of PSI's effectiveness as a course design. In order for students to receive information needed prior to entering the spare unit (basic delivery skills) the amount of time in game competition was reduced. Students need to apply the skills they are attempting to develop in order for the tasks to be perceived as valuable (Resnick,1987). The lack of time in realistic game situations may have influenced students' perceptions of the effectiveness of PSI as the course design.

Spare Conversion Unit Evaluations

The final set of analyses examined student perceptions among specific formats used in the spare conversion unit, collected from student course evaluations. Differences among

presentation formats were analyzed using three comparisons: (a) unit presentation format's ability to promote increased skill in converting spares, (b) unit presentation format's ability to promote increased knowledge concerning spare conversion, and (c) unit presentation format's effectiveness as a means to provide information for improving spare conversion.

Statistical analyses of mean student perceptions indicated that no significant differences existed among presentation format comparisons. Although a visual examination of the mean scores suggested that the TG group displayed the highest rating in promoting skill and knowledge and the T group was highest in effectiveness in providing information, no presentation format introduced in the study displayed a difference among presentation of information.

Conclusions

As stated earlier, much of the research conducted on the use of alternative presentation formats as part of the PSI design has been conducted in the cognitive domain. Evidence from this study suggests that there appears to be no significant differences among presentation formats in promoting learning in this particular psychomotor context and content. Based on these results the value of continued research in presentation formats should be questioned.

This study was designed to examine the effects of three presentation formats and determine significant differences

existing among the three formats in a specific psychomotor setting. However, as a Research and Development (R & D) model, this study does not represent the final stage of development. Perhaps the formats and/or course design examined need to be altered in order to determine effectiveness in providing information.

Clark (1983) has suggested that effects of results of studies related to media are influenced by content, novelty, and/or teaching method. Perhaps by changing any of these three variable results would be altered.

However, regardless of any changes or alterations made, this study appears to deny any influence based on presentation formats in psychomotor learning implemented in a PSI college level bowling course. Based on the results produced in this study benefits gained from continued research on presentation formats in this particular context and content appear highly unlikely.

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Appendix A: Definitions

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Definitions

Animation - creation of an illusion of movement in a visual display by use of special effects. Examples include animated computer graphics (where the display on the screen is made to change in the required manner) and animated motion pictures (where a slowly-changing sequence of drawings is produced and show one frame at a time) (Ellington & Harris, 1986)

Class Content Information - any occurrence of a verbal comment or set of verbal comments combined into one theme by the teacher directed to the entire class. It concerns the structure or operation of the tasks performed and does not include verbal information provided to an individual (Metzler, 1990).

Computer-Assisted Instruction (CAI) - use of a computer as an integral part of an instructional system, with the learner generally engaging in real-time interaction with computer via a terminal (Ellington & Harris, 1986).

Computerized Video - the generation and/or display of graphic materials via a video player or recorder, using a computer, either in soft copy form on a visual display unit or in hard copy form produced by an electronic, optical or mechanical plotter or printer (Ellington & Harris, 1986).

Cues - information given by the teacher to a single student or group of students (can be whole class) that

contains a strategy, prerequisite knowledge, or skill analysis intended to prepare students for an upcoming skill attempt. A cue can impart information on the whole skill, or a partial feature of the skill (Metzler, 1990).

Educational Technology - a systematic way of designing, implementing and evaluating the total process of learning and teaching in terms of specific objectives, based on research in human learning and communication and employing a combination of human and non-human resources to bring about more effective instruction (Ellington & Harris, 1986).

Feedback - Information communicated by the teacher to students on the result or adequacy of a completed task trial or other class activity. This includes verbal and non-verbal feedback (Metzler, 1990).

Gain Scores (change scores) - results of a pretest-post test comparison between groups, used to determine direction and amount of one groups change compared to another. Scores are determined by subtracting the mean of the pretest scores from the mean of the post test scores on an identified performance (Thomas & Nelson, 1985).

Graphics - a general term for a two-dimensional illustrative or representational material(s), and for artwork, captions, lettering, photographs, etc. that are incorporated into a presentation of some sort (Ellington & Harris, 1986).

Guidance - Information communicated from the teacher to a single student or group of students during an active skill trial. The trial can be any portion of the skill attempted at any speed (Metzler, 1990).

Information Technology (IT) - a term covering all the different methods of storing, retrieving, transmitting, receiving and using information (Ellington & Harris, 1986).

Interactive Video - an individualized learning system in which a random-access videotape recorder or videodisc player is linked to a digital computer through a special interfacing system that enables visual material stored on videotape or videodisc to be incorporated into computer-based learning program administered via a computer. In such a system the user has some control over what (s)he see and hear, the level of interactivity depending on the design of the system (Ellington & Harris, 1986).

Instructional Design (ID) - the process of solving instructional problems by systematic analysis of the conditions of learning. It is based on the premise that learning should not occur in a haphazard manner but should be developed in accordance with orderly processes and have measurable outcomes (Seels & Glasgow, 1990).

Instructional Systems Development Model (ISD) - a systems approach for the orderly and comprehensive design, development, and management of both instructional materials and instructional systems (McCombs, 1986).

<u>Lecture / Demonstration</u> - content information given by the teacher. This includes skill demonstrations, explanations of rules and strategies, and information concerning tasks structure. This does not include lecture / demonstrations listed as tasks in the learning task sequence, responses to student questions, and any information that is provided to students on a one-to-one basis which is unrelated to skill attempts (Metzler, 1990).

<u>Management</u> - teacher activities not directly related to class instructional goals and/or class content. These include taking roll, setting up equipment, giving directions about class organization, and performing administrative functions. It does not include responses to students' questions concerning positioning when performing a task (Metzler, 1990).

<u>Mastery Based</u> - frequent responses by students which produce specified consequences. Repeated testing and errors result in remediation rather than penalties which enable the student to progress toward the specified outcome or goal (Keller & Sherman, 1974).

<u>Media</u> - the physical tools if instructional technology, including printed materials, videotapes, films, filmstrips, slides, and other various combinations thereof (Ellington & Harris, 1986).

<u>Novice Spare Conversion System (NSCS)</u> - system designed to give bowlers logical, planned adjustments to convert all

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the 1,023 separate spare combinations and possible leaves in bowling (Russell, 1980).

Personalized System of Instruction (PSI) - an instructional design in which students determine their own rate and amount of learning by movement through a progression of tasks. PSI includes five defining characteristics: (a) stress on the written word, (b) teacher as motivator, (c) self-pacing, (d) mastery-based learning, and (e) use of student proctors (Keller & Sherman, 1974).

Research and Development (R & D) - systematic process for developing and validating an educational product (Ciccaglione, 1986, p.9).

Self-Pacing - students move at their own rate and ability level through a step-by-step progression without the teacher acting as a guide (Keller, 1974).

Skill Practice - time provided by the teacher in which students are involved in active pursuit of skill acquisition, including and limited to all designated tasks identified on learning task sequence sheets. Time students spend getting ready to make an attempt and watching the results of a trial are considered practice. This includes task lecture / demonstration, working on study guides, and taking written tests that are listed as tasks in the learning task sequence. Time allocated for active participation in scrimmages and games is recorded in this category (Metzler, 1990).

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Systems Approach - the planning of instruction in a highly systematic manner, with attention to the consistency and compatibility of technical knowledge at each point of the decision (Gagne, Briggs, & Wager, 1988, p. 15).

Text - information that is presented in alphanumerical rather than graphical form (Ellington & Harris, 1986).

Appendix B: Pre/Post Test Scoring Sheets

PRE-TEST 2

Beginning Bowling

Name: _____

Ability Level: ____ Adv. ____ Int. ____ Beg.

Grade Level: ____ Fr. ____ So. ____ Jr. ____ Se. ____ Gr.

Observer: _____

Sex: ____ M ____ F

Playing Experience: ____ yrs.

Age: ____ yrs. ____ mos.

No.	NAME:	1	2	3	4	5	6
		7	8	9	10		

Total Pick-ups: ____   Spare Attempts: ____   Date: ____

No.	NAME:	1	2	3	4	5	6
		7	8	9	10		

Total Pick-ups: ____   Spare Attempts: ____   Date: ____

Group: ____ T ____ T&D ____ CAI   Instructor/Course Proctor: _____

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Post Test

Beginning Bowling

Observer: _____

Name: _____

Ability Level: ____ Adv. ____ Int. ____ Beg.
Grade Level: ____ Fr. ____ So. ____ Jr. ____ Se. ____ Gr.

Sex: ____ M ____ F   Age: ____ yrs. ____ mos.

Playing Experience: ____ yrs.

No.	1	2	3	4	5	6
NAME:						
	7	8	9	10		Total Pick-ups: ____ Date: ____
						Spare Attempts:

No.	1	2	3	4	5	6
NAME:						
	7	8	9	10		Total Pick-ups: ____ Date: ____
						Spare Attempts:

Group: ____ T ____ T&D ____ CAI   Instructor/Course Proctor: _____

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Appendix C: Course Policy Guide

Course P.S.I. Manual

Beginning Bowling

POLICY GUIDE

INSTRUCTOR INFORMATION:

Name: Ron Cregger   **Office Ph. #:**   703-231-4900

Office: 120   **Home Ph. #:**   703-389-1327

                                                (Not After 10:00p.m.)

OFFICE HOURS: By appointment only!

MATERIALS:

1.   Strickland, R.H.   (1989).   Bowling: Steps to success.
Leisure Press: Champaign, IL.

2.   Class Manual

COURSE GOAL: Upon completion of this course, you will be able to perform the fundamental skills necessary to participate in the game of bowling.

COURSE DESCRIPTION: This course is designed to provide basic instruction in the fundamentals of bowling by utilizing Keller's Personalized System of Instruction (PSI). PSI will allow the student to progress at their own pace as they move through several learning drills and mastery task trials. The student will not be held back or penalized by other students, or forced to proceed before they are ready. Once the course is completed game play will begin. However, how fast the course is completed is up to the student.

PERFORMANCE OBJECTIVES: Performance will consist of the fundamental psychomotor and cognitive skills required to participate in the game of bowling. The course consists of a series of learning task sheets outlining a group of leaning drills and mastery task trials. Tasks are divided into several units sequenced in numerical order. Each unit is divided into a series of learning tasks with criterion designed to demonstrate development of the skills used in the game of bowling.

STUDENT RESPONSIBILITIES: All students will be responsible for: (a) attending class every day prior to or at class starting time. (b) immediately beginning work on the current drill and/or task, (c) progressing through the drills and tasks in a sequential order (no drill or task can begin until the individual has reached criterion on the previous drill or task), (d) performing all drills and tasks as described in the learning task sheets, (e) read all class materials and class text assigned, (f) follow all procedures as described in the class manual and/or unit booklet, and (g) meet all grading criteria described in the class manual

PARTICIPATION REQUIREMENT: All students are required to participate in at least 70% of the activity sessions. These requirements apply to instructional periods, quizzes, exams, skills evaluations, pre & post testing, game play, etc. If this participation level cannot be met, whatever the reason,

the student shall withdraw from the course or receive a grade of "I". Make-up sessions will not normally be available.

TEACHER RESPONSIBILITIES: The instructor will be responsible for providing cues, guidance, and feedback to aid in student drill and task progression. However, the students should be able to move independently through the course by following information provided in the class manual and/or unit booklet. The instructor will be responsible for generating and providing materials needed to understand course operations and providing a final evaluation of each student.

COURSE PROCTOR: This course will provide a "Course Proctor". The proctor will be able to provide information related to student performance. This will allow the instructor to move more freely between each student within the class. Often the proctor will be acting as the individual verifying criterion on many of the drills and/or tasks.

COURSE MANUAL: Once the students have completed all preliminary administrative duties each will receive a class manual. The manual will contain; (a) class policy guide, (b) criterion task summary sheet, and (c) learning task sheets.

A. Learning Task Sheets: All class manuals will contain 12 learning task sheets (2 learning task sheets will be contained in the spare conversion booklets). These sheets describe drills and tasks , drills and task targets, drills and task criteria, task completion dates, and when appropriate diagrams

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will be provided as an aid to task completion. Once the students have completed the pre-test each student will collect the class manual from the instructor. Once the manuals have ben received the students will begin working on the tasks following the sequences provided in the criterion task summary sheet. Beginning with the worm-up/stretching unit all tasks will be followed in sequential order with no task beginning until the prior task has reached criteria.

a. Tasks Sequence: Each task is numbered to indicate the proper progression. Any task with an asterisks proceeding the task number indicates that task completion must be witnessed by the instructor.

b. Drills/Task Criterion: Drills and task criterion indicate the amount of successful trials or appropriate performance necessary in order to complete the drills and/or tasks and progressing in the sequence.

c. Drills/Task Completion Dates: Dates are to be placed in the space provided indicating the date criterion has been achieved for each learning task sheet.

d. Drill/Task Diagrams: Some learning tasks and/or drills are accompanied by a diagram which indicates the performance of the drills and tasks. These diagrams will include the position which the ball should be released from, the area defining the target where the ball should be placed, and how the drill or task will be performed.

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GRADING CRITERIA:

1. Cognitive:

a. During the course, the student will demonstrate their knowledge of components in bowling by taking 4 quizzes as a part of the PSI sequence. These quizzes are indicated as mastery performance tasks in 4 of the learning task sheets. Each quiz will be taken until the student has met designated mastery criterion and signed off by the course proctor or instructor. Each of these quizzes will be recorded as part of the cognitive grade.

b. At the completion of the course the student will take a final exam to demonstrate their understanding of the psychomotor aspects of the game and the basic fundamentals of rules, scoring, and strategy associated with the game of bowling.

    1)   Quizzes......................... 40%

    2)   Final Exam.................. 60%

2. Psychomotor:

a. The student must complete 100% of the drills and tasks prior to taking the final exam. 100% of the learning task sheets' drills and mastery performance tasks reached to criterion must be meet in order to pass the course.

3. Summary: To pass the course the student must score at least 70% on the cognitive grade (determined by quizzes and

final exam), compete 100% of the drills and tasks, and meet all participation requirements.

INSTRUCTOR'S NOTE: Any student which has any unforeseen problem which will affect their participation should contact the instructor **immediately**. I will work with you any way that I deem to be reasonable, however, I must know about the problem as soon as possible.

Appendix D: Criterion Summary Sheet

Virginia Tech
Basic Instruction Program
Beginning Bowling

Student's Name: _____

(Please Print)

UNIT NUMBER	UNITS / TASKS	DATE BEGIN	END
Unit One	Warm-Up & Stretching		
	*1. warm-up & stretching quiz		
Unit Two	Approach		
	2. set-up		
	3. footwork		
Unit Three	Delivery		
	4. take away		
	5. push away		
	6. pendulum swing		
	7. ball dynamics		
	*8. utility delivery quiz		
Unit Four	Strike Targeting		
	9. aiming		
	*10. target points		
Unit Five	Spare Conversion		
	11. spare conversion media quiz		
	12. common spare pick-up		
Unit Six	Rules & Scoring		
	*13. rules & scoring quiz		
	*14. handicapping quiz		

4-Person team Tournament

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Appendix E: Learning Task Sheets

WARM-UP / STRETCHING LEARNING TASK SHEET

*Task 1

Warm-up/Stretching Quiz

Mastery Performance Task:

1. Study pages 19 - 21 of the course textbook.

2. Contact the instructor or course proctor and request to take the quiz on warming-up and stretching. To complete this task, you must score at least 70% on the test. If you are unsuccessful, you may retake the test during another class period. Have the instructor or course proctor place his/her initials here _____ when the test has been passed.

    This test was completed _____.

                                    (Date)

APPROACH LEARNING TASK SHEET

Task 2

Set-Up

Drills:

1.   Study pages 22 - 28 and 32 - 34 of the course textbook.

2.   Do all the checkpoints discussed in the Preparation and Execution Phases.

3.   Take turns with your partner. Pick up your ball and perform the set-up for the 4-step approach. When ready use your ball and act out each key as you recite your intentions (the key points) to your partner. Your partner will check your performance. Repeat this drill until each key is identified in the correct sequence 4 times. Have your partner place their initials here _____ when the drill has been completed.

Mastery Performance Tasks:

1.   Pick up your ball and using the 4-step approach roll the ball down the lane. Prior to rolling the ball identify the key points in the Preparation, Execution, and Recovery Phases of the set-up. Roll the ball beginning with each key point of the set-up. Your partner will check your performance. Repeat this process for 8 trials. To complete this task, you must

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perform 8 consecutive set-ups, verified by your partner, using the key points on each set-up. Have your partner place their initials here _____ when the drill has been completed.

This task was completed _____.

(Date)

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APPROACH LEARNING TASK SHEET

Task 3

Footwork

Drills:

1.   Study pages 46 - 51 and 54 - 56 of the course textbook.

2.   Perform the 4-step approach using the checkpoints discussed in the Preparation and Recovery Phases.

3.   Take turns with your partner. Step up to the approach starting point **(see Fig. T-3A on pg. 5 of this manual)**. When ready, without using a ball, walk through the 4-step approach using the key points in the Preparation, Execution, and Recovery Phases of footwork. Your partner will check your performance. Repeat this drill until each key is identified in the correct sequence 4 times. Have your partner place their initials here _____ when the drill has been completed.

4.   Step up to the approach starting point **(see Fig. T-3A on pg. 5 of this manual)**. When ready perform the 4-step to roll a ball.   During delivery use the key points in the Preparation, Execution, and Recovery Phases of footwork. Your partner will verify your performance. Repeat this process for 4 trials.   To complete this task, you must perform 4

consecutive trials using the correct 4-step approach, as identified in the text. Your partner will determine if the key points were used on each roll. Have your partner place their initials here _____ when the drill has been completed.

Mastery Performance Tasks:

1.   Step up to the approach starting point **(see Fig. T-3B on pg. 5 of this manual)**. When ready, without a ball, perform the 4-step approach using the key points in the Preparation, Execution, and Recovery Phases of footwork. Using a piece of tape, provided by the instructor, place the tape at the front foot at the end of the approach. Repeat this process, moving the tape each time until the tape is place 2-4 inches from the foul line. Continue this process until the tape remains in the same place for 6 consecutive approaches.

2.   Once the tape is placed 2-4 inches from the foul line turn and pace off 4 steps from the tape (add a half step for the slide) to establish a starting position. Pick up your ball and using the 4-step approach roll the ball down the lane using each key point of the Phases of footwork in the approach. Roll the ball from this starting position and notice how close your forward foot is to the tape. Readjust the tape until your forward foot is ending within 2-4 inches from the foul line. To complete this task, you must perform 8 consecutive rolls without moving the tape. Have your

partner place their initials here _____ when the drill has been completed.

This task was completed _____.

(Date)

APPROACH LEARNING TASK SHEET
Task 3

Fig. T-3A

Fig. T-3B

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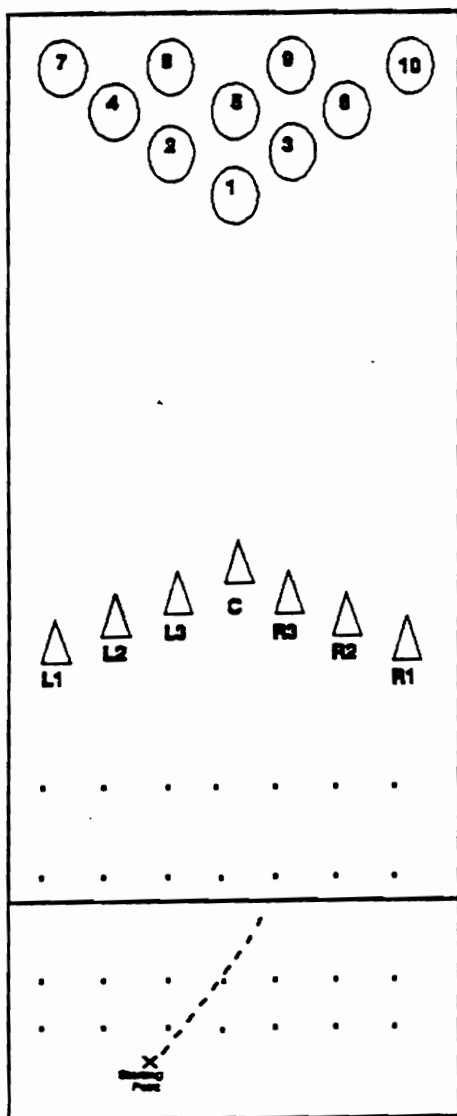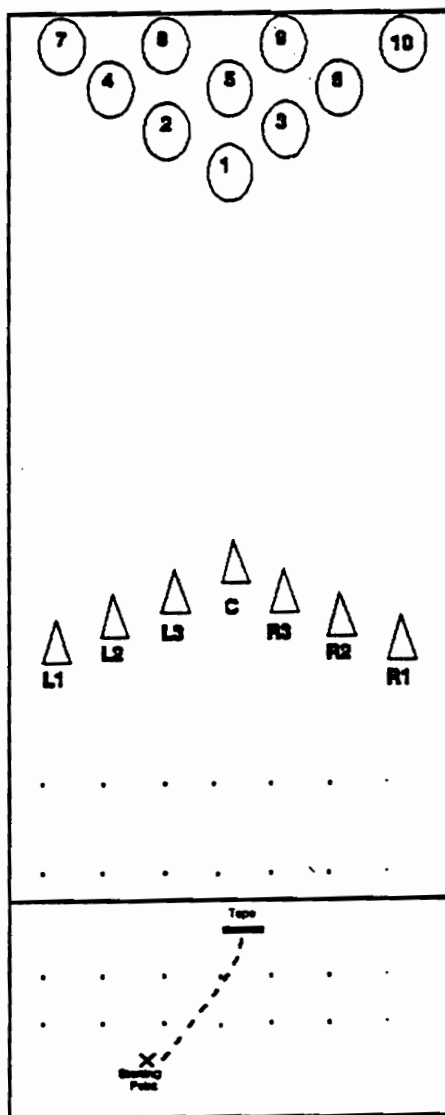
DELIVERY LEARNING TASK SHEET

Task 4

Take Away

Drills:

1.   Study pages 106 - 107 of the course textbook.

2.   Assume the set-up for a 4-step approach. Have your partner stand facing you and supporting the weight of your ball. Place your non-dominant hand underneath the ball. When you feel ready to allow the ball to swing say "one." Upon hearing this, your partner should let the ball slowly fall into the swing. Standing erect allow the ball to fall into the swing.

As the ball begins its fall, execute the take away and point the opposite arm (balance arm) out and to the side. Allow the ball to swing forward until it is back into your partner's hand. Allow the ball's momentum to carry it to shoulder height as it moves back and waist high as it moves forward. Repeat this drill 10 times so that it feels natural. Have your partner place their initials here _____ when the drill has been completed.

Mastery Performance Tasks:

1.   Assume the set-up position 1.5 steps from the foul line

(see Fig. T-4A on pg. 8 of this manual). Allow the ball drop naturally so that the momentum allows it to travel to the rear approximately shoulder height. Position non-ball arm so that it is pointing out to the side. Take 1 step/slide and roll the ball. (Do not force the ball forward. Allow the momentum from the back swing to take the ball forward while bending at the knees.) Deliver the ball down the lane. Repeat this task with 8 consecutive trials rolling the ball without it falling into the gutter. Have your partner place their initials here _____ when the task has been completed.

2.   Assume the set-up for a 4-step approach. On the first step allow the ball to drop naturally so that the momentum allows it to travel to the rear approximately shoulder height. Position your non-ball arm so that it is pointing out to the side. As you move toward the foul line allow the balls momentum to advance the ball so that it is rolled down the lane. (Do not force the ball forward. Allow the momentum from the back swing to take the ball forward and bending at the knees roll the ball down the lane.) To complete this task, 8 consecutive balls must move down the lane without falling into the gutter. Have your partner place their initials here _____ when the drill has been completed.

   **This task was completed** _____.

<div align="center">(Date)</div>

DELIVERY LEARNING TASK SHEET
Task 4

Fig. T-4A

8
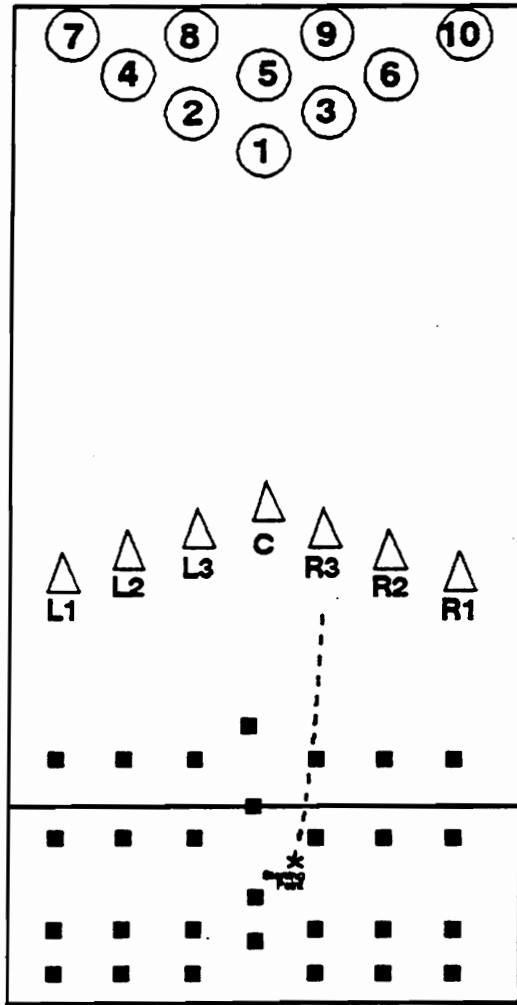
DELIVERY LEARNING TASK SHEET

Task 5

Push Away

Drills:

1. Study pages 111 - 112 and 119 - 120 of the course textbook.

2. Pick up your ball and assume the set-up position for the 4-step approach. Have your partner take a position directly in front of you. Your partner will and hold their arms out so that their hands are positioned 2-3 inches higher than your ball's position in your set-up position. Your partner should be ready for you to place your ball into their hands.

Begin counting the cadence aloud ("one," "two," et.) and on the count of "four" use both hands to push the ball forward so that it moves into your partner's hands. (Do not take a step forward.) Allow the momentum to gently carry the ball forward and up. Concentrate on keeping your back and shoulders stable and your bowling arm relaxed. Repeat this drill 6 times. Have your partner place their initials here _____ when the drill has been completed.

Mastery Performance Tasks:

1.   Pick up your ball and assume the set-up position 1.5 steps from the foul line **(see Fig. T-5A on pg. 11 of this manual).**   Allow the to ball drop naturally so that the momentum allows it to travel rearward and then forward so that it is directly in front of your body.   Take one step, bend your knees, and keeping your back straight roll the ball. Allow the momentum from the back swing to move the ball forward and extend your arm forward straight ahead.   Repeat this task with 8 consecutive balls so that the ball travels down the lane without falling into the gutter.   Have your partner place their initials here _____ when the drill has been completed.

2.   Pick up your ball and assume the set-up for a 4-step approach.   On the first step of the approach allow the ball to drop naturally so that the momentum allows it to travel to the rear at approximately shoulder height.   Position the non-ball arm so that it is pointing out to the side.   As you move toward the foul line push the ball directly in front of your body and forward.   Allow the momentum from the back swing to take the ball forward and extending the arm straight ahead roll the ball down the lane.   To complete this task, you must roll the ball 8 consecutive times without the ball falling into the gutter.   Have your partner

place their initials here _____ when the drill has been
completed.

    This task was completed _____.

<div align="center">(Date)</div>

DELIVERY LEARNING TASK SHEET
Task 5

Fig. T-5A

11
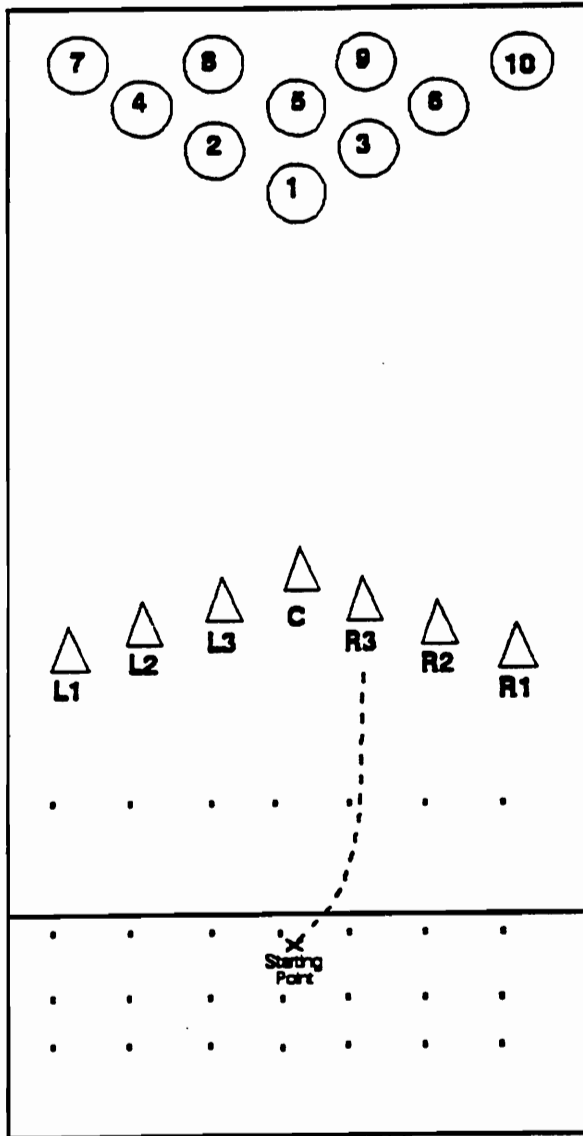
DELIVERY LEARNING TASK SHEET

Task 6

Pendulum Swing

Drills:

1.   Study pages 35 - 39 of the course textbook.

2.   Walk through the 4-step approach using the checkpoints discussed in the Preparation and Recovery Phases.

3.   Assume the set-up position 1.5 steps from the foul line **(see Fig. T-6A on pg. 14 of this manual).** Bring the ball into a back swing position directly behind your body. Roll the ball taking 1 step/slide, bend your knees, keeping your back straight with your body position square to the pins. Allow the momentum from the back swing to take the ball forward and extend your arm forward straight out and ahead. Repeat this task aiming for 6 consecutive trials so that the ball moves down the lane without falling into the gutter. Have your partner place their initials here _____ when the drill has been completed.

4.   Select a dart on the lane. Assume the set-up position 1.5 steps from the foul line **(see Fig. T-6A on pg. 14 of this manual).** bring the ball into a back swing position directly behind your body. Take one step, bend your knees, keeping

your back straight with your body positioned square to the pins. Roll the ball with your arm extending in the direction of the identified dart. Allow the momentum from the back swing to take the ball forward and extend your arm straight out and forward. Repeat this task from 6 different darts. The drill is completed when each of the 6 balls have crossed each dart identified. Have your partner place their initials here _____ when the drill has been completed.

Mastery Performance Tasks:

1.   Step up to the approach starting point **(see Fig. T-6A on pg. 14 of this manual).** When ready roll a ball using the key points in the Preparation, Execution, and Recovery Phases of the pendulum swing. Repeat this process for 8 trials. To complete this task, you must roll 8 consecutive balls so that they travel down the lane in a straight path. Have your partner place their initials here _____ when the drill has been completed.

   This task was completed _____.

<center>(Date)</center>

DELIVERY LEARNING TASK SHEET
Task 6

Fig. T-6A

Fig. T-6B

14
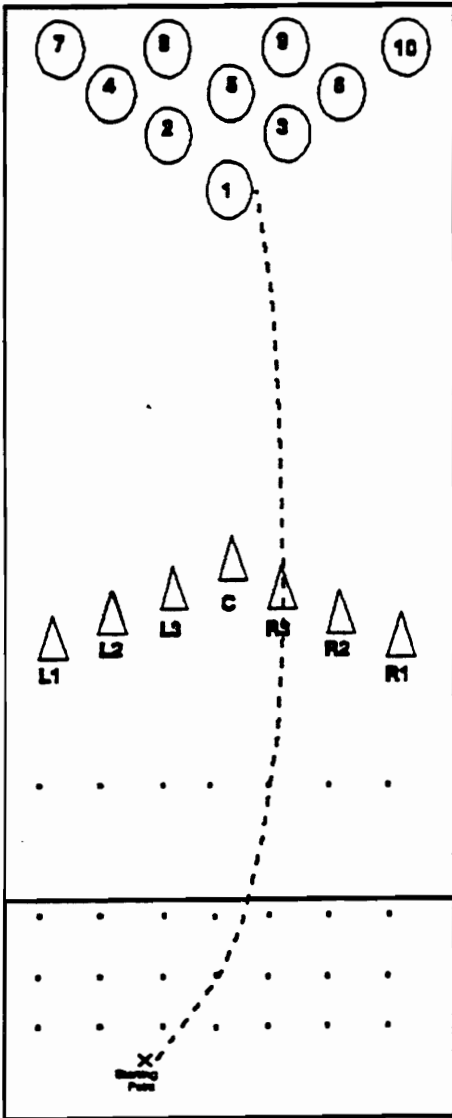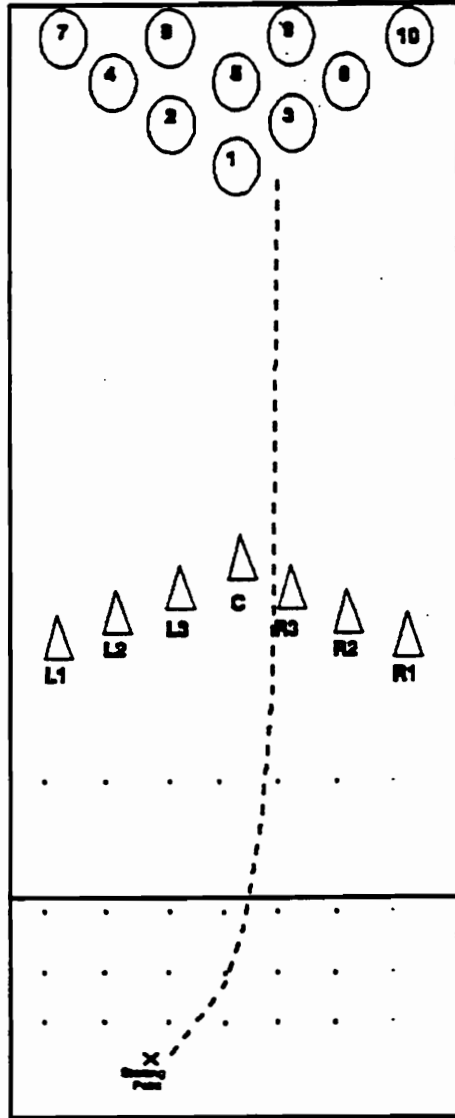
DELIVERY LEARNING TASK SHEET

Task 7

Ball Dynamics

Drills:

1. Study pages 63 - 77 of the course textbook.

2. Do all the check points discussed in the Preparation, Execution, and Recovery Phases. Alternate between the hook ball and the straight ball.

3. Take turns with your partner. Pick up your ball and walk through the delivery of the straight ball. Repeat the process for a hook ball. Your partner will check your performance. Repeat this drill until each key is identified in the correct sequence 4 times. Have your partner place their initials here _____ when the drill has been completed.

Mastery Performance Tasks:

1. Pick up your ball and assume the set-up for a 4 step approach. Turn to your partner and identify which pin you will try and contact and describe the type of ball path (straight or hook) you will be using. Based on the ball path identified state which dart the ball should cross. Using the 4-step delivery roll the ball attempting to meet all the conditions described. To complete this task, you must roll 4

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consecutive straight balls **(see Fig. T-7A on pg. 16 of this manual)** and 4 consecutive hooks **(see Fig. T-7B on pg. 16 of this manual)** so that each ball crosses the darts and pins described to your partner. Have your partner place their initials here _____ when the task has been completed.

This task was completed _____.

<div align="center">(Date)</div>

DELIVERY LEARNING TASK SHEET
Task 7

Fig. T-7A   Fig. T-7B

16
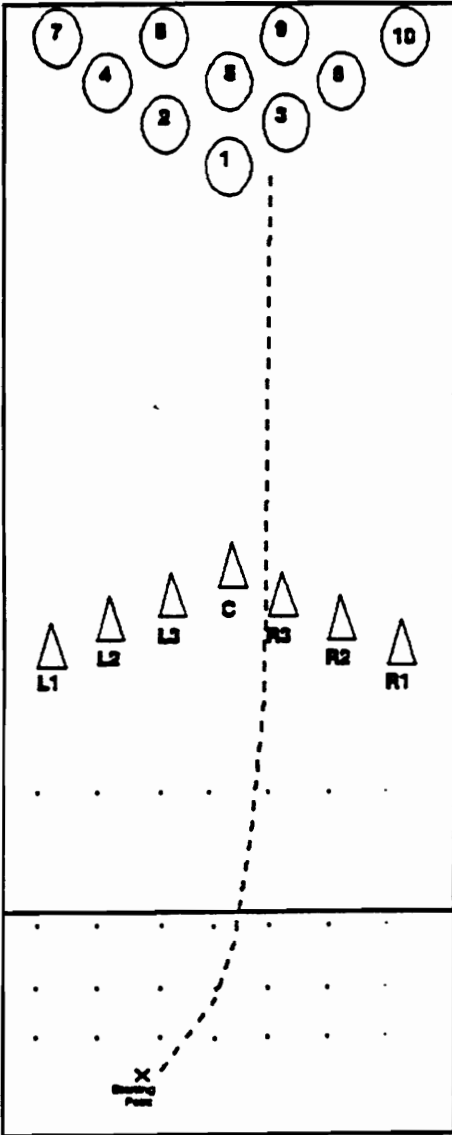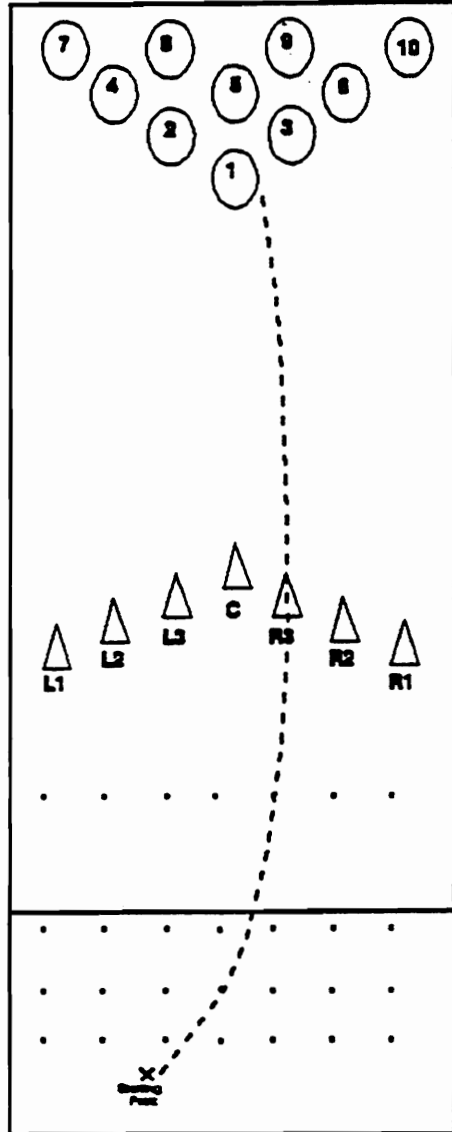
DELIVERY LEARNING TASK SHEET

*Task 8

Utility Delivery Quiz

Mastery Performance Task:

1. Review information on the psychomotor performance of bowling in the course textbook.

2. Contact the instructor or course proctor and request to take the quiz on the utility delivery. To complete this task, you must score at least 70% on the test. If you are unsuccessful, you may retake the test during another class period. Have the instructor or course proctor place his/her initials here _____ when the test has been passed.

This test was completed _____.

<div align="center">(Date)</div>

STRIKE TARGETING LEARNING TASK SHEET

Task 9

Aiming

Mastery Performance Task:

1.   Study pages 85 - 86 of the course textbook.

2.   Pick up your ball and assume the 4-step approach set-up. From the left/right side approach position (opposite side of dominant hand) deliver the ball across the 3rd dart (from dominant hand side) and using a slight hook attempt to place the ball in the strike pocket **(see Fig. T-9A on pg. 19 of this manual).**

Based on results make the necessary adjustments until the ball is placed in the strike pocket. From the determined strike position repeat this process for 8 balls. Continue until 6 of 8 attempts are placed in the strike pocket. Have your partner place their initials here _____ when the drill has been completed.

Mastery Performance Tasks:

1.   Pick up your ball and assume the 4-step approach set-up. Before rolling the ball declare your intended target line by identifying which dart the ball should cross and which key pin position the ball should contact or cross for each ball.

After each first ball attempt you partner should indicate if you hit the target line. If first ball attempt does not result in a strike reset the pins for the next attempt. To complete this task, you must roll 8 consecutive balls which cross the identified target points. Have your partner place their initials here _____ when the task has been completed.
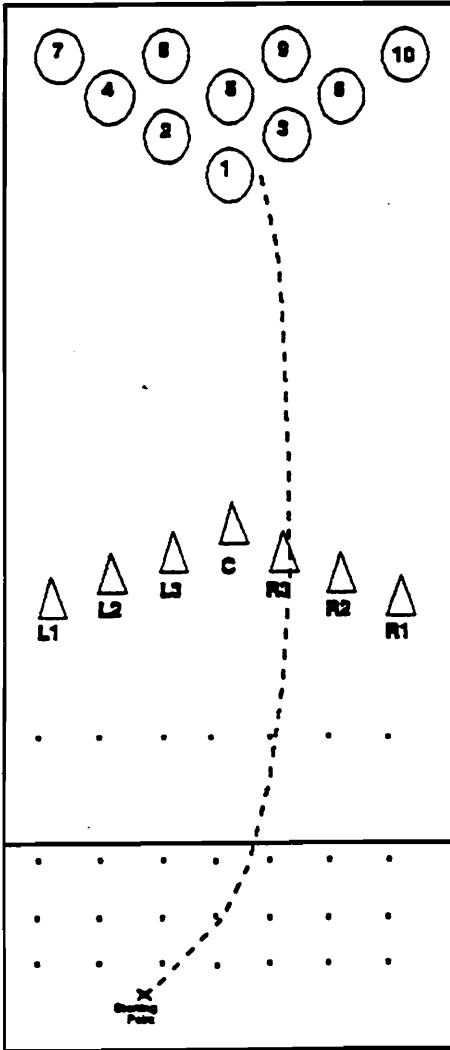

**This task was completed** _____.

(Date)

STRIKE TARGETING LEARNING TASK SHEET
Task 9

Fig. T-9A

19
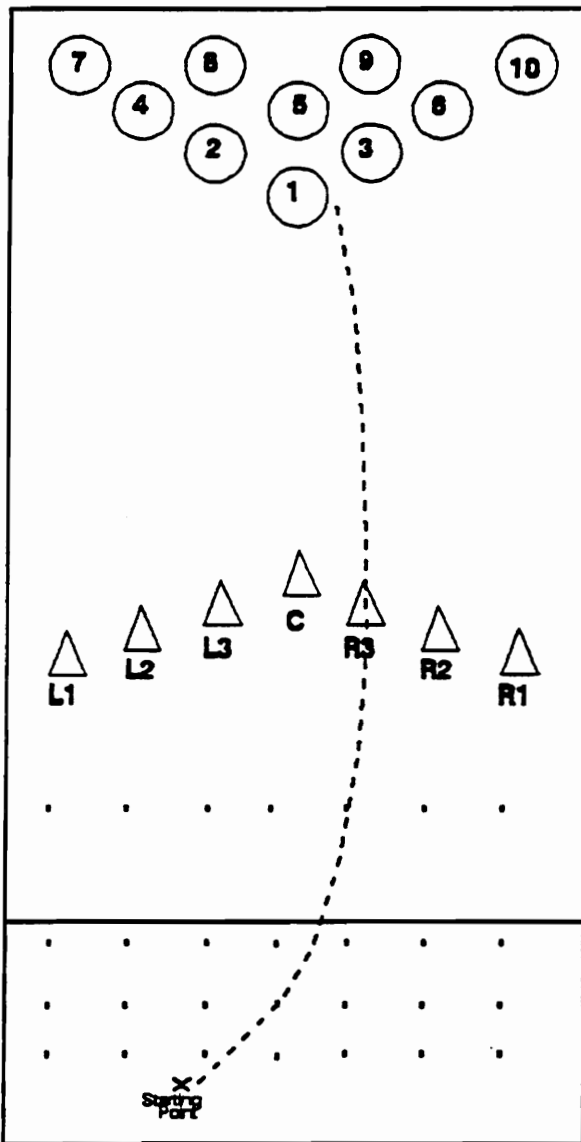
STRIKE TARGETING LEARNING TASK SHEET

*Task 10

*Target Points

Drills:

1.   Study pages 86 - 98 of the course textbook.

2.   Using steps 1 - 8 on pgs. 87-88 of the class text attempt to place your ball in the strike pocket. Reset the pins after each attempt.

Mastery Performance Tasks:

1.   This task uses the technique of shadow bowling. Once the first ball is rolled the pins will not reset.   The goal of this task is to cross the appropriate dart rather than focusing on the number of pins knocked down. Beginning from the left/right side (opposite of dominant hand) approach position deliver a ball so that is crosses the 3rd dart from the dominate hand side **(see Fig. T-10A and T-10B on pg. 21 of this manual).**

   Using the same side approach, deliver the ball so that it crosses the 2nd dart **(see Fig. T-10C and T-10D on pg. 22 of this manual).** Continue alternating until the ball has crossed each dart (2nd, then 3rd) 10 times, for a total of 20 successful trials. Have your partner place their

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initials here _____ when the task has been completed.

This task was completed _____.

STRIKE TARGETING LEARNING TASK SHEET
*Task 10

Fig. T-10A

Fig. T-10B

Right Hand
Dominance

Left Hand
Dominance

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STRIKE TARGETING LEARNING TASK SHEET
*Task 10

Fig. T-10C

Fig. T-10D

Right Hand
Dominance

Left Hand
Dominance

22

179
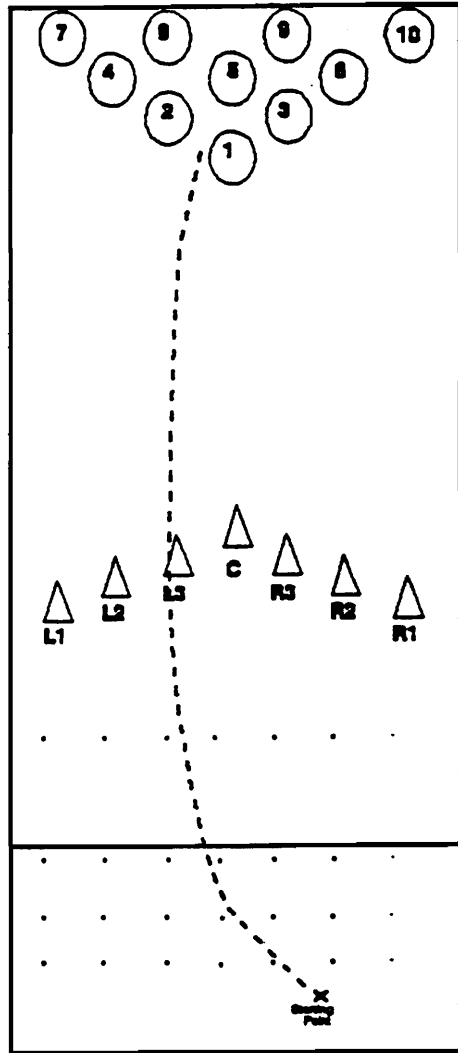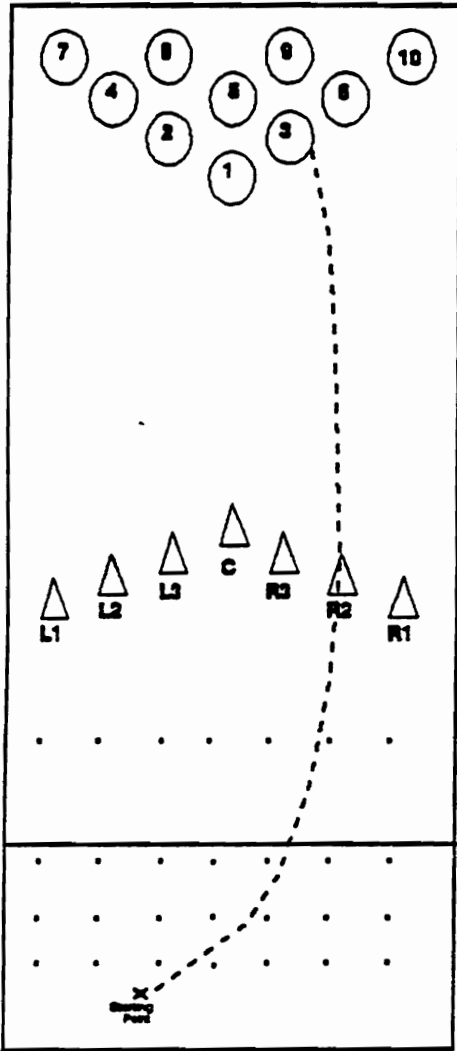
SPARE LEARNING TASK SHEET

Task 11

Spare Conversion Media Quiz

SEE THE COURSE INSTRUCTOR!

SPARE LEARNING TASK SHEET

Task 12

Common Spare Pick-Up

SEE THE COURSE INSTRUCTOR!

RULES / SCORING LEARNING TASK SHEET

*Task 13

*Rules & Scoring Quiz

Mastery Performance Task:

1.   Study pages 3 - 8 of the course textbook.

2.   Contact the instructor or course proctor and request to take the quiz on rules and scoring. To complete this task, you must score at least 70% on the test.   If you are unsuccessful, you may retake the test during another class period. Have the instructor or course proctor place his/her initials here _____ when the test has been passed.

This test was completed _____.

(Date)

RULES / SCORING LEARNING TASK SHEET

*Task 14

*Handicapping

Mastery Performance Tasks:

1.   Study pages 8 - 9 of the course textbook.

2.   Contact the instructor or course proctor to receive a list of scores of three game from four members of the class (only the instructor and course proctor will have the knowledge of the students' names).   Based on the scores provided by the instructor or course proctor you will be asked to identify the handicap of each member of the group your are given.   To complete this task, you must be correct on 3 of the 4 within the group.   If you are unsuccessful, you may retry during the next class period after receiving additional handicapping information from the instructor or course proctor.   Have the instructor or course proctor place his/her initials here _____ when the test has been passed.

This task was completed _____.

<div align="center">(Date)</div>

Appendix F: Innings Scoring Sheet

Task 12

Name: _____

Ability Level: ___ Adv. ___ Int. ___ Beg.

Grade Level: ___ Fr. ___ So. ___ Jr. ___ Se. ___ Gr.

Observer: _____

Sex: ___ M ___ F

Playing Experience: ___ yrs. ___ mos.

Age: ___ yrs. ___ mos.

No.	NAME:						
		1	2	3	4	5	6
		7	8	9	10	Total Pick-ups:	Spare Attempts:
						Date:	

No.	NAME:						
		1	2	3	4	5	6
		7	8	9	10	Total Pick-ups:	Spare Attempts:
						Date:	

Group: ___ T ___ T&D ___ CAI

Instructor/Course Proctor: _____

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Appendix G: NSCS Lane Target Positions

NOVICE SPARE CONVERSION SYSTEM

In this unit of the course students will attempt to convert spares using the Novice Spare Conversion System (NSCS).

The NSCS is based on the path of the ball moving along 3 positions on the lane. These positions are: (a) the correct approach starting point, (b) the path of the ball crossing over the correct lane dart, and (c) the ball crossing or contacting the correct key pin position.

The key pin position may or may not be occupied by a pin. In either situation the ball should cross that exact position as indicated by the mark on the screen.

KEY PIN POSITIONS

LANE DARTS

LEFT   RIGHT

APPROACH STARTING POINT

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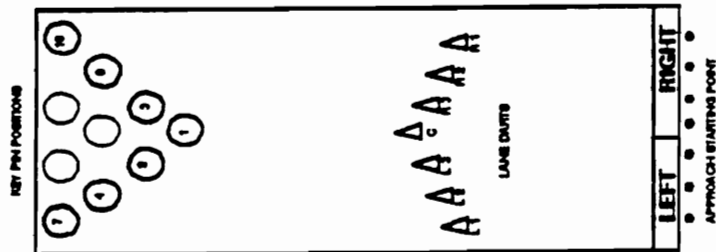
Appendix H: Observational Procedures

PROCEDURES FOR OBSERVATION

Part of your responsibilities as a member of this class is the ability to act as an observer and scorer during your partner's attempts at converting spares. As an observer and scorer it is necessary that you are able to correctly identify the path of your partner's ball during their spare conversion attempt.

In order to ensure that all students are able to correctly identify the target points necessary for promoting improvement of spare conversion during task twelve the following procedures for observation and scoring have been established. They will be provided in two parts (Part A and Part B).

Part A: **The following is a list of guidelines which should be followed when observing and scoring your partner's spare conversion attempts.**

1. **Location:** Dependent upon the hand with which the ball is being rolled, the observer/scorer should be positioned off the lane on the side opposite the ball hand and next to the scorer's table.

2. **Stance:** The observe/scorer should be standing during the spare conversion attempt in order to see the complete path of the student's ball. The path begins at the approach starting position and ends at the key pin contact position.

3. **Setting**: The observation will be conducted at the bowling lanes located in Squires Student Center. During observation verification the observer/scorer will be conducted on Lane 7.

4. **Information**: The observer will be able to clearly identify each target point the ball crosses during the spare conversion attempt. Any ball that does cross directly over the target point will be described as being located to the "right" or "left" of the correct target point. Special circumstances are described below:

   (a) **approach starting position** - if the bowler begins his/her approach from the middle or center of the approach starting positions (straddling the center locator dot) the staring approach is considered incorrect and adjustments will be determined to the right or left dependent upon the correct approach starting position (based on the spare produced).

   (b) **darts** - if the ball does not cross the appropriate dart all descriptions of "right" or "left" will be based on the ball's position related to the dart identified as correct. Also, any ball that does not cross the point of the dart will be deemed incorrect.

   (c) **key pin contact position** - if the ball does not cross the appropriate key pin contact position all descriptions of "right" or "left" will be based on the ball's position related to the key pin contact position identified as

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correct. Any ball that does not cross over the center of the correct key pin contact position will be deemed incorrect.

5. **Frame of Reference**: All directional information (right, left, etc.) will be based on the bowler's viewpoint as they are looking down the lane. Any reference to the position of a target point (first, second, third, etc.) will begin from the area of the lane located farthest from the pins.

6. **Target Points Identification**: The following information will be used to determine how each ball will be identified at the three target points used in the Novice Spare Conversion System.

(a) **Approach Starting Point** - The approach starting position will be determined by the bowler's position when beginning the 4-step approach. The side will be determined by the second set of seven locator dots on the lane positioned at the bowler's point of set up.

Any position located to the left of the center locator dot will be considered Left Starting Approach Position. Any position taken to the right of the center locator dot will be considered the Right Approach Starting Position. (See the diagram below.)
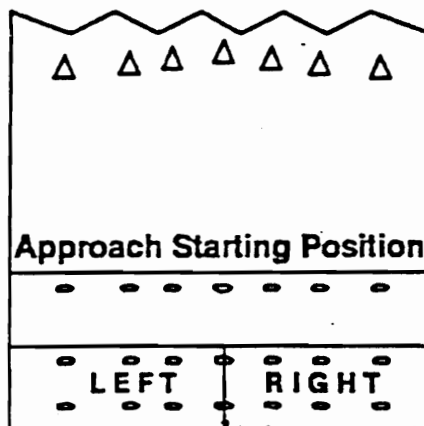
(b) <u>**Lane Darts**</u> - The dart which the ball crosses will be based on the ball's path covering the point of the dart as it travels down the lane. Corrections will be made based on the ball's position in relation to the correct dart. (See the diagram below.)

Darts

△ △ △ △ △ △ △
L1 L2 L3 C R3 R2 R1
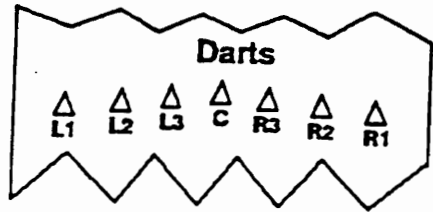
(c) <u>**Key Pin Contact Position**</u> - The pin contact position refers to the position where a pin would be placed at the beginning of each frame of bowling. The key pin position may or may not be occupied by a pin. In either situation, the ball should cross the exact center of the position as indicated by the diagram of pin positioning located above the end of the lane. (See the diagram below.)

⑦ ⑧ ⑨ ⑩
④ ⑤ ⑥
② ③
①
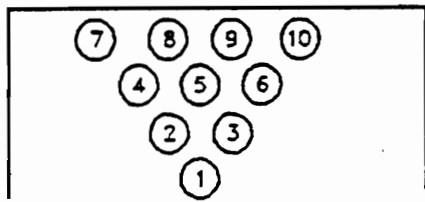
Key Pin Contact Positions

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Part B: Based on information contained above observation
verification will consist of describing the path of ten balls.
For each ball describe the target points crossed during each
ball roll.ed   Describe the information on the observation
sheets provided.

For this part of the procedure verification there is no
designated correct or incorrect target points. For each ball
provide information based on the path at each target point
without making a judgement of the correctness of the ball's
path. However, any ball that passes between two target points
a judgement must be made according to the point it most
closely contacts.

Ball One:

     Approach Starting Position - _____

                         Dart - _____

     Key Contact Position - _____

Ball Two:

     Approach Starting Position - _____

                         Dart - _____

     Key Contact Position - _____

Ball Three:

     Approach Starting Position - _____

                         Dart - _____

     Key Contact Position - _____

Ball Four:

 Approach Starting Position - _____

 Dart - _____

 Key Contact Position - _____

Ball Five:

 Approach Starting Position - _____

 Dart - _____

 Key Contact Position - _____

Ball Six:

 Approach Starting Position - _____

 Dart - _____

 Key Contact Position - _____

Ball Seven:

 Approach Starting Position - _____

 Dart - _____

 Key Contact Position - _____

Ball Eight:

 Approach Starting Position - _____

 Dart - _____

 Key Contact Position - _____

Ball Nine:

 Approach Starting Position - _____

 Dart - _____

 Key Contact Position - _____

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Ball Ten:

Approach Starting Position - _____

Dart - _____

Key Contact Position - _____

Appendix I: T & TG Spare Conversion Lists

TEXT(T) CONVERSION LIST

INSTRUCTIONS:

Below is list of common spares. Each spare is provided with a text description of the key points the ball should contact in order to convert common spare attempts.

Each common spare will first ask you to determine which dominant hand will be used to roll the ball. Once the selection is made the common spare information will be listed. This information will include: (a) correct approach starting position - which side of the lane to start your delivery from; (b) correct dart - arrow on the lane which the ball should cross as it rolls toward the pins; and (c) correct key pin contact position - the position on the pins the ball should contact or cross in order to convert the spare.

Remember not all spares can be listed therefore some spares will require you to use your judgement based on the pare information provided to determine which spare path the ball should follow.

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TEXT(T) CONVERSION LIST

RIGHT HAND DOMINANCE:

A.   (5-7)   (5-7-10)   (3-6)   (3-9)   (3-6-9)

   Approach Starting Position: Left Side

   Dart: Third Dart from the Right

   Key Pin Contact Position: 3 Pin

B.   (3-10)   (9-10)   (3-7-10)   (6-10)   (3-6-10)

   Approach Starting Position: Left Side

   Dart: Third Dart from the Right

   Key Pin Contact Position: 6 Pin

C.   (4-7-6-9-10)

   Approach Starting Position: Left Side

   Dart: Third Dart from the Right

   Key Pin Contact Position: 10 Pin

D.   (4-5)   (5-10)   (5-8-10)   (1-2-10)   (2-4-5)   (1-2-4)

   (1-2-4-7)   (1-10)   (2-8)   (2-4-5-8)   (1-2-4-10)

   Approach Starting Position: Right Side

   Dart: Second Dart from the Right

   Key Pin Contact Position: 2 Pin

E.   (2-7)   (7-8)   (2-10)   (2-4-7)   (4-7)   (4-7-8)

   Approach Starting Position: Right Side

   Dart: Second Dart from the Right

   Key Pin Contact Position: 4 Pin

F.   (4-9)   (4-7-9)   (4-7-10)   (4-7-9-10)

(4-6-7-10)

Approach Starting Position: Right Side

Dart: Second Dart from the Right

Key Pin Contact Position: 7 Pin

G.   (1-3-6)   (1-3-6-10)   (1-5)   (1-2-5)

Approach Starting Position: Right Side

Dart: Second Dart from the Right

Key Pin Contact Position: 1 Pin

TEXT(T) CONVERSION LIST

LEFT HAND DOMINANCE:

A.   (5-7)   (5-7-10)   (3-6)   (3-9)   (3-6-9)

   Approach Starting Position: Left Side

   Dart: Third Dart from the Left

   Key Pin Contact Position: 3 Pin

B.   (3-10)   (9-10)   (3-7-10)   (6-10)   (3-6-10)

   Approach Starting Position: Left Side

   Dart: Third Dart from the Left

   Key Pin Contact Position: 6 Pin

C.   (4-7-6-9-10)

   Approach Starting Position: Left Side

   Dart: Third Dart from the Left

   Key Pin Contact Position: 10 Pin

D.   (4-5)   (5-10)   (5-8-10)   (1-2-10)   (2-4-5)   (1-2-4)

   (1-2-4-7)   (1-10)   (2-8)   (2-4-5-8)   (1-2-4-10)

   Approach Starting Position: Left Side

   Dart: Second Dart from the Left

   Key Pin Contact Position: 2 Pin

E. (2-7) (7-8) (2-10) (2-4-7) (4-7) (4-7-8)

Approach Starting Position: Left Side

Dart: Second Dart from the Left

Key Pin Contact Position: 4 Pin

F. (4-9) (4-7-9) (4-7-10) (4-7-9-10) (4-6-7-10)

Approach Starting Position: Left Side

Dart: Second Dart from the Left

Key Pin Contact Position: 7 Pin

G. (1-3-6) (1-3-6-10) (1-5) (1-2-5)

Approach Starting Position: Left Side

Dart: Second Dart from the Left

Key Pin Contact Position: 1 Pin

TEXT & STATIC GRAPHICS(TG) CONVERSION LIST

INSTRUCTIONS:

Below is list of common spares. Each spare is provided with a text description and a diagram of the key points the ball should contact in order to convert common spare attempts.

Each common spare will first ask you to determine which dominant hand will be used to roll the ball. Once the selection is made the common spare information will be listed. This information will include: (a) correct approach starting position - which side of the lane to start your delivery from; (b) correct dart - arrow on the lane which the ball should cross as it rolls toward the pins; and (c) correct key pin contact position - the position on the pins the ball should contact or cross in order to convert the spare.

Remember not all spares can be listed therefore some spares will require you to use your judgement based on the pare information provided to determine which spare path the ball should follow.

TEXT & STATIC GRAPHICS(TG) CONVERSION LIST

RIGHT HAND DOMINANCE:

A. (5-7) (5-7-10) (3-6) (3-9) (3-6-9) (see Fig. A on pg. 12 of conversion booklet)

    Approach Starting Position: Left Side

    Dart: Third Dart from the Right

    Key Pin Contact Position: 3 Pin

B. (3-10) (9-10) (3-7-10) (6-10) (3-6-10) (see Fig. B on pg. 12 of conversion booklet)

    Approach Starting Position: Left Side

    Dart: Third Dart from the Right

    Key Pin Contact Position: 6 Pin

C. (4-7-6-9-10) (see Fig. C on pg. 13 of conversion booklet)

    Approach Starting Position: Left Side

    Dart: Third Dart from the Right

    Key Pin Contact Position: 10 Pin

D. (4-5) (5-10) (5-8-10) (1-2-10) (2-4-5) (1-2-4) (1-2-4-7) (1-10) (2-8) (2-4-5-8) (1-2-4-10) (see Fig. D on pg. 13 of conversion booklet)

    Approach Starting Position: Right Side

    Dart: Second Dart from the Right

    Key Pin Contact Position: 2 Pin

TEXT & STATIC GRAPHICS (TG) CONVERSION LIST

E.   (2-7)   (7-8)   (2-10)   (2-4-7)   (4-7)   (4-7-8)   (see
Fig. E on pg. 14 of conversion booklet)

    Approach Starting Position: Right Side

    Dart: Second Dart from the Right

    Key Pin Contact Position: 4 Pin

F.   (4-9)   (4-7-9)   (4-7-10)   (4-7-9-10)   (4-6-7-10)   (see
Fig. F on pg. 14 of conversion booklet)

    Approach Starting Position: Right Side

    Dart: Second Dart from the Right

    Key Pin Contact Position: 7 Pin

G.   (1-3-6)   (1-3-6-10)   (1-5)   (1-2-5)   (see Fig. G on
pg. 15 of conversion booklet)

    Approach Starting Position: Right Side

    Dart: Second Dart from the Right

    Key Pin Contact Position: 1 Pin

CONVERSION LIST

Fig. A
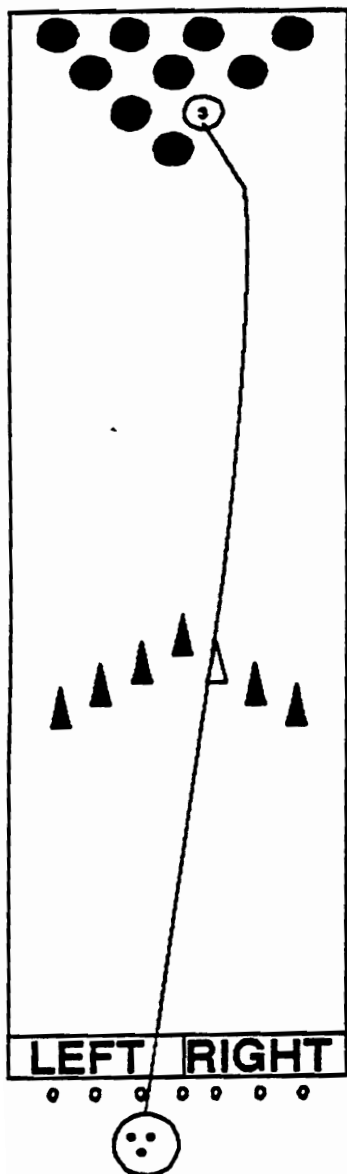
Fig. B
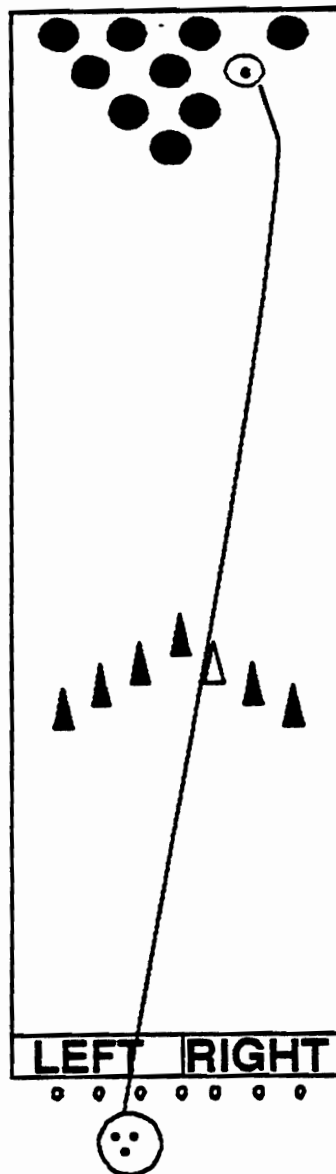
CONVERSION LIST

Fig. C

Fig. D

13
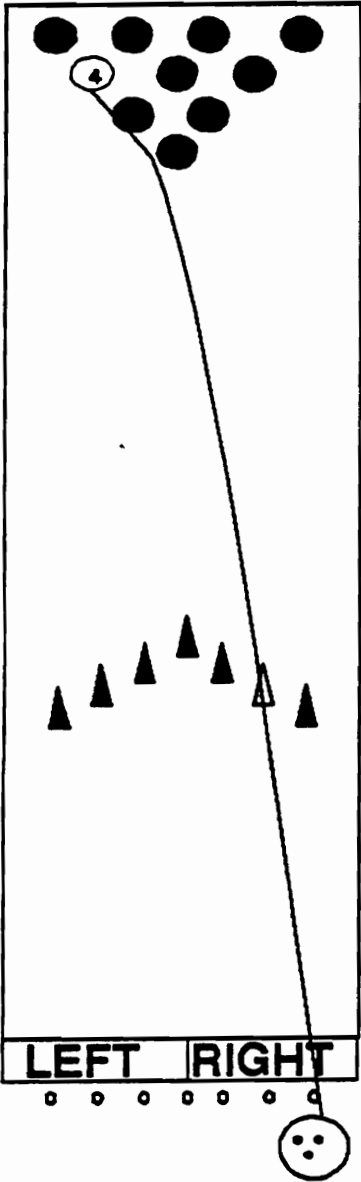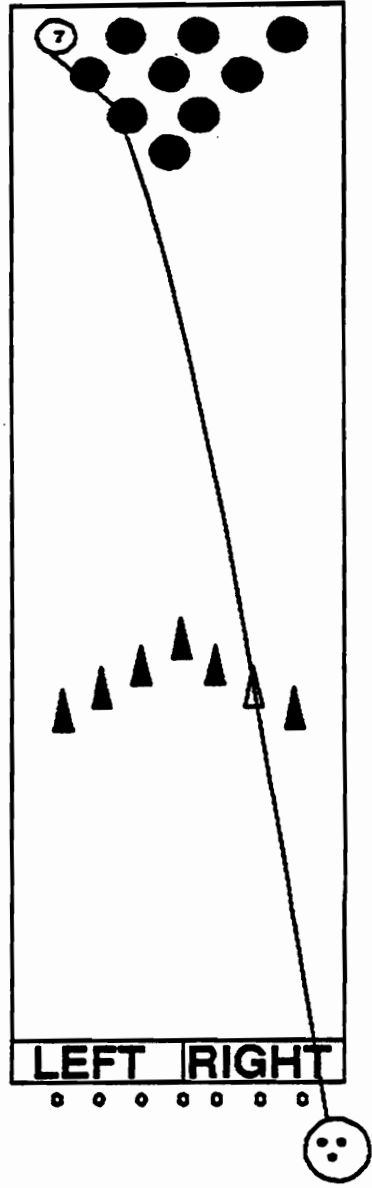
205

CONVERSION LIST

Fig. E

Fig. F

LEFT RIGHT

LEFT RIGHT

14

CONVERSION LIST

Fig. G

LEFT RIGHT

15
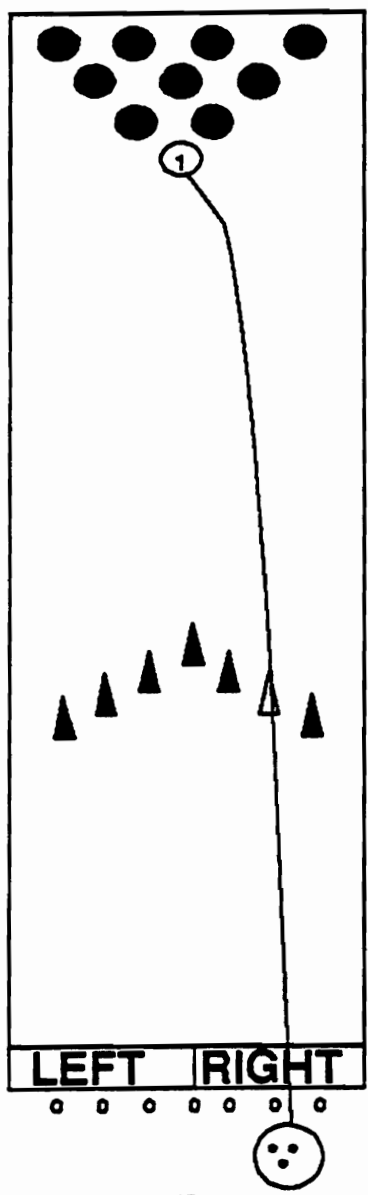
TEXT & STATIC GRAPHICS(TG) CONVERSION LIST

LEFT HAND DOMINANCE:

A.   (5-7)   (5-7-10)   (3-6)   (3-9)   (3-6-9)   (see Fig. LA on pg. 15 of conversion booklet)

   Approach Starting Position: Left Side

   Dart: Third Dart from the Left

   Key Pin Contact Position: 3 Pin

B.   (3-10)   (9-10)   (3-7-10)   (6-10)   (3-6-10)   (see Fig. LB on pg. 15 of conversion booklet)

   Approach Starting Position: Left Side

   Dart: Third Dart from the Left

   Key Pin Contact Position: 6 Pin

C.   (4-7-6-9-10)   (see Fig. LC on pg. 19 of conversion booklet)

   Approach Starting Position: Left Side

   Dart: Third Dart from the Left

   Key Pin Contact Position: 10 Pin

D.   (4-5) (5-10) (5-8-10) (1-2-10) (2-4-5) (1-2-4) (1-2-4-7) (1-10) (2-8) (2-4-5-8) (1-2-4-10) (see Fig. LD on pg. 19 of conversion booklet)

     Approach Starting Position: Left Side

     Dart: Second Dart from the Left

     Key Pin Contact Position: 2 Pin

E.   (2-7)   (7-8)   (2-10)   (2-4-7)   (4-7)   (4-7-8)   (see Fig. LE on pg. 20 of conversion booklet)

     Approach Starting Position: Left Side

     Dart: Second Dart from the Left

     Key Pin Contact Position: 4 Pin

F.   (4-9)   (4-7-9)   (4-7-10)   (4-7-9-10)   (4-6-7-10)   (see Fig. LF on pg. 20 of conversion booklet)

     Approach Starting Position: Left Side

     Dart: Second Dart from the Left

     Key Pin Contact Position: 7 Pin

G.   (1-3-6)   (1-3-6-10)   (1-5)   (1-2-5)   (see Fig. LG on pg. 21 of conversion booklet)

     Approach Starting Position: Left Side
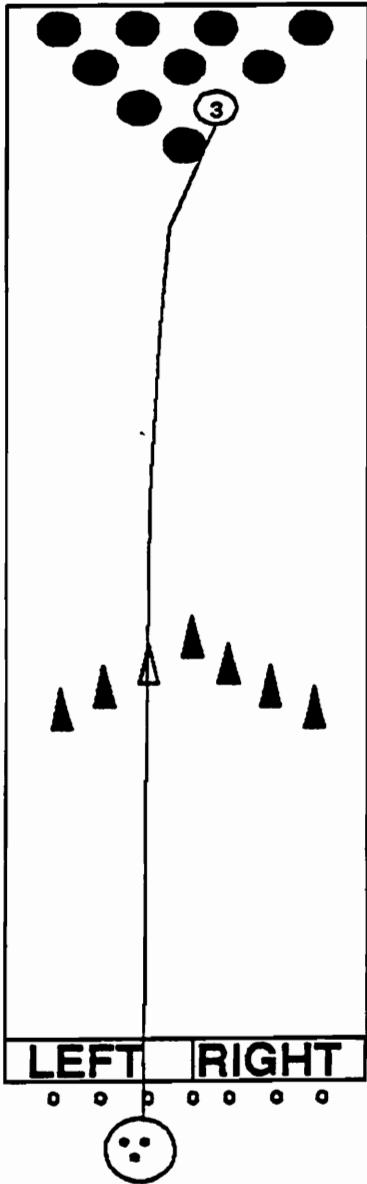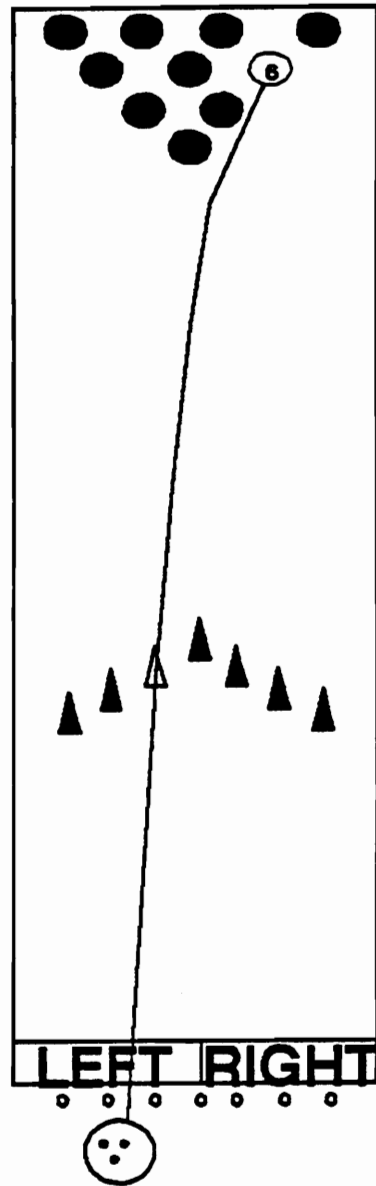
     Dart: Second Dart from the Left

     Key Pin Contact Position: 1 Pin

CONVERSION LIST

Fig. LA

Fig. LB

CONVERSION LIST

Fig. LC

Fig. LD

LEFT RIGHT

LEFT RIGHT

19

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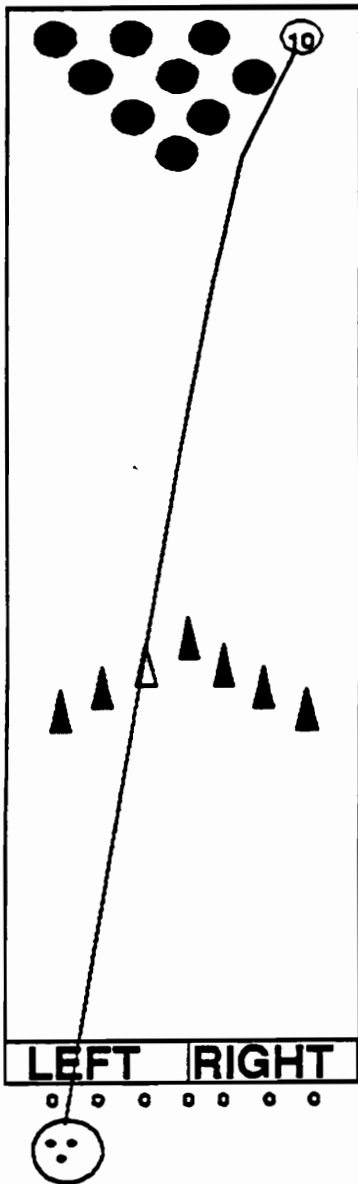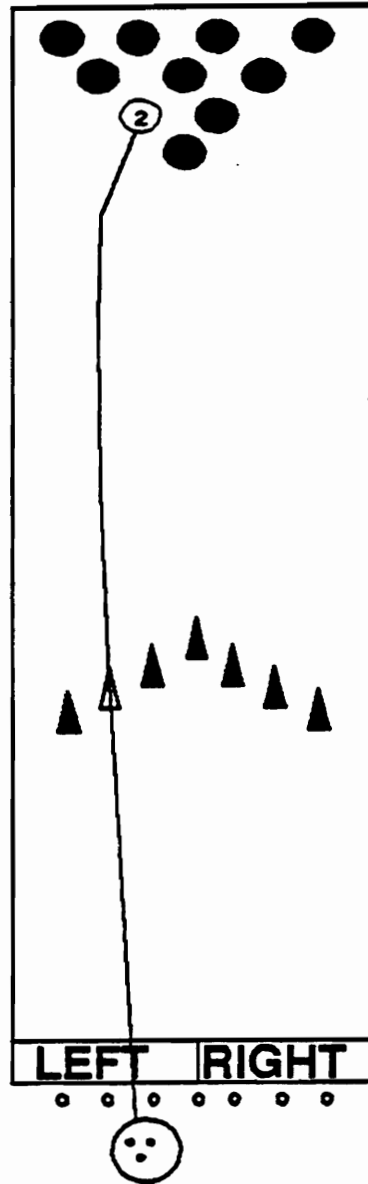
CONVERSION LIST

Fig. LE
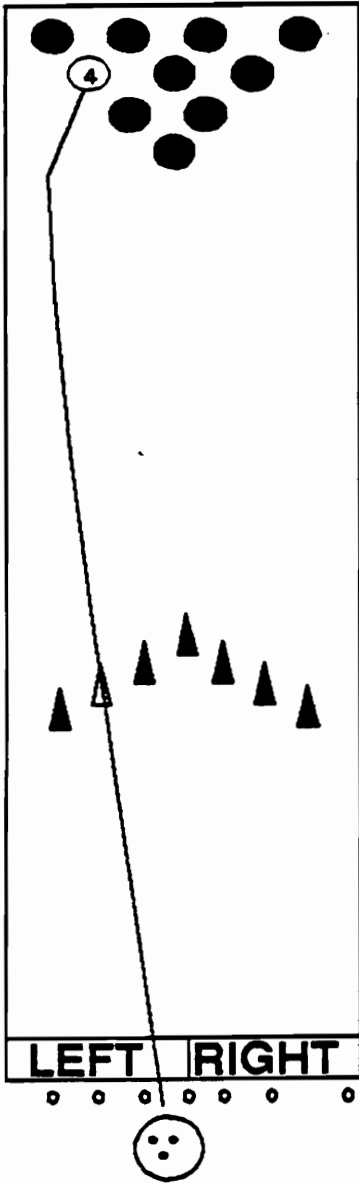
Fig. LF
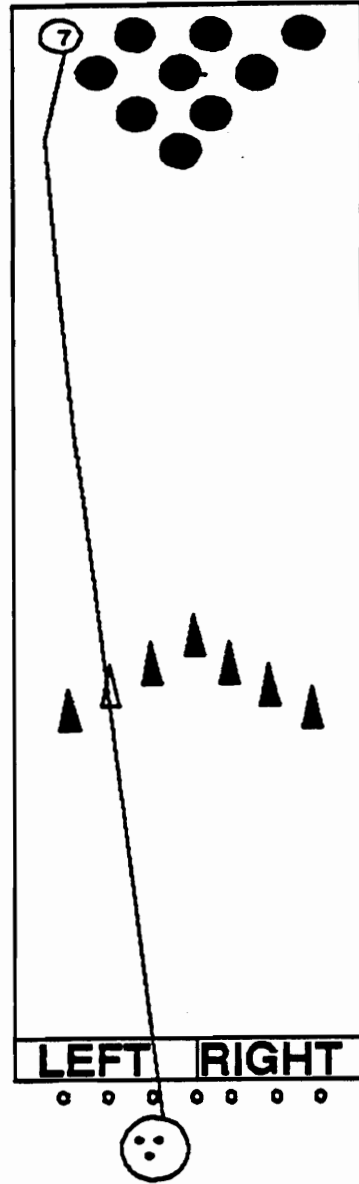
CONVERSION LIST

Fig. LG
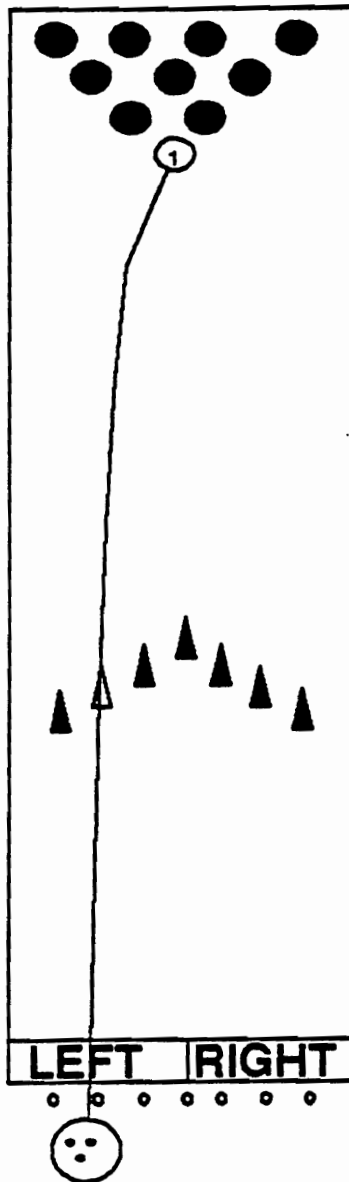
Appendix J: NSCS Operations

THE TEXT(T) NOVICE SPARE CONVERSION SYSTEM

INTRODUCTION:

Welcome to the spare conversion unit of this course. In this section students will learn to convert spares using the Novice Spare Conversion System (NSCS).

Students will be provided with information and feedback by responding to questions and by then progressing through each drill and task using the information provided on each page of this booklet.

Using the information contained in this booklet read all class readings, follow the information contained on the list of learning task sheets, and the list of common spares used to convert spares produced during the course.

THE NOVICE SPARE CONVERSION SYSTEM

The NSCS is based on the path of the ball moving along 3 positions on the lane. These positions are: (a) the correct approach starting point, (b) the path of the ball crossing over the correct lane dart, and (c) the ball crossing or contacting the correct key pin position. The key pin position may or may not be occupied by a pin. In either situation, the ball should cross that exact position as indicated by the pins original position.

THE TEXT(T) NOVICE SPARE CONVERSION SYSTEM

USING NSCS

Once class readings and task description have been read (both contained on the learning task sheet) the student moves to the lane. The spare conversion process then begins by rolling one ball in order to produce a spare combination. Once this is done the student will examine information about the type of spare combination and hand used to roll the ball by turning to the page listing the types of common spares and referring to the Novice Spare Conversion System description for conversion of spares.

After identifying the correct information about the spare produced the student will examine the description of the target points (provided on pg. 8 of this booklet) and the appropriate path the ball should take for conversion of the spare combination. The description will identify the correct approach starting point, the correct dart, and the correct key pin position.

Three questions will be asked concerning the path of the ball. After filling in each attempted answer on the spare attempt conversion record the student will then move to the lane to attempt to convert the spare and once completing the spare attempt the student will return to their unit booklet and fill out their responses on the spare attempt conversion record.

THE TEXT(T) NOVICE SPARE CONVERSION SYSTEM

Once the last question has been answered, return to the lane, roll the ball to produce another spare, and review the spare information and repeat the conversion process.

A note from the author:

A very conscious effort has been made to cover all common spare combinations. Still the list provided is not an exhaustive one (there are a total of 1032 possible spare combinations!). If the user encounters a spare that does not appear on the list, he or she may use proper judgement to choose the combination from the list provided that closely resembles the one obtained.

-Ron Cregger

THE TEXT & STATIC GRAPHICS(TG) NOVICE

SPARE CONVERSION SYSTEM

INTRODUCTION:

Welcome to the spare conversion unit of this course. In this section students will learn to convert spares using the Novice Spare Conversion System (NSCS).

Students will be provided with information and feedback by responding to questions and by then progressing through each drill and task using the information provided on each page of this booklet.

Using the information contained in this booklet read all class readings, follow the information contained on the list of learning task sheets, and the list of common spares and diagrams used to convert spares produced during the course.

THE NOVICE SPARE CONVERSION SYSTEM

The NSCS is based on the path of the ball moving along 3 positions on the lane. These positions are: (a) the correct approach starting point, (b) the path of the ball crossing over the correct lane dart, and (c) the ball crossing or contacting the correct key pin position. The key pin position may or may not be occupied by a pin. In either situation, the ball should cross that exact position as indicated by the pins original position (see Fig. 1 on pg. 8 of this booklet).

THE TEXT & STATIC GRAPHICS(TG) NOVICE
SPARE CONVERSION SYSTEM

USING NSCS

Once class readings and task description have been read (both contained on the learning task sheet) the student moves to the lane. The spare conversion process then begins by rolling one ball in order to produce a spare combination. Once this is done the student will examine information about the type of spare combination and hand used to roll the ball by turning to the page listing the types of common spares and referring to the Novice Spare Conversion System description for conversion of spares.

After identifying the correct information about the spare produced the student will examine the description and diagram of the target points (provided on pg. 8 of this booklet) and the appropriate path the ball should take for conversion of the spare combination. The description and diagram will identify the correct approach starting point, the correct dart, and the correct key pin position.

Three questions will be asked concerning the path of the ball. After filling in each attempted answer on the spare attempt conversion record the student will then move to the lane to attempt to convert the spare and once completing the spare attempt the student will return to

their unit booklet and fill out their responses on the spare attempt conversion record.

Once the last question has been answered, return to the lane, roll the ball to produce another spare, and review the spare information and repeat the conversion process.

A note from the author:

A very conscious effort has been made to cover all common spare combinations. Still the list provided is not an exhaustive one (there are a total of 1032 possible spare combinations!). If the user encounters a spare that does not appear on the list, he or she may use proper judgement to choose the combination from the list provided that closely resembles the one obtained.

-Ron Cregger

THE NOVICE SPARE CONVERSION SYSTEM

Fig. 1

NOVICE SPARE CONVERSION SYSTEM

In this unit of the course students will attempt to convert spares using the Novice Spare Conversion System (NSCS).

The NSCS is based on the path of the ball moving along 3 positions on the lane. These positions are: (a) the correct approach starting point, (b) the path of the ball crossing over the correct lane dart, and (c) the ball crossing or contacting the correct key pin position.

The key pin position may or may not be occupied by a pin. In either situation the ball should cross that exact position as indicated by the mark on the screen.

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THE TEXT, STATIC GRAPHICS,& ANIMATION(TGA)

NOVICE SPARE CONVERSION SYSTEM

INTRODUCTION:

Welcome to the spare conversion unit of this course. In this section students will learn to convert spares using the Novice Spare Conversion System (NSCS).

Students will be provided with information and feedback by responding to questions and then progressing through the computer program using the buttons provided on each screen.

Buttons will operate by using a mouse. Use the mouse to move the arrow on the screen so that it is placed on the appropriate button and then click the left mouse button once.

NSCS COMPONENTS:

The NSCS is based on the path of the ball moving along 3 positions on the lane. These positions are: (a) the approach starting point, (b) the correct lane dart, and (c) crossing or contacting the key pin position. The key pin position may or may not be occupied by a pin. In either situation, the ball should cross that exact position as indicated by the mark on the screen.

THE TEXT, STATIC GRAPHICS,& ANIMATION(TGA)
NOVICE SPARE CONVERSION SYSTEM

USING NSCS

The spare conversion process begins by rolling one ball in order to produce a spare combination. Once this is done the student will move to the computer. The student will respond to the dominant hand used to roll the ball and the type of spare combination by moving the arrow and clicking on the appropriate buttons.

Three questions will be asked concerning the path of the ball. One question at a time along with a picture of the lane will appear on the screen with a selection of possible responses. Using Part A of the spare attempt conversion record (Pg. 6) the student will use a tally mark to indicate attempted responses. The student will click on the appropriate buttons to check responses. An incorrect answer will be identified by a system error message. However, when the student clicks on the correct response, the diagram will show the correct target and the second question will appear. The same process will occur for the third question. After responding correctly to each question a picture will appear showing the lane and the appropriate path the ball should take for conversion of the spare combination earlier selected on the spare combination screen. The picture will identify the approach starting points, the lane darts, and the key pin positions.

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THE TEXT, STATIC GRAPHICS,& ANIMATION(TGA)

NOVICE SPARE CONVERSION SYSTEM

Next the student will move to the lane and attempt to convert the spare after clicking on the button marked CONTINUE. On completing the spare attempt the student will move back to the computer. Clicking on the button on the screen marked "VIEW ANIMATION" a comparison of the animation of the correct path on the computer to the ball path of your spare attempt will be made. Based on this comparison the student will fill out Part B of the spare attempt conversion record (pg. 18 - 27) and answer the questions that appear.

Once the last question has been answered, the student will return to the lane, roll the ball to produce another spare, move to the computer and repeat the spare information and conversion process.

A note from the author:

A very conscious effort has been made to cover all common spare combinations. Still the list provided is not an exhaustive one (there are a total of 1032 possible spare combinations!). If the user encounters a spare that does not appear on the list, he or she may use proper judgement to choose the combination from the list provided that closely resembles the one obtained.

-Ron Cregger

Appendix K: Unit Guidelines

UNIT GUIDELINES

This section is designed to provide a list of several guidelines which must be followed during your participation in this unit. These guidelines include, but are not limited to:

1. Discussion of any aspects of your performance should be limited to your partner (observer) and/or course instructor. There are a total of 1,032 different possible spare combinations. Part of developing the ability to convert spares requires understanding of the principles necessary to convert all spares.

2. Do not discuss performance in class or out of class until the unit is completed. Be sure that your performance does not influence another class member. This is not a competition and a higher score in this unit will in no way determine your grade.

3. Any comments concerning information related to bowling should only be directed to your partner/observer, the instructor, or course proctor. To ensure that information you receive is correct an instructor rather than a classmate should be the one to provide information related to bowling.

This is not to suggest that any and all questions should immediately be taken to the instructor (or proctor). Before asking the question refer to information in this booklet and your own knowledge to determine the answer.

4. Refrain from any practice outside of class time. During this unit practice should remain in class. By practicing outside of class the amount of improvement will vary and any data on the effectiveness of this system will be convoluted by extraneous variable.

Also, avoid outside practice without the aide of the instructor to ensure that the same principles of spare conversion are always followed and no bad habits develop.

5. Record all attempts to answer the initial three spare combination questions on the spare attempt conversion record sheets and do not solicit any type of assistance other than information provided in formulating your response.

You can aid in making this course the best it can be. By providing a record based on information in this booklet you can identify areas which are incomplete or need strengthening to improve later systems used in this class.

Appendix L: Spare Conversion Task Sheets

Beginning Bowling

Spare Conversion Unit

TEXT(T) SPARE LEARNING TASK SHEET

Task 11

Spare Conversion Media Quiz

Mastery Performance Task:

1. Study pages ii-iii, 6-8, 22-23, and 35 in spare conversion unit booklet.

2. Contact the instructor or course proctor and request to take the quiz on the Novice Spare Conversion System using text instruction. To complete this task, you must score at least 90% on the test. If you are unsuccessful, you may retake the test during another class period. Have the instructor or course proctor place his/her initials here _____ when test has been passed.

This task was completed _____.

(date)

TEXT(T) SPARE LEARNING TASK SHEET

Task 12

Common Spare Pick-Up

Drill:

1. Study pages 4-5 and 9-21 in spare conversion unit booklet.

2. Beginning from the left side approach position and begin the delivery set-up. Using the 4-step approach deliver one ball to produce a spare. After viewing the spare respond to the questions in Part A of the spare conversion attempt record (pgs. 23 - 34). Using the information provided in the conversion list (pgs. 9 - 21) use a 4-step approach, roll the ball so that it follows the appropriate path to convert the spare. Based on the information from the conversion list attempt to convert the spare. Compare your ball path to the description of the appropriate path in the conversion lists. Based on the comparison answer the last three question. Place the answers on Part B of spare conversion attempt record (pgs. 35 - 44). Repeat this process for a total of 10 attempts. Have the instructor or course proctor place his/her initials here _____ when all attempts and information has been completed.

Mastery Performance Task:

1.   Following the information provided in the unit guidelines convert 10 spares using the text instruction program. Be sure to provide all information on the spare conversion attempt record (pgs. 22 - 44). Have your partner record your attempts on the inning scoring sheets. Repeat this process 4 times. To complete this task, you must accumulate a total of 40 spare conversion attempts. Have your partner turn in your inning scoring sheet to the instructor and initial here _____ when the task has been completed.

This task was completed _____.

(date)

TEXT & STATIC GRAPHICS(TG) SPARE LEARNING TASK SHEET

Task 11

Spare Conversion Media Quiz

Mastery Performance Task:

1.   Study pages ii-iii, 6-8, 22-23, and 35 in spare conversion unit booklet.

2.   Contact the instructor or course proctor and request to take the quiz on the Novice Spare Conversion System using text instruction.   To complete this task, you must score at least 90% on the test.   If you are unsuccessful, you may retake the test during another class period.   Have the instructor or course proctor place his/her initials here _____ when test has been passed.

This task was completed _____.

(date)

TEXT & STATIC GRAPHICS(TG) SPARE LEARNING TASK SHEET

Task 12

Common Spare Pick-Up

Drill:

1. Study pages 4-5 and 9-21 in spare conversion unit booklet.

2. Beginning from the left side approach position and begin the delivery set-up (see Fig. T-12A on pg. 3 of this booklet). Using the 4-step approach deliver one ball to produce a spare. After viewing the spare respond to the questions in Part A of the spare conversion attempt record (pgs. 23 - 34). Using the information provided in the conversion list and diagrams (pgs. 9 - 21) use a 4-step approach, roll the ball so that it follows the appropriate path to convert the spare. Based on the information from the conversion list and diagrams attempt to convert the spare. Compare your ball path to the description on the appropriate path in the conversion list and diagrams. Based on the comparison answer the last three question. Place the answers on Part B of spare conversion attempt record (pgs. 35 - 44). Repeat this process for a total of 10 attempts. Have the instructor or course proctor place his/her initials here _____ when all attempts and information has been completed.

Mastery Performance Task:

1. Following the information provided in the unit guidelines convert 10 spares using the text instruction program. Be sure to provide all information on the spare conversion attempt record (pgs. 22 - 44). Have your partner record your attempts on the inning scoring sheets. Repeat this process 4 times. To complete this task, you must accumulate a total of 40 spare conversion attempts. Have your partner turn in your inning scoring sheet to the instructor and initial here _____ when the task has been completed.
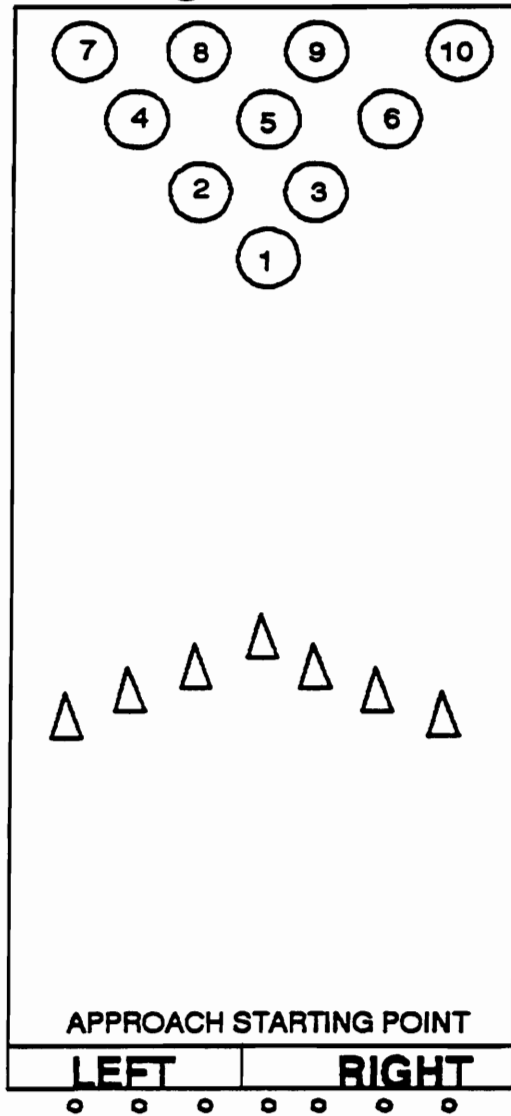

   This task was completed _____.

                                        (date)

SPARE LEARNING TASK SHEET
Task 12

Fig. T-12A

APPROACH STARTING POINT

LEFT | **RIGHT**

X
Starting Point

s

TEXT, STATIC GRAPHICS, & ANIMATION (TGA)

SPARE LEARNING TASK SHEET

Task 11

Spare Conversion Media Quiz

Mastery Performance Task:

1.   Study pages ii-iii, 3-6, and 18 in spare conversion unit booklet.

2.   Contact the instructor or course proctor and request to take the quiz on the Novice Spare Conversion System using computer-assisted instruction. To complete this task, you must score at least 90% on the test. If you are unsuccessful, you may retake the test during another class period. Have the instructor or course proctor place his/her initials here _____ when test has been passed.

   This task was completed _____.

                                             (date)

TEXT, STATIC GRAPHICS, & ANIMATION (TGA)

SPARE LEARNING TASK SHEET

Task 12

Common Spare Pick-Up

Drill:

1.   Go to computer and read screens 1 - 6.

2.   Working with the course instructor or course proctor move
through the computer assisted version of the spare conversion
system.

Take the strike approach position and begin the delivery
set-up. Using the 4-step approach deliver one ball to produce
a spare. After viewing the spare use tally marks to record
responses to the questions in Part A of the spare conversion
attempt record (pgs. 6 - 17).   Continue until the correct
response is provided for each question.   Based on the
information from the computer attempt to convert the spare.
Return to the computer and computer click on the button marked
"VIEW ANIMATION." Compare the animation (showing the correct
ball path) to your spare attempt.   Based on the comparison
answer the last three question.   Place the answers on Part B
of spare conversion attempt record (pgs. 18 - 27).   Repeat
this process for a total of 10 attempts. Have the instructor

or course proctor place his/her initials here _____ when all attempts and information has been completed.

Mastery Performance Task:

1.   Following the information provided in the unit guidelines convert 10 spares using the computer-assisted instruction program.   Be sure to provide all information on the spare conversion attempt record (pgs. 6- 27).   Have your partner record your attempts on the inning scoring sheets.   Repeat this process 4 times.   To complete this task, you must accumulate a total of 40 spare conversion attempts.   Have your partner turn in your inning scoring sheet to the instructor and initial here _____ when the task has been completed.

   This task was completed _____.

                              (date)

Appendix M: Spare Conversion Readings

CLASS READINGS

INTRODUCTION:

Most bowlers not only strike inconsistently but they experience difficulty and frustration in converting spares. The key to successful spare conversion is learning the proper approach starting position and aiming target and lining up to hit these targets dependent upon the type of spare produced.

Many bowlers choose to line up at the center approach position and swing their arm in the direction of pins in hopes that the ball will travel the correct path. This usually is unsuccessful and at best is inconsistent. Also many bowlers that do adjust there starting position over adjust and must again swing the arm in an awkward direction rather than following the direct, straight delivery necessary.

WHY IS SPARE TARGETING IMPORTANT?

In order to be a well-rounded bowler (and successful) you should be able to pickup (cover, or convert) any reasonable spare leave. There are approximately 250 spare leaves that you will commonly encounter, but this number is manageable when you realize that their are only a few angles from which all of them may be converted.

In order to convert spares you must begin to think about your movement process, just as you did when attempting to produce a strike. Regardless of the type of competition, if you patiently and persistently convert your spares, you can avoid really low game scores and stay in the running until you begin to strike more frequently. Remember, you can average 190 even if you never get a strike.

Spare conversion are based on several principles. Following these principles will make you a better bowler by allowing you to play spares through intelligent planning, increasing the probability of your spare conversion before you even roll your ball. While reading the principles listed below visualize yourself using the information in this booklet and picture using this information to convert the spare. If followed you can add to your success and enjoyment of the game.

PRINCIPLES:

1. Planning of all spare leaves are based on simple adjustments of the angle of approach.

2. Always approach in the direction toward your spare leave.

3. Always choose a spare key pin position that allows your ball to hit the pin closest to you first.

4. Always choose a key pin position that allows your ball to contact the most pins, minimizing the chance of hitting only the front pins while missing the ones farther back (referred to as chopping).

5. Unless you are attempting to convert a split do not depend on your ball to bounce (or carom) pins into other pins to convert the spare.

6. Always translate your spare into a simpler one before deciding how to shoot it. Concentrate on the key pin(s) that you need to contact in order to convert the leave.

7. Based on they key pin position and the usually path of your ball determine a dart that will lead the ball into they position you have selected.

CONCLUSION:

Remember, spare leaves provide an element of variety to the game, and you should think of them as an opportunities to become more accurate and more versatile. If you set you mind this way and are willing to remember some simple rules and numbers, you will become a better bowler.

Appendix N: Presentation Format Quizzes

Virginia Tech

Beginning Bowling

T Spare Conversion Unit

Task 11

PART I: Fill-In-The-Blank

Clearly print the correct word(s) or phrase in each blank provided in order to complete the statement (s). Each blank is worth 5 points.

1.   Inning scoring sheets will be provided for each mastery task in the unit. Accompanying the mastery task, there will be an inning scoring sheet which must be signed by the **INSTRUCTOR** or the **COURSE PROCTOR**.

2.   According to the unit guidelines spare conversion practice should only occur during **CLASS**.

3.   The NSCS is based on the path of the ball moving along 3 positions on the lane. The three potions are:

(a) **APPROACH STARTING POSITION**, (b) **DART**, and (c) **KEY PIN CONTACT POSITION**.

4.   Prior to attempting to convert a spare three questions are asked. Prior to attempting to answering each question on the screen a tally mark must be placed in Part A of the **SPARE ATTEMPT CONVERSION RECORD**.

5.   A list of common spares will be presented in the spare conversion list in the unit booklet for determining the target
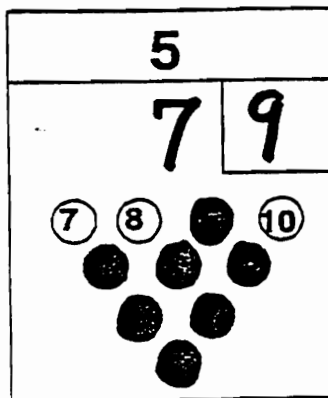
points. However, the list does not include all spares and the student must use their own judgment for some combinations. There are a total of **1032** possible spares.

6.   Part B of the **SPARE ATTEMPT CONVERSION RECORD** is used to record your success in each spare conversion attempt and asks for a comparison between your performance and the correct performance (ball path).

PART II: Situations

The following situation describes what has happened during a single inning of bowling. Based on the information provided fill in the inning scoring box below. Each number must be placed in the correct position in order to receive credit. No partial credit will be given. This problem is worth 10 points.

Description: The first ball rolled knocked down all the pins except the 7,8, and 10 pins. The second ball rolled knocks down the 7 and 8 pins.

PART III: Listing

Below are a list of processes which should occur during performing the mastery task in the unit. Place a number in the blank provided to indicate the order which should be followed during the spare conversion attempt. Each answer is worth 5 points.

__6__ turn to the Spare Conversion list in the unit booklet and identify the target points to convert the spare

__4__ place a tally mark in blanks provided for possible response to each question

__9__ based on a comparison between the spare attempt ball path and the correct path identified by the correct points identified in the Spare Conversion list and in Part A of the Spare Attempt Conversion circle the correct answer for each of the three question in Part B of the Spare Attempt Conversion Record

__5__ respond to each question until three have been answered

__1__ read the Class Readings in the unit booklet

__3__ In Part A of the Spare Attempt Conversion Record write the spare attempting in the unit booklet

__7__ move to the lane and attempt to convert the spare using the information provided

__8__ based on the spare attempt results record if the spare was converted or not converted in Part B of the Spare Attempt Conversion Record in the unit booklet

__2__ move to the lane and roll one ball to produce a spare

Virginia Tech

Beginning Bowling

TG Spare Conversion Unit

Task 11

PART I: Fill-In-The-Blank

Clearly print the correct word(s) or phrase in each blank provided in order to complete the statement (s). Each blank is worth 5 points.

1.   Inning scoring sheets will be provided for each mastery task in the unit. Accompanying the mastery task, there will be an inning scoring sheet which must be signed by the **INSTRUCTOR** or the **COURSE PROCTOR**.

2.   According to the unit guidelines spare conversion practice should only occur during **CLASS**.

3.   The NSCS is based on the path of the ball moving along 3 positions on the lane. The three potions are:

(a) **APPROACH STARTING POSITION**, (b) **DART**, and (c) **KEY PIN CONTACT POSITION**.

4.   Prior to attempting to convert a spare three questions are asked. Prior to attempting to answering each question on the screen a tally mark must be placed in Part A of the **SPARE ATTEMPT CONVERSION RECORD**.

5.   A list of common spares will be presented in the spare conversion list in the unit booklet for determining the target
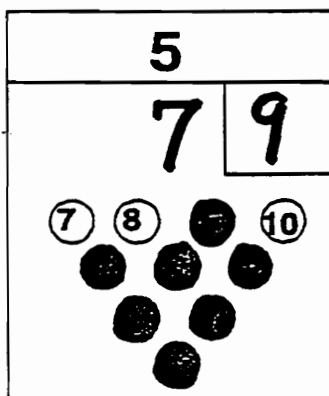
points. However, the list does not include all spares and the student must use their own judgment for some combinations. There are a total of **1032** possible spares.

6. Part B of the **SPARE ATTEMPT CONVERSION RECORD** is used to record your success in each spare conversion attempt and asks for a comparison between your performance and the correct performance (ball path).

PART II: Situations

The following situation describes what has happened during a single inning of bowling. Based on the information provided fill in the inning scoring box below. Each number must be placed in the correct position in order to receive credit. No partial credit will be given. This problem is worth 10 points.

Description: The first ball rolled knocked down all the pins except the 7,8, and 10 pins. The second ball rolled knocks down the 7 and 8 pins.

PART III: <u>Listing</u>

Below are a list of processes which should occur during performing the mastery task in the unit. Place a number in the blank provided to indicate the order which should be followed during the spare conversion attempt. Each answer is worth 5 points.

__6__turn to the Spare Conversion list & diagrams in the unit booklet and identify the target points necessary to convert the spare

__4__in Part A of the Spare Attempt Conversion Record place a tally mark in blanks provided to respond to each of the three questions about target points to convert the spare produced

__9__based on a comparison between the spare attempt ball path and the correct path identified by the correct points identified in the Spare Conversion list & diagrams and in Part A of the Spare Attempt Conversion circle the correct answer for each of the three questions in Part B of the Spare Attempt Conversion Record

__5__respond to each until all of the three questions have been answered

__1__read the Class Readings in the unit booklet

__3__In Part A of the Spare Attempt Conversion Record write the spare attempting in the unit booklet

__7__move to the lane and attempt to convert the spare using the information provided in the conversion list & diagrams

8 based on the spare attempt results record if the spare was converted or not converted in Part B of the Spare Attempt Conversion Record in the unit booklet

2 move to the lane and roll one ball to produce a spare

Virginia Tech

Beginning Bowling

TGA Spare Conversion Unit

Task 11

PART I: <u>Fill-In-The-Blank</u>

Clearly print the correct word(s) or phrase in each blank provided in order to complete the statement (s). Each blank is worth 5 points.

1.   Inning scoring sheets will be provided for each mastery task in the unit. Accompanying the mastery task, there will be an inning scoring sheet which must be signed by the **INSTRUCTOR** or the **COURSE PROCTOR**.

2.   According to the unit guidelines spare conversion practice should only occur during **CLASS**.

3.   The NSCS is based on the path of the ball moving along 3 positions on the lane. The three potions are:

(a) **APPROACH STARTING POSITION**, (b) **DART**, and (c) **KEY PIN CONTACT POSITION**.

4.   Prior to attempting to convert a spare three questions are asked. Prior to attempting to answering each question on the screen a tally mark must be placed in Part A of the **SPARE ATTEMPT CONVERSION RECORD**.

5.   A list of common spares will be presented in the spare conversion list in the unit booklet for determining the target
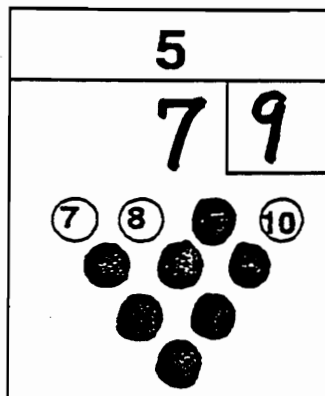
points. However, the list does not include all spares and the student must use their own judgment for some combinations. There are a total of **1032** possible spares.

6. Part B of the **SPARE ATTEMPT CONVERSION RECORD** is used to record your success in each spare conversion attempt and asks for a comparison between your performance and the correct performance (ball path). In order to make this comparison the **ANIMATED** ball on the computer screen will provide an example of the correct ball path.

PART II: Situations

The following situation describes what has happened during a single inning of bowling. Based on the information provided fill in the inning scoring box below. Each number must be placed in the correct position in order to receive credit. No partial credit will be given. This problem is worth 10 points.

Description: The first ball rolled knocked down all the pins except the 7,8, and 10 pins. The second ball rolled knocks down the 7 and 8 pins.

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PART III: <u>Listing</u>

Below are a list of processes which should occur during performing the mastery task in the unit. Place a number in the blank provided to indicate the order which should be followed during the spare conversion attempt. Each answer is worth 5 points.

__1__ at computer read the first 6 computer screens

__7__ answer the each question from Part A of the Spare Attempt Conversion record by clicking the mouse for each response until all three questions have been answered

__2__ move to the lane and roll one ball to produce a spare

__3__ move to the computer screen and click on the hand used to roll the ball

__10__ based on a comparison between the spare attempt ball path and the correct path identified by the correct points identified on the computer screen and in Part A of the Spare Attempt Conversion circle the correct answer for each of the three question in Part B of the Spare Attempt Conversion Record

__6__ in Part A of the Spare Attempt Conversion record answer each of three questions by first placing a tally mark in blanks provided for possible response to each question

__5__ In Part A of the Spare Attempt Conversion Record write the spare attempting in the unit booklet

___8___move to the lane and attempt to convert the spare using the information provided from the first three questions on the computer and Part A of the Spare Attempt Conversion Record

___9___based on the spare attempt results record if the spare was converted or not converted and answer the three questions in Part B of the Spare Attempt Conversion Record in the unit booklet

___11__answer the three questions comparing your spare attempt to the correct attempt and repeat the process

___4__click on the spare combination attempting to convert (or the one resembling the spare attempting)

Appendix O: Spare Attempt Conversion Records (Part A)

SPARE ATTEMPT CONVERSION RECORD

INSTRUCTIONS:

Each booklet contains several copies of the sheet contained in the manual. The sheet asks for the student's name and student identification number at the top of each. This will be a written record of student responses on the six questions concerning correctness of the spare attempt ball path compared to the correct ball path. These responses will be recorded on the sheet following each attempt.

Part A:

Part A indicates questions which are answered prior to attempting to convert the spare. 40 attempts to answer the questions are provided. Answer all question before you attempt to convert the spare. Be sure to list all attempts.

Name: _____

ID #: _____

Please use the following sheets to record your responses for the each set of three questions asked prior to and after each spare attempt in this unit.

SPARE ATTEMPT CONVERSION RECORD

Given is a list of spare combinations. In the space provided at the top list the spare combination you will be attempting to convert. Indicate your responses to each of the three questions in Part A for each attempted spare conversion by placing a tally mark for each response beside your answer. These questions are designed to show your understanding of the system and its use to improve spare conversion. Be sure to place a mark in the blank provided by each answer for every answer attempted, including the correct answer.

Common Spare combinations:

A.   (5-7)   (5-7-10)   (3-6)   (3-9)   (3-6-9)

B.   (3-10)   (9-10)   (3-7-10)   (6-10)   (3-6-10)

C.   (4-7-6-9-10)

D.   (4-5)   (5-10)   (5-8-10)   (1-2-10)   (2-4-5)   (1-2-4)

       (1-2-4-7)   (1-10)   (2-8)   (2-4-5-8)   (1-2-4-10)

E.   (2-7)   (7-8)   (2-10)   (2-4-7)   (4-7)   (4-7-8)

F.   (4-9)   (4-7-9)   (4-7-10)   (4-7-9-10)   (4-6-7-10)

G.   (1-3-6)   (1-3-6-10)   (1-5)   (1-2-5)

PART A:

Attempt 1

Spare Combination:_____

1.   **Where should the approach starting point be located?**

  (1) Left _____

  (2) Right   _____

2.   **Which dart should the ball cross during its path?**

  (1) Left 1   _____

  (2) Left 2   _____

  (3) Left 3   _____

  (4) Center _____

  (5) Right 1_____

  (6) Right 2_____

  (7) Right 3_____

3.   **What is the key pin position that should be contacted or crossed?**

  (1) Key Pin 1_____

  (2) Key Pin 2_____

  (3) Key Pin 3_____

  (4) Key Pin 4_____

  (5) Key Pin 6_____

  (6) Key Pin 7_____

  (7) Key Pin 10_____

Appendix P: Spare Attempt Conversion Records (Part B)

Beginning Bowling

Spare Conversion Unit

SPARE ATTEMPT CONVERSION RECORD

Given is a list of spare combinations. In the space provided at the top list the spare combination that most closely resembles the spare you were attempting to convert. In the blank provided beside each question indicate if you were able to convert the spare attempt by checking in the blank before "convert" or "not convert." Once you have responded about your conversion success circle the correct answer for each of the following questions. Comparisons will be based on information provided in conversion lists or animation (dependent upon the type of presentation format being used).

Common Spare combinations:

A. (5-7) (5-7-10) (3-6) (3-9) (3-6-9)

B. (3-10) (9-10) (3-7-10) (6-10) (3-6-10)

C. (4-7-6-9-10)

D. (4-5) (5-10) (5-8-10) (1-2-10) (2-4-5) (1-2-4)

   (1-2-4-7) (1-10) (2-8) (2-4-5-8) (1-2-4-10)

E. (2-7) (7-8) (2-10) (2-4-7) (4-7) (4-7-8)

F. (4-9) (4-7-9) (4-7-10) (4-7-9-10) (4-6-7-10)

G. (1-3-6) (1-3-6-10) (1-5) (1-2-5)

PART B:

Attempt 1   ____convert   ____not convert

Spare Combination : _____

1. Where was your approach starting point in comparison with that in the animation ?

(1)   To the left

(2)   To the right

(3)   Same

2. Where did your ball cross the dart in comparison with that in the animation ?

(1)   To the left

(2)   To the right

(3)   Same

3. Where did your ball cross or contact the key pin in comparison with that in the animation ?

(1)   To the left

(2)   To the right

(3)   Same

Appendix Q: Computer Information Screens

INTRODUCTION

Welcome to the spare conversion unit of this course.
In this section students will learn to convert spares using
the Novice Spare Conversion System (NSCS).

Students will be provided with information and feedback
by responding to questions and by then progressing through
each screen using the buttons provided on each screen.

Buttons will operate by using a mouse. Use the
mouse to move the arrow on the screen so that it is
placed on the appropriate button and then click the left
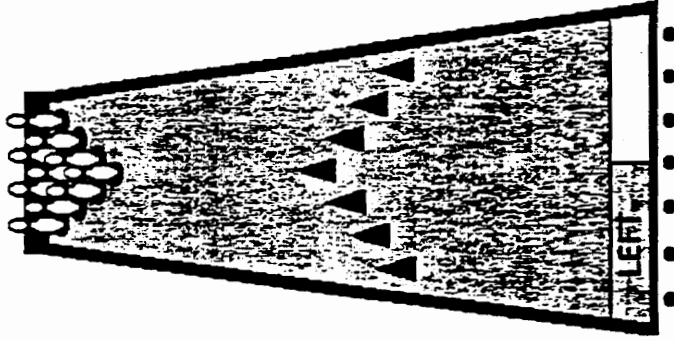mouse button once.

Click on the CONTINUE to proceed...

| HELP | | CONTINUE | | EXIT |

NOVICE SPARE CONVERSION SYSTEM

In this unit of the course, the students will attempt to convert 10 spares using the Novice Spare Conversion System.

The NSCS is based on the path of the ball moving along 3 positions on the lane. These positions are: (a) the correct approach starting point, (b) the path of the ball crossing over the correct lane dart, and (c) the ball crossing or contacting the correct key pin position. The key pin position may or may not be occupied by a pin. In either situation, the ball should cross that exact position as indicated by the mark on the screen.

| HELP | CONTINUE | EXIT |

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BEGINNING THE UNIT

The spare conversion process begins by rolling one ball in order to produce a spare combination. Once this is done the student will move to the computer. The student will respond to the type of spare combination and hand used to roll the ball by moving the arrow and clicking on the correct button.

After responding to each question a picture will appear showing the lane and the appropriate path the ball should take for conversion of the spare combination, earlier selected on the spare combination screen. The picutre will identify the correct approach starting point, the correct dart, and the correct key pin position.

| HELP | CONTINUE | EXIT |

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BEGINNING THE UNIT

3 questions will be asked concerning the path of the ball. One question at a time along with a picture of the lane will appear on the screen with a selection of possible responses. When the student clicks on the correct response, the second question will appear. On a correct answer to the second, the third question will appear. Once the thrid question has been answered correctly, the student will then move to the lane to attempt to convert the spare after clicking on the button marked CONTINUE.
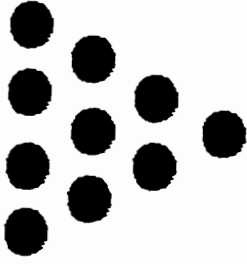
| HELP | | CONTINUE | | EXIT |

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NOMENCLATURE

The arrangement of pins in the alley is as shown below:

The darts on the lane are named as follows:

1. Left 1
2. Left 2
3. Left 3
4. Center
5. Right 3
6. Right 2
7. Right 1

HELP	CONTINUE	EXIT

BEGINNING THE UNIT

On completing the spare attempt the student will move back to the computer, rewind the tape in the VCR, play it to view the path of the ball the student rolled and compare it to the picture of the correct path on the computer which can be seen by clicking on the button "VIEW ANIMATION". After viewing the animation, click the mouse button anywhere on the screen to continue.

After the comparison, answer the questions that appear.

Once the last question has been answered, return to the lane, roll the ball to produce another spare, move to the computer and repeat the spare information and conversion process.
The process is repeated for 10 times.

HELP   CONTINUE   EXIT

Appendix R: Observational Accuracy Raw Data

Table 1a: Text Interobserver Reliability for Spare Conversion Feedback

Subject	Obs. 1	Obs. 2	Obs. 3	Obs. 4	Obs. 5
Video	L R2 7	L R2 2	L R1 1	L R2 2	L R2 2
A	L R2 7	L R2 4	L R1 1	L R2 2	L R2 2
B	L R2 7	L R2 2	L R1 1	L R2 2	L R2 2
C	L R2 7	L R2 1	L R1 1	L R2 2	L R2 2
D	L R2 7	L R2 2	L R1 1	L R2 2	L R2 2
E	L R2 7	L R2 4	L R1 1	L R2 2	L R2 2
F	L R2 7	L R2 1	L R1 1	L R2 2	L R2 2
G	L R2 7	L R2 2	L R1 1	L R2 2	L R2 2
H	L R2 7	L R2 4	L R1 1	L R2 2	L R2 2
I	L R2 7	L R2 4	L R1 1	L R2 4	L R2 2
J	L R2 7	L C 4	L R1 1	L R2 4	L R2 2
K	L R2 7	L R2 2	L R1 3	L R3 2	L R2 2
L	R R2 7	L R2 2	R R1 1	L R2 2	L R2 2
M	L R2 7	L R2 2	L R1 1	L R2 2	L R2 2
N	L R2 7	L R2 2	L R1 1	L R2 2	L R2 2
O	L R2 7	L R2 2	R R1 1	L C 2	L R2 2
P	L R2 7	L R2 2	L R1 1	L R2 2	L R2 2
Q	R R2 7	L R2 2	L R1 1	L R2 2	L R2 2

Table 1b: Text Interobserver Reliability for Spare Conversion Feedback

Subject	Obs. 6	Obs. 7	Obs. 8	Obs. 9	Obs. 10	% Accuracy
Video	L R2 7	L R2 1	L R2 1	L R2 4	L R1 2	———
A	L R2 7	L R2 1	L R2 1	L R2 4	L R1 3	93
B	L R2 7	L R2 1	L R2 3	L R2 4	L R1 2	97
C	L R2 7	L R2 1	L R2 1	L R2 4	L R1 3	93
D	L R2 7	L R2 1	L R2 1	L R2 4	L R1 2	100
E	L R2 7	L R2 1	L R2 1	L R2 4	L R1 2	97
F	L R2 7	L R2 1	L R2 1	L R2 4	L R1 2	97
G	L R2 7	L R2 1	L R2 1	L R2 4	L R1 2	100
H	L R2 7	L R2 1	R R2 3	L R1 4	L R1 2	87
I	L C 7	L R2 1	L R2 1	L R2 4	L R1 2	90
J	L R1 7	L R2 1	L R2 1	L R2 4	L R1 2	87
K	R R1 7	L R2 1	L R2 1	L R3 4	L R1 2	83
L	L R2 7	L R2 1	L R2 3	L R2 4	L R1 1	87
M	L R2 7	L R2 1	L R2 1	L R2 4	L R1 2	100
N	L R2 7	L R2 1	L R2 1	L R2 4	L R1 2	100
O	L R2 7	L R2 1	L R2 1	L R1 4	L R1 1	87
P	L R2 7	L R2 1	L R2 1	L R2 4	L R1 2	100
Q	L R2 7	L R2 1	L R2 1	L R2 4	L R1 2	97

Table 2a: Text and Static Graphics Interobserver Reliability for Spare Conversion Feedback

Subject	Obs. 1	Obs. 2	Obs. 3	Obs. 4	Obs. 5
Video	R L3 3	R L3 2	R C 3	R C 3	R C 3
R	R L3 3	R L3 2	L C 3	R C 3	R R3 3
S	R L3 3	R L3 2	R C 3	R C 3	R R3 1
T	R L3 3	R L3 2	L C 3	R C 3	R C 3
U	R L3 3	R L3 2	R C 3	R C 3	R C 3
V	R L3 3	R L3 2	R C 3	R C 3	R C 3
W	R L3 3	R L3 2	R C 3	R C 3	R C 3
X	R L3 3	R L3 2	R C 3	R C 3	R C 3
Y	R L3 3	R L3 2	R C 3	R C 3	R C 3
Z	R L3 3	R L3 2	R C 3	R C 1	R C 3
AA	R L3 3	R L3 2	R C 1	R R3 3	R C 3
BB	L L3 3	R L3 2	R C 3	R C 3	R C 3
CC	L L3 3	R L3 2	R C 3	R C 3	R C 3
DD	R L3 1	R L3 2	R C 3	R C 3	R C 3
EE	R L3 3	R L3 2	R C 3	R C 3	R C 3
FF	R L3 3	R L3 2	R C 6	R C 3	R C 3
GG	R L3 3	R L3 2	R C 3	R C 3	R C 3
HH	R L3 3	R L3 2	R C 3	R C 3	R C 3
II	L L3 3	R L3 2	R R3 3	R C 3	R C 3

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Table 2b: Text and Static Graphics Interobserver Reliability for Spare Conversion Feedback

Subject	Obs. 6	Obs. 7	Obs. 8	Obs. 9	Obs. 10	% Accuracy
Video	R L31	R C 1	L L33	R L31	R L31	———
R	R L31	R C 1	L L33	R L31	R L33	90
S	R L31	R C 1	L L33	L L31	R L33	87
T	R L31	R C 1	L L33	T L31	R L31	93
U	R L31	R C 1	L C 3	R L31	R L31	97
V	R L31	R C 1	L C 3	R L31	R L31	97
W	R L31	R C 1	R L31	L L31	L L31	87
X	R L31	R C 1	L R33	R L31	R C 1	93
Y	R L31	R C 1	L L33	R L31	R L33	97
Z	R L31	R C 1	L L33	R L32	R L31	93
AA	L C 1	R C 1	L L33	R R31	R L31	83
BB	R L31	R C 1	L L33	R L31	R L31	97
CC	R L31	R C 1	L L33	R L31	R L31	97
DD	R L31	R C 1	L L33	R L31	L L31	93
EE	R L31	R C 1	L L33	R L31	R L31	100
FF	R L31	R C 1	L R33	R L31	R L31	93
GG	R L21	R C 1	L L33	R L31	R L31	97
HH	R L31	R C 1	R L33	R L31	R L31	97
II	R L33	R R31	R L33	R L31	L L31	80

Table 3a: Text, Static Graphics, and Animation Interobserver Reliability for Spare Conversion Feedback

Subject	Obs. 1	Obs. 2	Obs. 3	Obs. 4	Obs. 5
Video	R R2 1	R R2 1	R C 1	R R2 3	R R2 1
JJ	R R2 1	R R2 1	R C 1	R R1 1	R R2 1
KK	R R2 3	R R2 1	L C 1	R R2 3	R R2 1
LL	R R2 3	R R2 1	L C 1	R R2 3	R R2 1
MM	R R2 2	R R2 1	R R3 1	R R1 1	R R2 1
NN	R R2 1	R R2 1	R C 1	L R1 3	R R2 1
OO	R R2 1	R R2 1	R C 1	R C 2	R R2 1
PP	R R2 1	R R2 1	L C 1	R R2 3	R R2 1
QQ	R R2 1	R R2 1	L R3 1	R R2 3	R R2 1
RR	R R3 1	R R3 1	R C 1	R R1 3	R R1 1
SS	R R2 1	L R1 1	R C 2	R R2 3	L R2 1
TT	R R2 1	R R2 1	R C 1	R R2 3	R R2 1
UU	R R2 1	R R2 1	R C 1	R R2 3	R R2 1
VV	R R2 1	L R2 1	L R3 1	R R2 3	R R2 1
WW	R R2 1	R R3 1	L C 1	L R2 3	R R2 1

Table 3b: Text, Static Graphics, and Animation Interobserver Reliability for Spare Conversion Feedback

Subject	Obs. 6	Obs. 7	Obs. 8	Obs. 9	Obs. 10	% Accuracy
Video	R R2 1	R R2 1	L R2 6	R R2 1	L L3 7	———
JJ	R R2 3	R R2 1	L R2 6	R R2 1	L L3 7	90
KK	R R1 1	R R2 1	L R2 6	R R2 1	L L3 7	90
LL	R R2 1	R R2 1	L R2 6	L R2 1	L L3 4	87
MM	R R2 3	R R2 1	L R2 6	R R2 1	L L3 7	83
NN	R R2 2	R R2 1	L R2 6	R R2 1	R L3 4	83
OO	L R2 4	R R2 1	L R2 6	R R2 1	R L3 7	83
PP	R R2 1	L C 1	R R2 6	R R2 1	L C 4	80
QQ	R R1 1	R R2 1	L R1 6	R R2 1	L L3 7	87
RR	R L2 1	R R2 1	L L2 6	R R2 1	L L3 7	83
SS	R R2 1	L R2 4	L R2 6	R R2 1	L L3 7	80
TT	R R2 1	R R2 1	L R2 6	R R2 1	L C 4	93
UU	R R2 1	R R2 1	L R2 6	R R2 1	L L3 7	100
VV	R R2 1	R R2 1	L R2 6	R R2 1	L C 7	87
WW	L R2 1	R R2 1	L R2 6	R R2 1	L L3 7	87

Appendix S: Course Evaluations

<center>**P.S.I. COURSE**</center>

Circle the form of presentation used during the spare conversion unit.

T   TG   TGA

For each question below circle the number that best describes your perception for each question. Below your rating indicate your reason for your rating. Be as specific as possible.

Poor 1	Below Average 2	Average 3	Above Average 4	Excellent 5

Part I. In this section of the evaluation all responses should be based on your perceptions of the P.S.I. course operations.

1. How effective was P.S.I.'s ability in promoting increased skill?

1   2   3   4   5

2. How effective was P.S.I.'s ability in promoting increased knowledge?

1   2   3   4   5

3. How appropriate were the tasks for reaching intended course outcomes?

1   2   3   4   5

4. How effective were the P.S.I. course tasks in aiding your ability to participate in bowling as a recreational activity?

1   2   3   4   5

5. How effective was P.S.I. in promoting enjoyment of the course when compared to other activity courses you have taken?

1   2   3   4   5

6. How valuable to you perceive the self-pacing feature in P.S.I. in your overall course success?

1   2   3   4   5

7. How well did the course manual explain the P.S.I. features used in this course?

1   2   3   4   5

8. How effective was P.S.I. as a course design for teaching college level bowling?

1   2   3   4   5

9. How would you rate the course instructor in this course?

1   2   3   4   5

SPARE CONVERSION UNIT

Circle the form of presentation used during the spare conversion unit.

T   TG   TGA

For each question below circle the number that best describes your perception for each question. Below your rating indicate your reason for your rating. Be as specific as possible.

Poor	Below Average	Average	Above Average	Excellent
1	2	3	4	5

Part I. In this section of the evaluation all responses should be based on your perceptions of the specific presentation format used during the spare conversion unit of the course.

1. How effective was the specific spare conversion unit format's ability in promoting increased skill?

1   2   3   4   5

2. How effective was the specific spare conversion unit format's ability in promoting increased knowledge?

1   2   3   4   5

3. How appropriate were the spare conversion unit tasks for reaching intended course outcomes?

1   2   3   4   5

4. How effective were the specific spare conversion unit tasks in aiding your ability to participate in bowling as a recreational activity?

1   2   3   4   5

5. How effective were the specific spare conversion unit in promoting enjoyment of the course when compared to other activity courses you have taken?

1   2   3   4   5

6. How valuable to you perceive the self-pacing feature during the spare conversion unit in your overall success in converting spares?

1   2   3   4   5

7. How well did the course spare conversion unit booklet explain the operations of the specific unit format used during the spare conversion unit?

1   2   3   4   5

8. How effective was the specific spare conversion unit in providing information on converting spares during the spare conversion unit during a college level bowling course?

1   2   3   4   5

9. How would you rate the course instructor during the spare conversion unit of this course?

1   2   3   4   5

Vita

Ronald N. Cregger was born August 07, 1959 in Bristol, Tennessee. He attended public school in Salem, Virginia where he graduated from Andrew Lewis High School in 1977. He attended Ferrum College and received an A.A. in Political Science in 1979. After working for one year he attended the University of Tennessee at Knoxville and received a B.S. in Education with a concentration in recreation in 1983.

At the completion of undergraduate school he worked as Youth and Aquatic Director at the Roanoke Central Y.M.C.A. until 1987. In 1987 he returned to school at Virginia Polytechnic Institute and State University where he received his state teaching certificate in physical education and a teaching endorsement in health. After completing requirements for his teaching certificate he worked as a Graduate Teaching Assistant while completing his M.S. in Physical Education in 1991 and began working toward his Ph.D. in Physical Education.