ANDROZZI, JARED, M.S. Efficiency of Teaching Biomechanical Motor Assessment via Video Observation and Verbal Feedback. (2008)
Directed by Dr. Tom Martinek. 58 pp.

The purpose of this study was to test the efficiency of motor skill assessment that incorporates s viewing video recordings of individuals performing motor skills. Cognitive assessment measures included static analysis, dynamic analysis, direction/angle analysis, body relationship analysis, and physics analysis.

Sixteen participants, 10 males and 6 females, with a mean age of 23.3 (20-37) years comprised the sample. All participants were enrolled in the University of North Carolina at Greensboro's Beginning Bowling course and volunteered to participate in the study. The subjects were randomly placed into one of two groups: experimental and control. Participants in the experimental group received 6 lessons of biomechanical instruction which included viewing 2 male, professional, performers demonstrating a bowling strike as well as verbal feedback on participants' questions.

Pre-test scores using a 2 x 2 repeated measures analysis of variance (ANOVA) found no significant difference within or between the experimental and control groups. A total of three separate 2 x 2 ANOVAs were used in this study, one for each of the following factors; differences in improvement between groups in accuracy in assessment, the presence of gender bias between groups in assessment of motor skills, and differences in accuracy between groups within the five sub-scaled biomechanical components. A total of three separate 1-way ANOVAs were also used in this study, one for each of these factors to determine if both groups were initially equivalent within each of the above listed factors. The experimental group (M= 20.5, SD= 3.02) did show a significant difference ($F_{1,14}$ = 4.89, p <.05) between the control group (M= 17.88, SD= 1.46) over time when assessing the female

performer however, the experimental group (M= 17.13, SD= 2.36) did not show a significant difference ($F_{1,14}$ = 2.16) between the control group (M= 15.13, SD= 3.04) when post-tested using the male performer. The experimental group maintained a consistent discrepancy score (M=4.125 on pre-test SD 3.356, M=4.125 on post-test 1.885) whereas the control group's discrepancy (M=3.750, SD= 2.251 on pre-test, M=4.000, SD 1.690) actually increased.

When testing the sub-scales, there were no significant differences between groups during the pre-test ($F_{1,14}$ = .069) or between groups over time ($F_{1,14}$ = .019) when $p < .05$. post-test data showed a significant difference ($p < .05$) between the experimental (M= 5.13) and the control group's (M=4.88) accuracy of body relationship analyses when assessing a female performer. Post-test data revealed a significant difference (p. <.05) between the experimental (M=3.75) and the control group's (M= 2.75) accuracy of physics analyses when assessing a male performer.

The results of the data analyses show a significant difference in improvement between groups over time when assessing a female performer. As for the male performer, the results did show a significant improvement for both the experimental and control group over time but did not show a significant difference between groups over time. The results of the data analyses show no significant difference over time or between groups when examining subjects' perception of performance based on the performer's gender.

While it may be beneficial to include biomechanical analysis as part of a curriculum within physical education, instruction of such may have more influence if 2 performers of different genders are utilized for skill demonstration.

EFFICIENCY OF TEACHING BIOMECHANICAL ASSESSMENT VIA VIDEO OBSERVATION AND VERBAL FEEDBACK

By

JARED ANDROZZI

A Thesis Submitted to
the Faculty of The Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfilment
of the Requirements for the Degree
Masters of Science

Greensboro
2008

Approved by

Tom Martinek_____________

Committee Chair

APPROVAL PAGE

This thesis has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

Committee Chair ____________________________

Committee Members ________________________

____

____

____
Date of Acceptance by Committee

____
Date of Final Oral Examination

ACKNOWLEDGEMENTS

Thank you Dr. Martinek, for your devotion to my development, interest in my ideas for research, and patience in providing feedback when I so needed it! I will always strive to provide the same for my students as well. Thank you Dr. Richards for having an open ear to my questions and concerns as both a student and teacher for in doing so you have always provided support and helped me to believe in my students, colleagues, and myself. Thank you Dr. Villaverde for your involvement in my research and providing insight into many of the sociological aspects of teaching and learning. I will remember to keep an eye open to attempt to provide all students with the opportunities they deserve to learn. Thank you Mom for supporting me at all times, teaching me to cook, clean, listen, love, giving me feedback, advice, guidance, and everything a person needs to survive. I've always admired you and although I'll never be a Mom, someday I'll do my best at giving my children all the love you have given me.

TABLE OF CONTENTS

LIST OF TABLES

LISTS OF FIGURES

Figure Page

CHAPTER I

INTRODUCTION

Physical education is taught to children and adolescents in every state in America. The unified ambition of physical educators is to educate students throughout their growth and development in three learning domains; physical skill development, affective maturation, and cognitive learning. Achieving student progress and development is an objective pursued by physical activity instructors in many fields including physical education, coaching, and athletic training. Physical education strives to improve students' physical performance abilities along with their physical health. Physical activities such as competitive team and individual sports are implemented as a means in which to provide children of all ages with experiences that will teach affective and social skills such as teamwork, communication, and effort. All these can be applied to their everyday lives.

Cognitive learning is often achieved through activities requiring strategy in game tactics, along with comprehension of the physical effects caused by movement of the body, or kinesiology. All three domains share great importance in the growth and development and each must be investigated thoroughly to understand the effectiveness of various teaching strategies within each domain. When students learn a motor skill in the physical domain they are first obliged to develop cognitive apprehension of the movement.

In this study, I explored students' understanding of biomechanical principals within sports, the reason being that if students are to have any basis for understanding "the effects of forces on humans and, vice versa, the effects of forces that humans apply" they must be educated on the concepts within (Carr, 2004, p. 4). We must ask ourselves if the teaching methods we utilize, particularly when checking for students understanding, are truly effective in accomplishing the knowledge we wish to pass on to students. What are the reasons students may not fully absorb the material? And most importantly, what are effective teaching methods that physical activity instructors can implement to improve students' cognitive development in biomechanics?

Routes to Fulfilling Physical Education Objectives

Physical activity instructors, physical educators, athletic coaches, and exercise and conditioning trainers attempt to improve students' motor skills. When doing so, it is first necessary for the student to comprehend the biomechanics involved with motor skill development. Instructors frequently demonstrate or have a student's peer correctly demonstrate the motor skill in an attempt to provide the student with a vicarious learning experience. This form of vicarious learning is quite valuable in boosting self-efficacy when the observer realizes that success in the skill is possible (Carroll & Bandura 1982). If vicarious learning is the educational approach taken via teacher demonstration, a correct demonstration is beneficial for the students to gain a thorough understanding of the motor skill. It will also assist the student in being more likely to improve their level of skill proficiency (Liang, 2001). This is perhaps one of the most common routes taken by physical educators in an attempt to improve students' comprehension of the technique involved in the movement.

With advancements in the world of technology, a method for teaching motor skill comprehension that has become more commonly employed is the use of Video Observation and Verbal Instruction (VOVI). VOVI instruction typically entails the physical activity instructor showing students a video of a motor skill performed by a professional. In other scenarios, the teacher has students observe a video that displays a recording of the student performing the motor skill. In both cases, the teacher provides a demonstration of the motor skill that is observable on video for the students. While the supplemental teaching method of VOVI instruction is gaining popularity, the efficiency of exploiting this technique must be evaluated so educators will understand whether or not students' cognitive ability is improved. Cognitive ability can be evaluated by testing students' ability to assess the biomechanics of a motor skill.

Purpose of Study

The purpose of this study was to test the efficiency of motor skill assessment that incorporates subjects viewing video recordings of individuals performing motor skills. It is imperative to clarify that motor skill assessment should not solely be administered via video observation and analysis. Previous research has shown more success in biomechanical comprehension when students also received verbal cues pertinent to the demonstrations observed in video recordings rather than solely viewing video observations (Zetou, Tzetzis, Vernadakis, & Kioumourtzoglou, 2002). It is also necessary to emphasize the importance of including students learning motor skill assessment in the physical education curriculum, and when doing so, determine the effectiveness of implementing video observations. This is due to the fact that it is often challenging for students to understand the biomechanics of sports without a strong curriculum focus on motor skill assessment. Frequently, more emphasis is placed in the curriculum on improving students' physical performance, than on developing students' cognitive understanding of the execution of motor skills (Lawson, 1987; Ayers, 2002). Students must have a sound foundation in the biomechanical elements of the skill if they are to improve the performance of the skill. It is important that we distinguish performance skill levels from cognitive skill levels. Performance skill levels evaluate the proficiency of a student's physical ability while cognitive levels evaluate the proficiency of a student to accurately assess physical performance.

Instructors often attempt to advance their students' motor skill comprehension by describing how the subject bio-mechanically performed the skill, what important elements have room for improvement and what kinesthetics are required in progressing the development of that skill. Although this technique is common in instructing motor skills, educators must take note not to make the assumption that the student has, in turn, garnished the ability to accurately assess the motor skill on the same level as that of the instructor. Or at least, has done so with an improved degree of accuracy. Before taking any further steps it is necessary to "check for the student's understanding". Checking for students' understanding is a tactic frequently employed by physical educators that must provide the instructor with a precise and clear answer. Unfortunately, it is common for many educators to simply ask the students "Does everyone understand?" A simple reply of "yes" from the students does not guarantee their understanding. Ayers, Housner, Gurvitch, Pritchard, Dell'Orso, Dietrich, Kim, and Pearson (2005) clearly describe these common methods used to check for understanding:

> Checking students' understanding (CFU) is another element of clearly communicating tasks to students. After lesson material has been clearly presented, having students demonstrate skills, answer questions, or chorally respond by

> showing a thumbs-up if they understand are ways of checking to make sure students understand the presented material. Unfortunately, studies have not been conducted to examine the contribution that checking for understanding makes to student achievement (Ayers et al., 2005, p. 137).

When teaching, each student must be assessed individually in order to proceed with future lessons that will accommodate each student's different level of understanding.

In this study students' comprehension of motor skills was not tested. Rather this study described their accuracy of assessing a motor skill when observing a performer. This study investigated the elements of cognitive learning in physical activity. The main inquiries were: (1) What effect will VOVI have on students' learning biomechanics; (2) Will the gender of the performer have an effect on subjects' biomechanical assessment; and (3) Will subjects' improvement between groups have greater significance within any of the five sub-scaled sections of biomechanics? These questions were confronted in this study that involved a pre and post test of subject assessment accuracy and the implementation of six motor skill assessments lessons via the supplemental teaching method of VOVI instruction.

Research Question 1

Will video observation and verbal instruction of biomechanics have an effect on group differences in students learning biomechanics?

Hypothesis 1

With the increasing usage of technology in education, the true efficiency of such implementation must be measured to ensure quality learning. Subjects in the experimental group will receive instruction of biomechanics via video observation and verbal instruction. The grounds on which the experimental group will be instructed to assess performances are factually based and supported by the laws of natural physics (Carr, 2004) and therefore, the experimental subjects are hypothesized to show greater accuracy in assessing performance than the control subjects over time.

Research Question 2

Will the gender of the performer have an effect on subjects' biomechanical assessment?

Hypothesis 2

Previous research (Cassadya, Clarkeb, & Latham, 2004; Dodds, 1993) has shown gender stereotyping of performance capability. Therefore, subjects in the control group which receive basic bowling instruction are expected to show greater differences than the experimental group in assessment of a male performer to that of a female performer. Subjects in the experimental group will receive instruction of biomechanics via video observation and verbal instruction (VOVI) and are expected to show little or no difference in assessment of a male performer to that of a female performer.

Research Question 3

Will subjects' improvement between groups have greater significance within any of the five sub-scaled sections of biomechanics?

Hypothesis 3

Subjects in the experimental group will receive biomechanical instruction which instructs students how to organize motor skill assessment into body and movement segments (Knudson & Morrison, 1997; Kelly, 1971). These learning segments include static, dynamic, directional, body relationship, and physics analyses. Therefore, it is hypothesized that subjects in the experimental group will show a greater significance of improvement within each of the five sub-scaled measures of biomechanical performance.

Definition of Terms

In order to provide clarity in the usage of terms within this study, definitions are presented below:

1. Video Observation and Verbal Instruction. A method of teaching used by physical activity instructors which provides students with a demonstration of a motor skill displayed on video including verbal instruction of the biomechanics involved with the performance typically by a professional of that skill or a learner such as a student.

2. Authentic assessment. Objective and accurate methods for gathering data concerning students' learning.

3. Biomechanics. The application of mechanical principles to the study of living organisms (Hall, 1995).

4. Statics. The branch of mechanics that analyzes mechanical systems in a constant state of motion (Hall, 1995).

5. Dynamics. The branch of mechanics dealing with systems subject to acceleration (Hall, 1995).

5. Direction/Angle Analysis. Analysis of the angular degree to which the body or parts of the body are facing.

6. Body Relationship Analysis. Analysis of how parts of the body are positioned in relation to each other in terms of parallelism, opposition, and distance. Body Relationship Analysis can involve static or dynamic body positions.

7. Physics Analysis. Analysis of what physical effects such as inertia, gravity, and torque will have on the body or the bowling ball due to the biomechanical position and movement of the body.

Significance

This study was important for providing more insight into supplemental teaching methods to enhance cognitive learning in physical activity instruction. VOVI instruction of physical activity has become more common with advancements in technology and the use of these tools in the classroom was investigated. While previous research has focused on the relationship between improvement in physical performance and VOVI instruction, little research has examined the relationship between improvement in cognitive understanding of biomechanics and VOVI instruction (Zetou, Tzetzis, Vernadakis, & Kioumourtzoglou, 2002; Lawson, 1987; Ayers, 2002; Cassadya et al., 2004). Physical activity instructors commonly check for understanding by utilizing a broad-spectrum of methods that do not offer a precise evaluation of students' comprehension of the lesson content. The results of this study showed significant improvement in motor skill assessment accuracy, and it is therefore advisable for physical educators to include video observation and verbal instruction of biomechanics in the curriculum.

CHAPTER II

REVIEW OF LITERATURE

Research on the Routes to Fulfilling Physical Education Objectives

In physical education, teachers take on the responsibility of educating students' in three domains, the cognitive, physical, and affective. The educator must in turn evaluate students' progress and design learning activities that will engage students' in a physically active environment involving scenarios that challenge the students' minds, bodies, and personal character development. *Assessment in physical education: a teacher's guide to the issues* (Carroll, 1994) investigates various topics of evaluation in physical education, their purpose, and the efficiency of various methods of evaluating students' learning. Carroll (1994) suggests "that performance assessments aimed at assessing the abilities to demonstrate and apply skills, techniques, tactics and rules to the physical activity or game/competitive situation should be kept separate from assessments aimed at assessing cognitive skills of knowing and understanding, evaluation and analysis" (p. 100). Unfortunately, the majority of physical educators pay limited or no attention to the cognitive and affective domain when evaluating and assigning grades to students' progress in physical education. The main topic of evaluation is that of the physical, while two additional domains are part of the learning objectives set forth by national and state physical education standards.

North Carolinas Healthful Living Standard Course of Study for the year 2006, (http://www.ncpublicschools.org/docs/curriculum/health/scos/finalhlscsonly2006.pdf) applies the following educational philosophy for all students in kindergarten though high school: “Fitness and Sport Literacy (using cognitive information to understand and enhance motor skill acquisition and performance; application of concepts from disciplines such as motor learning and development, biomechanics, and exercise physiology; knowledge and application of these concepts and practice enhance the likelihood of independent learning and therefore more regular and effective participation in physical activity) (p. 20).” The biomechanical principles are found in Competency Goal 6: 6.01, 6.02, 6.03, and 6.05. All of these goals are within NASPE Standard 1. Biomechanical learning concepts are also in NASPE Standard 2, Competency Goal 7: 7.03. For grades 9-12 “Students will be able to create and assess beginning biomechanical, physiological, and sociological concepts as they relate to a healthy active lifestyle (p. 22).”

The majority of research on subjects’ ability to assess motor skills has been done mostly on performance and cognitive outcomes in both school and university activity settings. It still is beneficial for student’s learning, however, to include more in-depth instructional methods for skill assessment. Research performed by Hare (2000) that tested seven freshmen and fourteen sophomore (11 males and 11 females) physical education students’ understanding of motor skills showed that many still have several misconceptions about the biomechanics and rules of badminton. The students were divided into two groups in which group one participated in 11 days of badminton instruction and group two participated in 12 days of instruction. The students showed misconceptions on the rules, strategies, teacher instructions, and complex concepts “such as generating force and power”

(Hare, 2000, p. 80). Misconceptions of teacher instructions "that is, instructions surrounding drill execution and game rules were often confusing to students. On those occasions when students misunderstood directions, they were observed to incorrectly perform drills and not adhere to instructions when participating in games" (Hare, 2000, p. 80). Hare implemented six data collection techniques for "uncovering misconceptions" each with "advantages and disadvantages" (Hare, 2000, p. 90). Among these six techniques, videotape segment interview which involved "The technique of asking students to analyse videotaped segments of their classmates performance proved to be fruitful. By utilizing this technique, the researcher was able to gain a deeper understanding of the badminton knowledge constructed by participants" (Hare, 2000, p. 93). Some of the students were at a stage in which their misconceptions were less solidified and were open to change, and other students had these misconceptions so firmly grounded that in turn, were not open to change. Hare's research exemplifies the need to check students' current understanding of assessing motor skills in order to correct these misconceptions before they are impermeable to improvement. Hare (2000) also noted that "The knowledge base for understanding student misconceptions in physical education is in its infancy" and advised that "additional investigations must be conducted in order to construct a more complete understanding of how, or under what conditions, students develop misconceptions" (p. 109).

One might now speculate why it is so common that students have misconceptions. The answer might lie in the fact that unfortunately, proper demonstration of the skill performed by the instructor or a peer does not always occur. There are times when the physical educator may be unable to perform the skill due to lack of mastery of the skill, injury, or any other factor which may limit his or her ability to demonstrate the skill.

Schmidt (1991) advocates for skill performance observation by stating that "skill information is easily transmitted through demonstration, because it is not limited by the use of words. If the teacher is therefore unable to model the skills themselves, this removes this important visual learning and teaching aid." An imperative point that must be considered is that proper demonstration must occur in order to transmit the correct "skill information" rather than misleading the students via an incorrect demonstration.

Gordon and Inder's (2000) research showed that the majority of pre-service teachers were unable to properly perform fundamental skills prior to receiving instruction involving motor skill assessment. Gordon and Inder observed pre-service teachers' ability to properly demonstrate the leap, dodge, two-handed side arm-strike, and punt and overhand throw. Results showed that of the 20 third year undergraduate pre-service Physical Education teachers (10 male, 10 female), 75% were unable to demonstrate these basic skills at mastery level. When focusing on these teachers' inability to properly demonstrate motor skills, Gordon and Inder then proposed the question "how is it possible that students could graduate from an educational system, supposedly having experienced many hours of compulsory physical education, and still not be able to perform fundamental skills at the most basic level?"

In their study, Gordon and Inder additionally investigated a group of post-graduate pre-service teachers' improvement in demonstrating fundamental motor skills after receiving a forty minute instructional session which included peer observation and assessment, and verbal feedback on performance. These subjects incorrectly performed the overhand throw prior to exposure to this treatment. After subjects participated in this session, which included instruction on motor skill assessment, all showed significant improvement in their ability to perform the overhand throw. These undergraduate and graduate students had years of previous physical education and were still unable to perform fundamental motor skills until they were exposed to an instructional environment which included student self-assessment of motor skills. If pre-service teachers and current physical activity instructors are to provide students with a proper demonstration for vicarious learning, motor skill assessment must be a learning objective in both teacher and scholastic education. Students must be given the opportunity to vicariously improve via proper demonstration of a motor skill by their peers.

Problems with Peer and Self-Assessment in Instruction

Identifying students' misconceptions of biomechanical principles and therefore creating lessons designed to improve students' ability to assess motor skills as well as their ability to perform the skills is an objective sought after by a number of physical activity instructors (Hare, 2000). While many physical activity instructors agree that motor skill assessment is of great importance not all concur on the teaching methods in doing so. Some physical activity instructors believe that peer and self assessment are beneficial since the student will gain an enhanced conception of the skill. Others feel that certain biases occur in the peer and self-assessments made by a student, which in turn do not allow for student learning as well as an accurate evaluation of student comprehension. The question now is, whether or not students' peer and self assessment should be used in motor skill assessment and in testing students' comprehension.

The value of evaluating the student's comprehension of motor skills is beneficial to the physical educator, as well as the student. Miller's (2002) *Measurement by the Physical Educator: Why and How* is designed for physical educators to use as a guide for preparing evaluation methods for psychomotor, affective, and cognitive lessons. When evaluating students in the cognitive domain Miller supports that "Authentic assessment should include student self assessment and peer assessment" (Miller, 2002, p. 81). Authentic assessment is used in Miller's work to describe objective and accurate methods for gathering data concerning students' learning. Assessing performance technique can be challenging for students to carry out so Miller recommends teachers provide students with "Charts or forms that include clearly stated performance criteria" (Miller, 2002, p. 81) and that "Students may perform self-assessment if their performance can be videotaped" (Miller, 2002, p. 82.) making self-assessment a less complicated and time-consuming task to accomplish. Miller advocates that including motor skill assessment is also advantageous for physical educators that are attempting to gain further understanding of their students' cognitive development and is beneficial for the students since "watching and analyzing the performance of their peers will help the students learn more about a skill" (Miller, 2002, p. 82).

As research shows, peer assessment can however, have particular limitations due to competitive, social, and adolescent developmental factors. For example, a study performed by Cassadya, Clarkeb, and Latham (2004) researched the feelings dance student subjects had about being evaluated and about evaluating peers' dance skills as part of their training process. The goal of Cassadya et al.'s (2004) study was to use this information to improve the practice and training methods of dance students and hence, improve the students' cognitive and movement performance.

Cassadya et al. (2004) had two groups of female dance students to serve as subjects. The first group consisted of a total of 24 (13-14 years old) subjects, and the second group consisted of 11 (15-16 years old) subjects. In attempting to learn more about the pressures involved with self and peer-evaluation, the researchers required subjects to complete written questionnaires and verbally state their evaluations of live and video recorded performances. Cassadya et al. (2004) stated that “The tasks were completed in both written and verbal form” requiring students to evaluate peers’ performance and also “required the pupils to give feedback to other pupils.” Although this approach does examine the pressures of self and peer-evaluation, it makes it difficult to understand the accuracy and legitimacy of such motor skill evaluations. This is due to the fact that the subjects were required to provide verbal feedback of their peer assessment directly to their peers. Cassadya et al. (2004) were obviously aware of these distortions and attributed the students’ bias in evaluations to peer competition.

Cullingford and Morrison (1997) state that “within peer groups there is always evidence of competition, thereby suggesting that even when pupils belong to a peer group there is always an underlying aim to be the best within the group” and therefore may alter their peer and self assessment for the sake of placing themselves in a better view due to competition. An additional benefit of Cassadya’s et al. (2004) study is the researchers’ recognition of subjects’ stereotyping individuals based on gender. Dodds (1993) refers to these occurrences as “ugly ‘isms”.

In summary, it appears that several of the biomechanical misconceptions within students (Hare, 2000) have stemmed from teacher’s inability to properly demonstrate the skill (Gordon & Inder, 2000), lack of objective student evaluation of demonstrations performed by peers and the self due to competition (Cassadya et al., 2004) and the presence of “ugly-isms” (Dodds, 1993) when students stereotype the performer’s motor performance according to the performers’ gender. Teaching students to employ scientific facts as a source of how to analyze technique is a more certified educational approach to improving students' comprehension of motor skill technique (Carr, 2004).

Instruction of Biomechanical Assessment in Physical Activities

Regrettably, students are also exposed to inconsistent skill performance instruction and advice from different sources. When learning a new motor skill these sources of information range from peers in games, parental coaching, and unfortunately, even across different coaches and instructors. While one source may state that the correct performance of a skill should be executed using one technique, a separate source might advice a completely different technique in performing the same skill. Carr (2004) describes these common, unprincipled approaches, which coaches sometimes use; "They reason that "this is how it was done in the past and it worked well, so this is how we should do it now" (p. 6). They have no idea why some movements may be good and others bad (Carr, 2004, p. 6)." When this occurs, the misconceptions discussed earlier, are more likely to develop, eventually leading to frustration and perhaps even loss of interest in learning the skill.

The development of "Critical thinking skills" and more independent cognitive analysis of movement might serve as a scientific and factual guide to skill achievement since "biomechanical classes lean more heavily on scientific and quantitative modes of inquiry" (Charles, 2002, p. 39). Introducing biomechanics into the physical activity curriculum might allow students the opportunity to advance their cognitive ability. Students may learn to utilize a scientific approach based on facts rather than suggestions from inconsistent sources since "Critical thinking skills are essential in modern culture to determine the truth of conflicting claims, to selectively sift through mounds of information, and to analytically prioritize competing demands on limited time" (Charles, 2002, p. 39).

Carr (2004) clarifies the value of not only the instructor learning biomechanics, but also the potential cognitive benefits for students developing a sound comprehension of biomechanics:

> If you are a coach and you understand how all these forces interrelate, you'll be better able to analyze an athlete's technique and improve the athlete's performance. If you are an athlete and you have this knowledge, you'll understand why it's better to apply muscular force at one instant than at another and why certain movements in your technique are best performed in a particular manners. Even as a spectator and sport fan, you'll find that an understanding of basic mechanical principles helps you become more knowledgeable and appreciative of what it takes to produce an excellent performance (p. 4).

Pangrazi (2001) also supports implementing a biomechanical unit within a physical activity curriculum, even for students at a younger age:

> When planning for skill instruction, mechanical principles need to be considered an integral part of skill performance. It is best to teach young children the proper way to perform a skill so they won't have to unlearn it later. Many teachers have experienced the difficulty of changing a performer's motor patterns after a skill has been learning incorrectly. Stability, force, leverage, and motion are concepts that are best learned when they accompany a skill being taught (p. 51).

When designing a biomechanical study guide to be used for distance learning, Mills' (1997) instructional approach supported that "the biomechanical curriculum should be based on the principles of anatomical kinesiology and the analysis of human movement in physical activity" (p. 10). Knudson and Morrison (1997) recognize that when students are assessing a motor skill, "A key component of observation in qualitative analysis is the use of a systematic observational strategy (SOS), a plan to gather relevant information about a movement" (p. 81). Kelly (1971) suggests breaking the analysis and instruction of biomechanics down into smaller, less complex segments to "simplify the discussion of motor description" (p. 58). For example, the analysis of body motion is divided into eight segments and then the body parts are paired; "the pair of feet, the pair of legs, the pair of thighs, and the pairs of hands, forearms, and arms" (p. 70).

By teaching students how to systematically identify the biomechanical factors involved with motor skills, be it positioning of the feet in relation to the knees in a sprinting activity, or attempting to identify the reason a tennis serve always travels too high, students might be prone to identify the problem with the technique as well as understand what biomechanics are required to produce the desired outcome. When teaching biomechanics Mills (1997) states that "the principles of kinetics and kinematics should not be theoretically based but studied through practical movement skills" (p. 10) and therefore should be incorporated into a practical physical activity setting.

There are a variety of sports that can be used for the instruction of biomechanics. One sport, bowling, has been an activity appreciated by physics and biomechanics instructors seeing as its concepts include a wealth of information regarding kinetic energy and practical physics (Burgess, 1996). Burgess realized the potential learning applications of bowling when instructing a high school physics course. Students were taken to a local bowling alley and given physics assignments which focused on first determining the physical properties of the different bowling balls, finding the center of gravity of the bowling pin, and analyzing how the weight distribution and density of different balls effect the game and what effects biomechanics have on such. Burgess implemented learning activities which required students to practice physics concepts; "Graphing potential energy as a function of the x positions at the center of mass of a pin provides students with an opportunity to apply the ideas related to stability, instability, energy, and force" (p. 317). These biomechanical and physics activities were then converted into a game where "The class chooses a common method for estimating the kinetic energy given the ball" (p. 318). Upon completion of the game, the students then "compare the ratio of pins downed (in first shot) to the energy provided", therefore "the strongest arm is not guaranteed victory!" and students are compelled to answer, "Where does the energy for the through come from? How the bowler increase or decrease the energy provided the roll?" (p. 318). In Burgess's activity, students were given the opportunity to analyze in a practical sense, how biomechanics influence the speed and velocity of the bowling ball rather than merely assuming strength is the sole factor in generating speed and power.

Benefits of Video Observation when Instructing Biomechanics

Although one of the goals is to have students be able to assess biomechanical concepts, the physical education methods of instructing assessment of motor skills typically lack the use of video recordings as supplemental teaching tools. Instead, the majority of physical educators rely solely on verbal instruction which provides descriptions of technique. What little research that has been done on the use of video observation in learning biomechanical concepts has been encouraging. Research testing the efficiency of an educational intervention involving VOVI instruction of motor skill assessment has showed improvement in the ability to identify performance errors in 80 third and fifth grade public school children (Liang, 2001). Liang concludes that based on the results of the motor skill assessment appear to substantiate new directions in effectively teaching "motor skill knowledge (e.g., short-term classroom-based video-assisted training). Such instructional interventions can facilitate the cognitive-analysis to skill-performance connection for elementary school-aged children in physical education."

Zetou, Tzetzis, Vernadakis, and Kioumourtzoglou (2002) designed a study to test the effectiveness of instructing motor skill performance via video observation by comparing two different types of modelling. Subjects were randomly divided into two groups, the first group observing video-recordings of the self performing the skill and the second group observed recordings of a professional performing the skill. The participants consisted of 63 males and 53 females with the mean age of 11.7 years. Both groups also received verbal cues relevant to the technique of the performer's serve and set in volleyball. The first group observed the video from both a side view and a front view. Participants in the second group were each video taped individually performing the skill and then also received verbal cues from the instructor. The models in the video consisted of one male performer and one female performer both of which were gold medallists in the 1996 Olympic Games. It was found that the "Expert Modelling Group" improved set and serve skills more on acquisition and on the retention test than the "Self Modelling Group". There is the possibility that the subjects that watched professionals perform the skills improved their self-efficacy. Bandura's (1977) "Self-Efficacy Model" theorizes that a person's self-efficacy is likely to increase when he or she witnesses the success of an individual perform the skill.

An additional benefit of using a video tape in motor skill instruction is that when students are able to view the skill being performed repetitively, more time is available for students to analyze the motor skill being performed and learning time is not wasted (Kelly, Walkley, & Tarrant, 1988). Early work on instructing motor skill assessment began with teacher education programs. Kelly, et al. recognized the lack of motor skill assessment teaching tools suitable for teacher educators. Their goal was to create a teaching tool that would allow teachers to provide students with video demonstrations that could jump from one segment to another without sacrificing classroom time from by rewinding and fast forwarding. Hoffman (1977) argues that one must grasp the criterion of what defines mastery of a skill and be capable of differentiating room for improvement with proficiency. The “interactive videodisc motor skill assessment training module” developed by Kelly et al., had similarities to the modern day Digital Versatile Disc or DVD in that clips could be paused to permit students time for analysis, jumping from one segment to another, repeating clips, and slow motion. The videodisc training module, however, was a computer assisted instructional tool that was designed to have students practice assessing motor skills individually and receive feedback on their accuracy from the training module after assessing the motor skill performances on video. Kelly et al. realized the importance of educating pre-service physical educators in how to assess motor skills and explored a new teaching technique; incorporating student observation of video recorded motor performances.

In the present study, the efficiency of teaching students motor skill assessment via students observing video-recorded performances was researched. Subjects were also permitted to view motor performances repetitively on video, and received feedback on their accuracy of assessment during group discussions within the motor skill assessment lessons. Feedback specific to students’ accuracy of motor skill assessment, however, came directly from the teacher in verbal form during each lesson. The feedback included how accurate students have verbally presented their motor skill assessment and directed students to focus on specific techniques in bowling, such as the release, the performers’ footwork, and follow-through after releasing the ball.

Summary

Much of the research on motor skill assessment involves studies that tested pre-service teacher education curricula and teaching methods used by physical educators focusing on how to assess motor skills and teach students do to such. Various teaching approaches were taken in doing so and those that proved the most effective in improving subjects' accuracy consisted of having students assess the motor performances of individuals they did not know rather than assessing peers or the self. Teachers must learn the basics in assessing fundamental motor skills in order to diagnose and treat areas of improvement for all of their students. Adding more emphasis on the instruction of motor skill assessment to the K-12 physical education curriculum is a novel teaching approach that has not received sufficient research attention. Further research on biomechanical instruction in physical activity learning environments is necessary for broadening the scope of understanding this teaching approach. If students can also learn to accurately assess fundamental motor skills, self-guided, exploratory, and independent learning will be more effective. It is not uncommon for physical educators to state the purpose of performing a motor skill in a particular fashion in order to correctly perform a movement, however lessons are rarely designed that actually place motor skill instruction as the topic of learning. Since research has shown positive results in having subjects observe and analyze performances on video it is necessary to test the accuracy of subject's ability to assess motor skills. Teaching students how to assess motor skills, might improve independence, self-awareness, and confidence.

CHAPTER III

METHOD

Design

This study was designed to test the efficiency of utilizing video observation and verbal instruction as a method of teaching biomechanics in a physical activity setting. As advancements in the world of technology are rapidly increasing so is the implementation of such within education. Physical educators and athletic coaches frequently use video recordings of a motor performance along with verbal instruction when teaching students concepts of motor performance.

Physical educators are also confronted with social issues concerning students' basing their perception of performance ability on gender. Teachers must therefore discover how much of an impact that providing students with a scientific approach to assessing performance might have on omitting or reducing gender assessment bias, and whether or not any differences in improvement of assessment accuracy occur.

Video observation and verbal instruction of biomechanics was intended to provide students with a factual approach to learning by dividing this complex field into subcomponents: Static Analysis, 2) Dynamic Analysis 3) Direction/Angle Analysis 4) Body Relationship Analysis 5) and 6) Physics Analysis. Therefore, when evaluating the true effectiveness and value of this method of teaching within an educational context I inquired:

(1) Did video observation and verbal instruction of biomechanics have an effect on group differences in students learning biomechanics?

(2) Did the gender of the performer have an effect on subjects' biomechanical assessment?

(3) Did the experimental group show a greater significance of improvement within all five of the sub-scaled measures of biomechanical performance?

Participants

This study included 18 college students recruited from a Beginning Bowling class (Exercise and Sport Science 128-01) taught by a teaching associate at The University of North Carolina at Greensboro (UNCG) during the spring semester of 2007. A beginning bowler is a student that has received little or no instruction on the fundamentals of bowling including rules and technique. Prior to participation subjects completed the Participant Demographic Questionnaire (PDQ) which inquires information regarding the subjects' age, gender, race, as well as experience in athletics, bowling, or motor skill assessment instruction. All subjects were treated at the same location:

AMF All Star Lanes
910 South Holden Road
Greensboro, NC 27407

The instructor holds a Bachelor of Science in Education, which certifies teaching grades K-12 Health and Physical Education. The instructor previously taught Beginning Bowling at the UNCG in the spring semester of 2006. The class began on January 9, 2007 and ended on May 1, 2007 with a total of 31 lessons, 6 of which the volunteer students will participate in the study. Students participating in the course received 1 college credit and voluntarily registered for the course, while participation in the study was also completely voluntary and non-obligatory. The ages of the subjects ranged from 20 to 37 (17 years) with a mean age of 23.3 years. The study had 6 females and 10 males.

Video Observation and Verbal Instruction of Motor Skill Assessment

Video observation and verbal instruction was divided into six lessons in which students observed different segments of the instructional video, *Brunswick Division, The No. 1 Name in Bowling*, while receiving verbal feedback from the instructor. The instructional video consisted of two professional bowlers, Johnny Petraglia and Marshall Holman. Johnny Petraglia was shown first in the video and is a right handed bowler, while Marshall Holman was shown second in the video and is a left handed bowler. Both performers were played at real speed. Petraglia was the first of the two bowlers shown in the video. Both bowlers were shown four times from behind, eight times from the front left, four times from the front, and eight times from the left. Petraglia was then shown eight times from the left, front, left front, and four times from behind at real speed. The next video segment was titled "Upper Body Focus" in which Petraglia was shown four times from behind, and eight times from the front left, front, and left. He was then shown eight times from the left, front left, and four times from the front and behind view. The final segment was titled "Lower Body Focus" in which Petraglia was shown four times from behind, eight times from left front, front, left, left again, front, left front and four times from behind. Marshall Holman was then shown the same number of times from the same angles. Each bowler therefore, was shown from each angle a total of 48 times. The total length of the video was 30 minutes.

During lessons one, two, and three, subjects observed the first performer, right-handed professional bowler Johnny Petraglia and during lessons four, five, and six, subjects observed the second performer, left-handed professional bowler Marshall Holman. Since the demonstrations of each bowler in the video were divided into three segments, lesson one focused on Johnny Petraglia's entire body assessment, lesson two focused on Petraglia's "Upper Body", and lesson three focused on Petraglia's "Lower Body".

The same lesson format was employed during lessons four, five, and six, when subjects observed Marshall Holman. The VOVI learning approach allowed the instructor to provide verbal feedback on the technique of each performer's body segments, and as well as provide verbal feedback to subjects' questions and statements. During the time in which the experimental group received VOVI motor instruction on the performers' starting stance, approach, release, and follow through techniques, the control group practiced these techniques in bowling lanes located on the opposite end of the AMF All Star Lanes. This prevented discussion of lesson content between subjects in the experimental group and control group. The subjects in both groups participated according to their protocol in the study for two, one hour and fifteen minute lessons each week on Tuesdays and Thursdays from 9:30am-10:45am.

Measures

Two different questionnaires were administered to the participants: (1) The Participant Biomechanical Assessment Questionnaire (PBAQ), which was administered prior to commencement of instruction and upon completion of participation in the study; and (2) The Participant Demographics Questionnaire (PDQ), which was administered prior to the start of the study. The PDAQ was designed to gather data regarding subjects' level of accuracy when assessing biomechanical performance. The PDQ asks subjects to state their age, gender, and any prior bowling experience and biomechanical instruction that may influence their assessments of motor skills when completing the PDAQ.

Prior to the commencement of basic bowling instruction, both groups completed the PBAQ. The experimental group received basic bowling instruction and biomechanical instruction via VOVI and the control group received basic bowling instruction. Upon completion of the 6 lessons, both groups retook the PBAQ.

The PBAQ is located in Appendix A. The questionnaire consists of a 30-item questionnaire that asks subjects to assess the two separate performers' demonstrations in the Biomechanical Assessment Video (BAV). Both performers are residents of Greensboro, NC. The female performer is Sara Utz (Age = 25), an exercise and sport science graduate student at UNCG, and the male performer is Doug Ramey (Age = 34), a league bowler and bowling technician employed by AMF All Star Lanes in Greensboro, NC. The questionnaire was divided into five subscales. These include 1) Static Analysis, 2) Dynamic Analysis 3) Direction/Angle Analysis 4) Body Relationship Analysis 5) and 6) Physics Analysis. Therefore, results were grouped into separate biomechanical assessment categories. Both performers also presented a consistent number of errors and demonstrated a consistent number of proper techniques. For example, performer A will neglected to bring the right leg behind the left leg after the "release" of the ball but perform the correct number of steps when making the "approach".

Performer B also performed these two biomechanical components in the same manner as Performer A. In light of the research performed (Cassadya et al, 2004; Cullingford & Morrison, 1997; Dodds, 1993) on the effects of using the peer and self or teaching motor skill assessment, it was advisable to include performers the subjects do not know. If the subjects are to be assessed on their accuracy of motor skill assessment, they must complete an objective analysis, free of any bias towards the performers' race or gender as well as any bias when evaluating peers or the self.

Subscale Items in Participant Biomechanics Assessment Questionnaire

The PBAQ was comprised of 30 multiple-choice questions. Each question was equal to one point, with the highest number of points possible being 30 correct answers out of 30 questions. Kelly (1971), Mills (1997), Pangrazi (2001), Charles (2002), and Carr (2004), recommend that instruction of biomechanics be broken down into focusing on segments of the body as well as the physics related to body movement. Therefore, the PBAQ was designed so that biomechanical sub-components were divided into five sub-scaled categories for analyses. For example, question 16 on the PBAQ asked the subject to describe the length of the stride of the performer as "Long, Medium, or Short". During the instruction of biomechanical principles, students were taught that "Instability is useful in some activities, such as when a rapid start is desired" (Pangrazi (2001, p. 51) and therefore a "Long" stride is recommended to permit the ball to more naturally "Loop" during the approach. It is important to bear in mind that the performers did not always use proper technique in the Biomechanical Assessment Video (BAV). The PBAQ included all of the following concepts in order to separately analyze any greater improvement between each subscale. Rather than organizing each question into the subscale group it describes, the PBAQ disperses the questions throughout the entire test. The distribution of each subscale question is categorized and listed below:

Static Analysis (item numbers 6, 7, 8, 10, 12, 13)

Dynamic Analysis (item numbers 14, 16, 17, 20, 22, 26)

Direction Analysis (item numbers 4, 18, 19, 25, 27, 29)

Body Relationship Analysis (item numbers 3, 5, 9, 11, 21, 30)

Physics Analysis (item numbers 1, 2, 15, 23, 24, 28)

A 2 x 2 repeated measures ANCOVA will be used for:

1) Comparing any improvement between the experimental and control group's pre and post test accuracy of motor skill assessment and any interaction between gender biomechanical assessments.

2) Testing for any gender bias in relation to the gender of the performer in both the experimental and control group.

3) Testing for differences in subjects' pre and post test accuracy of the sub-scaled biomechanical components.

Development of the Biomechanical Assessment Video

The Biomechanical Assessment Video (BAV) was recorded with a Mini DV recorder owned by the UNCG Teaching and Learning Center onto a Panasonic Mini DV cassette. After filming the BAV, the video was transferred onto a DVD by the Broadcasting and Television Department at UNCG. All demonstrations were repeated a total of 5 times making a total of 30 repetitions per bowler. The length of the video was 15 minutes.

The BAV provided subjects with a non-audio demonstration of two separate bowlers performing a roll at all 10 pins. The first roll attempts to gain a strike. A strike as defined by Grinfelds and Hultstrand (1980) is to "Knock down all the pins with the first roll of the ball in a frame" (p. 132.) Only the strike was assessed by the participants during the study for the reason that the spare is a more complex skill appropriate for advanced players.

The BAV was filmed at AMF Lanes where a practice session with both performers was held prior to filming the demonstrations. Each bowler rehearsed their performance to ensure the same motor skill techniques would be demonstrated in the BAV. During the starting stance the bowlers' left leg was straight and the right knee bent. Their feet were pointed to the front-right and their right elbow was not tucked into the right hip. On the follow-through, the bowlers' balance was disturbed as the right leg is kept straight rather than shifted behind the left leg which maintains a suitable equilibrium. The subjects were unaware that both demonstrations were the same in all biomechanical aspects measured in the BAV in order to test for any gender bias in subjects' assessment of motor skill performances.

Procedure

The goal of the present study was to test the accuracy of subjects' ability to assess motor skills. Therefore, subjects assessed individuals they did not know. This also eliminated any social concerns the subjects were apt to encounter, such as embarrassing the performer they were assessing. The PBAQ was designed to measure the accuracy of subjects' motor skill assessment and was administered before and after the implementation of two separate forms of bowling instruction. During the first form of motor skill instruction, VOVI bowling instruction was administered for six lessons to the experimental group of college students and the second form of motor skill instruction, basic bowling instruction, was administered to the control group of college students (ages 20-37).

In this study the subjects assessed two separate performers, each of different gender; one Caucasian female, and one Caucasian male. The participants were asked if they would be interested in voluntarily participating in a Bowling Instruction and Assessment study. All students agreed and completed the subject consent form which describes to the participants the purpose of the study, tasks they would be required to complete, learning benefits of participation, duration of the study, verification of confidentiality, and consent to use data collected in research and submission for professional journal publication. Subjects were informed that participation was completely voluntary, that there would be no obligation to participate, and withdrawal from the study would be possible at any time. After consent was obtained all subjects completed the pre-test PBAQ designed to evaluate subjects' accuracy in motor skill assessment. The subjects were randomly placed into two different groups (N = 8 subjects): N = 8 (5 male/3 female, *M* age = 23.25) in the experimental group, and N = 8 (5 male/3 female, *M* age = 24.38) in the control group. Both groups received instruction adhering to the curriculum for the Beginning Bowling course. The curriculum was designed to teach students beginner bowling skills including the basic techniques involved with bowling as well as the rules, score, and etiquette. Both the control and experimental groups received the Beginning Bowling course curriculum while the experimental group received a six lesson VOVI unit on motor skill assessment. During the portion of the lessons in which the experimental group received VOVI instruction on motor skill assessment of the starting stance, approach, release, and follow through techniques, the control group practiced the starting stance, approach, release, and follow through techniques.

Each subject completed a separate PBAQ for each of the two bowlers. Refer Figure 1:

1. Experimental Group: *Received basic instruction on rules and techniques*.

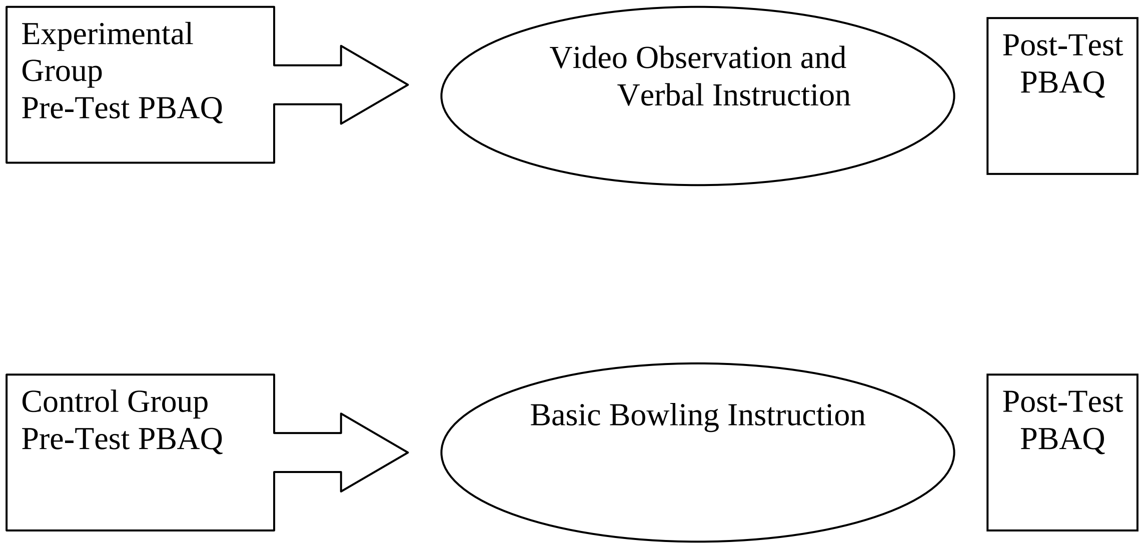
Received VOVI motor skill assessment instruction while watching the Instructional Video.

Completed PBAQ before and after the six lessons.

2. Control Group: *Received basic instruction on rules and techniques*.

Completed PBAQ before and after the six lessons.

Figure 1: Procedural Design



Data Analysis

The subjects' scores taken from the pre-test PBAQ and the post-test PBAQ were analysed using a 2 x 2 repeated measures analysis of variance (ANOVA). A total of three separate 2 x 2 ANOVAs were used in this study, one for each of the following factors; differences in improvement between groups in accuracy in assessment, the presence of gender bias between groups in assessment of motor skills, and differences in accuracy between groups within the five sub-scaled biomechanical components. A total of three separate 1-way ANOVAs were also used in this study, one for each of these factors to determine if both groups were initially equivalent within each of the above listed factors.

CHAPTER IV

RESULTS

Chapters I, II, and III introduce and describe the purpose of this study, review the literature on previous research related to educational approaches aimed at improving students' cognitive development of biomechanics and the relationship of gender perceptions within, and discuss the methods used to examine the efficiency of Video Observation and Verbal Instruction of biomechanics (VOVI).

Chapter IV presents the results of data accumulated throughout this study including the demographics of the participants (frequencies, means, and standard deviations), improvement of accuracy when assessing one male and one female performer, and the presence of subjects' accuracy discrepancies between one male and one female performer, and group differences in improvement within the five sub-scaled biomechanical components. Subsequently, the three hypotheses were analysed using a general linear model, repeated measures ANOVA (Thomas and Nelson, 2005). Finally, the results of the data are analysed to determine findings relevant to the hypotheses tested.

Description of Participants

A total of 48 participants were originally intended for potential participants in this study. The first 30 candidates were also students participating in an additional activity course offered by the University of North Carolina at Greensboro and remaining 18 from the Beginning Bowling class. Due to conflicts in time, the 30 subjects from the former class were unable to participate as subjects leaving the latter group of 18 students in the Beginning Bowling class as possible candidates. Of the 18, two students were able to participate in the study. The first student was unable to participate due to time conflicts and the second student was also unable to participate due to time conflicts as well as language barriers. However, both students were placed in the control group to receive basic bowling instruction during the time they were able to attend, with no data collected for either of the two students.

The Participant Demographic Questionnaire (PDQ) (Appendix A) was administered on March 27, 2007, preceding each subject's completion of the Participant Biomechanical Assessment Questionnaire (PBAQ, Appendix A). The demographics frequencies are located in Table 1. Of the total (n=16) participants 37.5% were female (n=6) and 62.5% were male (n=10). The ages of the participants ranged from 20 to 37 (17 years) with an average of 23.3 years of age. The PDQ provides a description of subjects' ethnicity as "Caucasian" 62.5% (n=10), 31.25% (n=5) as "African American", and 6.25% (n=1) as "Other". As for students having received bowling instruction prior to being enrolled in the Beginning Bowling class, 68.75% (n=11) stated they had never experienced instruction, 18.75% (n=3) stated they had little instruction, and 12.5% (n=2) stated they had some instruction. Two of the students had taken Beginning Bowling at the University of North Carolina at Greensboro (UNCG) one year prior to retaking the course with the same instructor. Basic bowling instruction was the emphasis during the Spring of 2006 Beginning Bowling course and did not include the treatment, as in the spring of 2007. Neither of the students stated they had received biomechanical instruction prior to taking the Beginning Bowling course.

Table 1. Demographic descriptors of participants (N=16).

Demographic characteristics	n	%
Gender		
Female	6	37.5
Male	10	62.5
Age		
Mean	16	23.3
Median	1	22.5
Mode	5	21
Ethnicity		
African American	5	31.25
Caucasian	10	62.5
Other	1	6.25
Bowling Instruction		
Never	11	68.75
Little	3	18.75
Taken a Course	2	12.5
Currently Enrolled	16	100
Biomechanical Instruction		
Never	10	62.5
Little	2	12.5
Taken a Course	0	0
Currently Enrolled*	4	25

*Please review random distribution of subjects below.

The majority of students 62.5% (n=10) stated they had never experienced biomechanical instruction, 12.5% (n=2) stated they had little instruction, and none of the students had taken a full course in biomechanics. The PDQ asks students to list and describe any course they have or are currently enrolled in that includes biomechanical learning content. Four students (25%) stated on the PDQ that they were currently enrolled in ESS 375, Physiology of Sport and Physical Activity at UNCG while also taking beginning bowling. All four of these subjects were randomly assigned to groups, two of which participated in the control group while the other two participated in the experimental group. None of these participants' scores showed outliers of any kind.

Pre-test Equivalencies in Assessments of Female and Male Assessment

Analysis of data showed that there was no significant difference ($F_{1,14}$ = 1.606) between the experimental (M= 15.5, SD= 4.57) and the control group (M= 18.0, SD= 3.21) when pre-tested on accuracy assessing the female performer. When assessing the female performer, pre-test accuracy scores in the experimental group ranged from 5 to 19 (14 points) while the control group ranged from 13 to 24 (11 points). The experimental group (M= 13.63, SD= 4.00) did not show a significant difference ($F_{1,14}$ = .236) between the control group (M= 14.5, SD= 3.16) when pre-tested using the male performer. When assessing the male performer, pre-test accuracy scores in the experimental group ranged from 7 to 18 (11 points) while the control group ranged from 9 to 19 (10 points).

Improvement in Female Assessment

The experimental group (M= 20.5, SD= 3.02) did show a significant difference ($F_{1,14}$ = 4.89, $p < .05$) between the control group (M= 17.88, SD= 1.46) over time when assessing the female performer. The experimental group ranged from 15 to 24 (9 points) when post-tested assessing the female performer, while the control group ranged from 16 to 20 (4 points).

Improvement in Male Assessment

The experimental group (M= 17.13, SD= 2.36) did not show a significant difference ($F_{1,14}$ = 2.16) between the control group (M= 15.13, SD= 3.04) when post-tested using the male performer. When post-tested using the male performer, the experimental group ranged from 13 to 19 (6 points), while the control group ranged from 11 to 20 points (9 points). A summary of all subjects' scores is located below in Table 2.

Description of Subjects' Scores

Table 2. Means, standard deviations, F values, and significance for experimental and control groups' scores on pre and post tests in biomechanical assessment accuracy (BMA).

Scores and Improvement	M	S.D.	F	S
Female Pre-test				
Experimental	15.5	4.57		
Control	18.0	3.21		
Total	16.75	4.03	1.61	.226
Female Post-test				
Experimental	20.5	3.02		
Control	17.88	1.46		
Total	19.19	2.66	4.89	.044
Male Pre-test				
Experimental	13.63	4.00		
Control	14.5	3.16		
Total	14.06	3.51	.236	.635
Male Post-test				
Experimental	17.13	2.36		
Control	15.13	3.04		
Total	16.13	2.83	2.16	.164

Gender Perception

The experimental group maintained a consistent discrepancy score (M=4.125 on pre-test SD 3.356, M=4.125 on post-test 1.885) whereas the control group's discrepancy (M=3.750, SD= 2.251 on pre-test, M=4.000, SD 1.690) actually increased. There were no significant differences between groups during the pre-test ($F_{1,14}$ = .069) or between groups over time ($F_{1,14}$ = .019) when $p < .05$.

Table 3: Means, standard deviations, F values, and significance over time and between groups for experimental and control group discrepancy scores between the male and female performer.

Means, standard deviations and significance	M	S.D.	F	S
Pre-test Discrepancy				
Experimental	4.13	3.36		
Control	3.76	2.25		
Total	3.94	2.77	.069	.797
Post-test Discrepancy				
Experimental	4.13	1.89		
Control	4.00	1.69		
Total	4.06	1.73	.019	.891

Subscale Scores

Analysis of data showed that there was no significant difference ($p < .05$) between the experimental and the control group's subscale scores when pre-tested on each of the five sub-scaled biomechanical categories. As depicted in Table 4, post-test data showed a significant difference ($p < .05$) between the experimental ($M= 5.13$) and the control group's ($M=4.88$) accuracy of body relationship analyses when assessing a female performer.

Female Subscale Scores

Table 4: Means, standard deviations, F values, and significant differences between groups over time for subscales scores in the pre and post tests of a female performer.

Independent Variable	Mean	Standard Deviation		Sig.
Pre-Test Static				
Experimental	2.00	.926		
Control	2.63	1.408		
Total	2.31	1.195	1.101	.312
Post-Test Static				
Experimental	2.88	.835		
Control	2.25	.886		
Total	2.56	.892	.381	.145

Pre-Test Dynamic				
Experimental	3.63	1.188		
Control	4.13	1.126		
Total	3.88	1.147	.747	.402
Post-Test Dynamic				
Experimental	4.13	1.246		
Control	4.25	1.165		
Total	4.18	1.167		.660
Pre-Test Direction				
Experimental	1.88	1.126		
Control	2.38	.744		
Total	2.13	.957	1.098	.312
Post-Test Direction				
Experimental	3.38	1.302		
Control	2.38	1.506		
Total	2.88	1.454		.075
Pre-Test Body Relationship				
Experimental	3.75	1.389		
Control	4.88	.991		
Total	4.31	1.302	3.479	.083
Post-Test Body Relationship				
Experimental	5.13	.835		
Control	4.88	.354		
Total	5.00	.632		.029
Pre-Test Physics				
Experimental	4.25	1.389		
Control	4.00	1.069		
Total	4.13	1.204	.163	.693
Post-Test Physics				
Experimental	5.00	1.195		
Control	4.13	.991		
Total	4.57	1.153		.378

Table 5 shows that post-test data reveals a significant difference ($p. < .05$) between the experimental (M=3.75) and the control group's (M= 2.75) accuracy of physics analyses when assessing a male performer.

Male Subscale Scores

Table 5: Means, standard deviations, F values, and significant differences between groups over time for subscales scores in the pre and post tests of a male performer.

Independent Variable	Mean	Standard Deviation	F Value	Sig.
Pre-Test Static				
Experimental	2.00	1.309		
Control	1.25	.707		
Total			2.032	.176
Post-Test Static				
Experimental	2.13	.641		
Control	1.50	.923		
Total				.821
Pre-Test Dynamic				
Experimental	3.13	1.126		
Control	3.63	1.302		
Total			.675	.425
Post-Test Dynamic				
Experimental	3.50	.756		
Control	4.13	.991		
Total				805
Pre-Test Direction				
Experimental	2.25	1.282		
Control	2.13	1.126		
Total			.043	.839
Post-Test Direction				
Experimental	3.50	.926		
Control	2.38	1.302		
Total				.108
Pre-Test Body Relationship				
Experimental	3.38	1.302		
Control	4.13	1.256		
Total			1.518	.238
Post-Test Body Relationship				
Experimental	4.25	.707		
Control	4.38	.744		
Total				.395
Pre-Test Physics				
Experimental	2.88	1.458		
Control	3.38	1.188		
Total			.566	.464
Post-Test Physics				

Experimental	3.75	1.165	
Control	2.75	.463	
Total			.027

Summary

The results of the data analyses show a significant difference in improvement between groups over time when assessing a female performer. As for the male performer, the results did show a significant improvement for both the experimental and control group over time but did not show a significant difference between groups over time.

The results of the data analyses show no significant difference over time or between groups when examining students' perception of performance based on the performer's gender. No significant differences were found in the data for either groups' accuracy of male or female performer assessment prior to participation in the study.

CHAPTER V

DISCUSSION

This chapter aims to discuss the results presented in Chapter IV. The data are representative of subjects' perception of gender in performance and accuracy of assessing motor skills after having participated in a VOVI unit in a physical activity curriculum. Improvement of subjects' exposure to VOVI will first be discussed, followed by a discussion of subjects' perception of gender performance.

Improvement in Accuracy

The first purpose of this study was to test the effectiveness of improving students' accuracy of performance assessment by teaching biomechanics via VOVI in a physical activity learning environment. As hypothesized, the experimental group significantly improved their accuracy ($p < .05$) more than the control group over time when assessing a female performer. For subjects' mean improvement, the experimental group improved more when assessing the female ($M=5$), while the control group actually showed a slight decrease ($M=-.12$). These results support previous research on improving motor skill assessment (Liang, 2001) via "short-term classroom-based video-assisted training". Given the innovative teaching approach, improvement is beginning in the expected direction.

When assessing the male performer however, neither group improved significantly more than the other over time when $p < .05$. Still, subjects in the experimental group scored improved their average on their post-test by 3.5 points, while the control group only slightly improved (M=.63). It is interesting that both groups did improve significantly over time (.024) when $p < .05$ while assessing the male performer. This may be due to the possibility that both groups' gender expectations were higher for a male than for a female. This is likely, seeing that both groups were instructed by a male teacher, which would account for the control group's significant improvement over time. Zetou et al (2002) exposed the experimental group to one male and one female professional athlete during instruction of motor skill performance via video observation, unlike this study, in which the experimental group observed two male professional bowlers during their treatment which may have led to higher expectations for a male performer. Had this study followed a similar format to Zetou et al's (2002) study, in which both a male and female performer were observed by subjects, it is likely that a significant improvement difference between groups over time when assessing a male performer would have been attained.

Gender Perception

The experimental group was treated with a factual, scientific, approach to learning the mechanisms of the body, while the control group received basic bowling instruction and were therefore more open to relying on presumptions unrelated to scientifically sound, factual support (Charles, 2002). As previous research (Cassadya et al. 2004) has suggested, it was expected that the experimental group would show a significantly lower discrepancy score than the control group over time. Although data did not show a significant difference between groups over time, it still is interesting that results began in the expected direction since, subjects within the experimental group did in fact, reduce their variance of scores greater over time (SD= 1.471) than did the control group (SD=.561). The experimental group maintained a consistent discrepancy score over time and managed to reduce their within group discrepancy scores, while the control group contrarily increased their number of differences when assessing two, diversely, gendered, performers.

Improvement in Sub-Scaled Biomechanical Assessment

Previous physical activity instruction (Knudson & Morrison, 1997; Kelly, 1971; Carr, 2004) has suggested that instructors divide the complexity of biomechanics into separate learning categories in order to assist students in distinguishing the various elements of movement. This study focused on categorizing such variables as static, dynamic, directional, body relationship, and physics analysis (Burgess, 1996). Of the five sub-scaled categories, body relationship and physics analyses showed a significant difference in accuracy when $p < .05$. As for the remaining categories, directional analyses approached significance, while static and dynamic analyses were not significant. After completion of the post-test, subjects stated that “watching both performers’ position when they were standing was difficult because they did not stand still long enough”. Hence, assessment of the performers’ idle stance involved questions falling in the static subscale category, explaining why subjects did not show more accurate scores. As for dynamic analyses, it is puzzling that no significant differences were found, considering the education emphasizing proper application of technique when moving. Overall, the experimental group improved their accuracy in all five of the sub-scaled PBAQ test items.

Classroom Implications for Physical Educators and Coaches

The rapidly increasing rates of advancements in technology have equally increased usage of such within school classrooms. More research on physical educators and coaches implementation of students' and athletes' video recorded performances has brought about the focus on the improvements in motor performance. Less research however, has been done on the improvements in students' cognitive development of assessing motor skills accurately. The results of this study relate improved accuracy of motor skill assessments to Video Assisted and Verbal Instruction (VOVI) of biomechanics in a physical activity curriculum. This study suggests that short term (e.g. one unit of six lessons) instruction of VOVI is likely to improve students' and athletes' cognitive development and also supports previous research suggesting VOVI implementation should also improve the physical (motor skill performance) domain of learning (Liang, 2001). This study also supports the suggested value of repeated observation at various angles of a performer using an interactive video disc (Kelly et al, 1988) to show students while verbally instructing biomechanics. Subjects within the experimental group were exposed to technology coherent with Kelly et al's (1988) interactive video disc design which also permits the educator the pause the video, in order to enhance teaching opportunities. These include more time available for student-teacher discussions on movements, body segments, and clarifying misconceptions, and answering students' questions. Kelly et al's (1988) innovative video developments can be valuably applied, most especially in a biomechanical learning environment.

As for students' perception of gender relating to performance, the results of this study imply that having students observe only a single gender, male or female, performing the skill correctly may lead to students having higher performance expectations for the gender of the performer observed. Therefore, it is advisable to recommend physical educators and coaches interested in including a VOVI unit in their curriculum, to provide demonstrations of both male and female, elite, professional (Zetou, 2002) athletes, performing the motor skill at hand.

Limitations and Directions for Future Research

While the results of this study signify the benefits of VOVI, certain limitations are present. The main limitation may be lack of power (N=16) and duration (6 lessons) in terms of revealing a greater significance in improvement between groups when assessing the male performer. Improvement began in the expected direction in view of the fact that the experimental group improved accuracy when assessing both the female and indeed, the male performer. Future studies should consider that a greater difference in improvement between groups when assessing a male performer would likely be more apparent with a larger (N=48) number of subjects, as earlier intended and to increase the duration of the treatment to 10 lessons.

An additional limitation is that unlike Zetou et al's (2002) study which had one male expert performer as well as one female expert performer, this study lacked a female expert performer for instructional demonstrations during treatment. This may have led to higher expectations in the experimental group for a male than that of a female. This study used both a male and female performer while applying the pre and post tests and therefore should follow the same format during instruction. Doing so in the future might reveal a significant difference in subjects' perception of gender.

This study used a 2 x 2 repeated measures ANOVA for testing its research questions. Future researchers may consider utilizing a Solomon Four-Group Group (Thomas and

Nelson, 2005) research design to examine any distinctions between the four instructional approaches to biomechanics at hand; verbal instruction, video observation, verbal instruction and video observation (VOVI), and control (basic bowling instruction), could be examined.

Researching the relationship of gender perceptions by comparing subjects' mean scores a male to that of a female is a unique and novel approach to studying the influence of gender perceptions of motor performance. While prior investigations of gender stereotyping, mostly focusing on the relationship of the subject's gender and their self-expectations for performance, undoubtedly host great value to this topic, inviting the demonstration of both male and female performers has potential for providing more insight to gender perceptions of motor skills. In light of this, future studies should check for interactions between the gender of the subject and the gender of the performer.

Conclusion

This study examined collegiate students' progress learning biomechanics in a physical learning environment. While the ultimate goal for many educators of the physical is to improve motor skills, it is also vital to address students' cognitive growth in physical education. Results indicated that improved accuracy of assessing a female performer is related to video observation and verbal instruction of biomechanics. Inclusion of biomechanics in a developmental motor skill course is a novel approach to physical education and future research is needed to better accommodate students' learning. The presence of gender perceptions of performance was an additional component examined in this study. While significant differences in discrepancies between students' assessments of a male performer and female performer were not found between groups, reduction of discrepancies for students participating in video observation and verbal instruction of biomechanics occurred and therefore should be involved in future research.

BIBLIOGRAPHY

Ayers, S. F. (2002). Assessing Subdisciplinary Content Knowledge of Preservice Physical Education Teachers. West Virginia University. [Conference at Beijing, China].

Ayers, S. F., Housner, L. D., Gurvitch, R., Pritchard, T., Dell'Orso, M., Dietrich, S., Kim, H. Y., & Pearson, M. (2005). An examination of skill learning using direct instruction. *The Physical Educator.* Vol. 62, No. 3. pp. 136-144.

Bandura, A. (1977). *Social learning theory*. Englewood Cliffs, NJ: Prentice-Hall.

Burgess, T. (1996). The Physics of Bowling. *Physics Teacher*. Vol. 34 No. 5, pp. 316-318. May 1996.

Charles, J. M. (2002). *Contemporary Kinesiology: Second Edition.* Stipes Publishing L. L. C. Champaign, IL.

Carr, G. (2004). *Sport Mechanics for Coaches: Second Edition.* Human Kinetics. Champaign, IL.

Carroll, B. (1994) *Assessment in physical education: a teacher's guide to the issues.* London, The Falmer Press.

Carroll, WR & Bandura, A. (1982). The role of visual monitoring in observational learning of action patterns: making the unobservable observable. *Journal of Motor Behavior*. Vol. 14, pp. 153-167. Jun 1982.

Cassadya, H., Clarkeb, G., & Latham, A. M. (2004). Experiencing evaluation: a case study of girls' dance. *Physical Education and Sport Pedagogy*. Vol. 9, No. 1, pp. 21-36.

Cullingford, C., & Morrison, J. (1997). Peer group pressure within and outside of school. *British Research Educational Journal.* Vol. 23. No. 1, pp. 61-79.

Dodds, P. (1993) Removing the ugly '-isms' in your gym: thoughts for teachers on equity, in: J. Evans (Ed.) *Equality, education and physical education* (London, The Falmer Press).

Gordon, B., & Inder, T. (2000). The competency levels of third year pre-service primary teachers in performing and learning fundamental motor skills. *Journal of Physical Education New Zealand.* Vol. 33, No. 3, pp. 53. Dec. 2000.

Grinfelds, V., & Hultstrand, B. (1992). *Right Down Your Alley: The Complete Book of Bowling*. Englewood, CO: Morton Pub.

Hall, S. J. (1995). *Basic Biomechanics*. St. Louis, MO. Mosby-Year Book.

Hare, Molly K. (2000). *Investigating knowledge acquisition and developing misconceptions of high school physical education students.* Dissertation Abstracts International Part A: Humanities and Social Sciences. Vol. 61, No. 10, 3938 p. Apr 2001.

Hoffman, S. (1977). Toward a pedagogical kinesiology. *Quest*, Monograph 28. 38-48. 1977.

Holman, M., & Petraglia, J. (1985). Sybervision Neuro-Muscular Programming. Bowling with Marshall Holmann and Johnny Petraglia. Sybervision Systems, Inc.

Kelly, D.L. (1971). *Kinesiology: Fundamentals of Motion Description*. Prentice-Hall, Inc. Englewood Cliffs, NJ.

Kelly, K. E., Walkley, J., & Tarrant, M. R. (1988). Developing an Interactive Video Disc Application. *Journal of Physical Education, Recreation, and Dance*. Vol. 59, No. 4, pp. 22. Apr. 1988.

Knudson, D. V., & Morrison, C. S. (1997). *Qualitative Analysis of Human Movement*. Human Kinetics. Champaign, IL.

Lawson, H. (1987). Teaching the Body of Knowledge. *Journal of Physical Education, Recreation, and Dance, 58*(7), 70-72.

Liang, Guoli (2001). Teaching Children Qualitative Analysis of Fundamental Motor Skill, Dissertation, West Virginia University, [*Online Abstract*].

Miller D. K. (2002). *Measurement by the Physical Educator: Why and How*. New York, NY: McGraw Hill.

North Carolinas Healthful Living Standard Course of Study for the year 2006 http://www.ncpublicschools.org/docs/curriculum/health/scos/finalhlscsonly2006.pdf

Pangrazi, R. P. (2001). *Dynamic Physical Education for Elementary School Children; Thirteenth Edition.* A Pearson Education Company. Needham, MA.

Schmidt, R. (1991). *Motor Learning and Performance: From Principles to Practice*. Champaign, IL: Human Kinetics.

Thomas, J. R., Nelson, J. K., and Silverman, S. J. (2005). *Research Methods in Physical Activity; Fifth Edition.* Champaign, IL: Human Kinetics.

Williams, A.M. Ward, P. Herron, K. and Smeeton, N.J. (2004). Using situational probabilities to train perceptual and cognitive skill in novice soccer players. *Journal of Sports Sciences*. Vol. 22, No. 6 p.576, June 2004.

Zetou, E., Tzetzis, G., Vernadakis, N., & Kioumourtzoglou, E (2002). Modeling in learning two volleyball skills. *Perceptual and Motor Skills.* Vol. 94, pp. 1131-1142.

APPENDIX A

Participant Biomechanical Assessment Questionnaire

(“Bowler’s Analysis Chart” Grinfelds and Hultstrand, 1980; Modification)

Please Print First and Last Name: Date (Month/Day/Year)

____

_______/_______/_______

Directions: Circle the letter that best describes the bowler’s performance.

BALL ROLL

1. Action
A. Straight
B. Hook
C. Curve
D. Back-up

2. Landing on Lane
A. Considerable bounce
B. Little Bounce
C. No Bounce

BALL and STANCE

3. Ball Height:
A. Chest high
B. Waist high
C. Knee high

4. Feet:
A. Straight to intended line B. Pointed away from the intended line

5. Feet:
A. Left foot ahead B. Right foot ahead C. Together

6. Positioning of Head:
A. Straight B. Slightly bowed C. Bowed

7. Weight distribution:
A. Mostly right B. Mostly left C. Evenly distributed

8. Knees:
A. Both bent B. Right bent C. Left bent D. Straight

9. Alignment of ball:
A. Right of the shoulder
B. In line with shoulder
C. At center line
D. Between shoulder and center line

10. Positioning of Ball:
A. Supported by the right hand
B. Supported by the left hand
C. Evenly distributed between both hands

11. Positioning of Elbow:
A. Tucked into hip
B. Away from hip

12. Positioning of Wrist:
A. Straight
B. Fairly straight
C. Bent

13. Palm of Dominant Hand
A. Flat
B. Bent
C. Turned to side

APPROACH:

14. Number of steps _______

15. Force of first step
A. High
B. Normal
C. Low

16. Length of Remaining Steps
A. Long
B. Moderate
C. Short

17. Tempo
A. Fast

B. Moderate
C. Slow

18. Arm-swing
A. Parallel
B. Outside-in
C. Inside-out
D. Loop

19. Shoulders are
A. Facing right
B. Facing left
C. Parallel

20. Hips are facing
A. Right
B. Left

21. Backswing
A. Below waist
B. Waist high
C. At shoulder level
D. Above shoulder level

22. Wrist
A. Firm
B. Bent back
C. Cupped

Balance

23. Knee bend
A. Too much
B. Not enough

24. Waist bend
A. Too much
B. Not enough

RELEASE

25. Palm
A. Down

B. Left
C. Up

26. Wrist
A. Firm
B. Sagged

27. Rotates
A. To the left
B. To the right
C. No rotation

28. Lift
A. Smooth
B. Crisp
C. Weak

FOLLOW THROUGH

29. Direction Relative to Target
A. In line
B. Right of target
C. Left of target

30. Height
A. Waist
B. Shoulder
C. Overhead

Appendix B

Participant Demographics Questionnaire

Please Print First and Last Name:

____

1. Please circle which ethnicity you would use to describe yourself:

A. Caucasian
B. African American
C. Hispanic
D. Native American
E. Other

2. Please circle your gender

A. Male
B. Female

3. What is your age?

_____

4. Have you received instruction from a bowling instructor, teacher, or coach in bowling? If so, describe in detail, what topics were covered, and the duration of instruction.

Never Little Some Plenty

____

____

5. Have you had instruction on biomechanics? If so, describe in detail, what topics were covered, and the duration of instruction.

Never Little Some Plenty

____

____

<u>APPENDIX C</u>

Subject Consent Form
For Participation in Human Subject Research
Motor Skill Assessment Instruction in Adolescent Physical Education
Investigator: Jared Androzzi

(Please print)

Subject Name: ____

Research Purpose and Procedures:

The study you are being asked to participate in is designed to examine teaching methods for motor skill cognitive development. The information received will be beneficial in assisting physical activity instructors including physical educators, athletic coaches and trainers in designing programs which focus on students' comprehension of motor skill techniques. You will benefit from this study by participating in additional course specific content that is hypothesized to increase your level of understanding in the content. We will be studying 18 collegiate students 18-35 years of age. You are being asked to participate in this study based on your age level and the location of your school within that of the investigator. If you consent to participate, you will receive six 1 hour and 15 minute lessons focusing on the rules and fundamental techniques of bowling including the observation of the Motor Skill Assessment Video. You will be required to complete six motor skill assessment questionnaires.

Benefits: You will receive no direct benefit from this study. This study will add to the current knowledge of teaching methods for motor skill apprehension. Physical activity instructors will be able to modify where needed, the cognitive domain in the curricula they instruct in motor skill development. This study will also allow educators a further understanding of teaching methods which include technology in our advancing world of science. Society will benefit from this study by adding more individuals capable of utilizing the content involved.

Risks: There is no risk associated with this study.

Confidentiality: All data collected will be kept confidential. The questionnaires collected will be stored in a locked cabinet in the investigator's home for one year, after which they will be shredded.

By signing this consent form, you agree that you understand the procedures and any risks and benefits involved in this research. You are free to refuse to participate or to withdraw your consent to participate in this research at any time without penalty or prejudice; your participation is entirely voluntary. Your privacy will be protected because you will not be identified by name as a participant in this project.

The University of North Carolina at Greensboro Institutional Review Board, which ensures that research involving people follows federal regulations, has approved the research and this consent form. Questions regarding your rights as a participant in this project can be answered by calling Mr. Eric Allen at (336) 256-1482. Questions regarding the research itself will be answered by Jared Androzzi by calling 336-508-0439. Any new information that develops during the project will be provided to you if the information might affect your willingness to continue participation in the project.

By signing this form, you are agreeing to participate in the project described to you by Jared Androzzi.

______________________________________ ______________

Participant's Signature* Date