SELF EVALUATION IN VOLLEYBALL A COGNITIVE APPROACH

BY

MARGOT D ALNWICK

DEPARTMENT OF PHYSICAL EDUCATION

McGILL UNIVERSITY, MONTREAL

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH IN

PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE

DEGREE OF MASTERS OF ARTS

FEBRUARY 1994

ABSTRACT

The purpose of this study was to develop, implement and evaluate a self-evaluation instrument that students would be able to use to assess their metacognitive awareness of volleyball skill and knowledge The Self Evaluation in Volleyball Questionnaire (SEV) was designed to include a series of self-evaluation items within the five areas identified in a knowledge-based approach to skill acquisition, namely procedural, declarative, affective, metacognitive knowledge and metacognitive skill

The reliability, face and content validity of the SEV were found to be very acceptable The scores on the SEV show that the questionnaire was easily understood by the students, but the students found certain sections were more difficult to answer Students were categorized by their teacher into top, middle and bottom skill groups Analysis of variance procedures showed that there were significant differences in SEV scores due to skill level, which demonstrated the value and the sensitivity of the SEV in differentiating such skill levels Even though this was a descriptive study, it was also shown that the instructional programme did have a positive effect on the students' SEV scores

RÉSUMÉ

Le but de cette étude était de développer, implanter et évaluer un instrument d'auto-évaluation que les étudiants pourraient utiliser pour évaluer leur perception métacognitive des habilités et des connaissances en volleyball. Le questionnaire d'auto-évaluation en volleyball (SEV) a été conçu pour inclure une série d'items d'auto-évaluation se rapportant aux cinq domaines de l'approche d'acquisition des habilités axée sur les connaissances, procédural, déclaratif, affectif, connaissance et habilité métacognitive

La fiabilité et la validité de la forme et du contenu du questionnaire d'auto-évaluation (SEV) se sont avérés acceptables Les réponses au questionnaire ont démontré qu'il a été bien compris par les étudiants, même si certaines sections ont présenté des difficultés Les étudiants furent classés par leur professeur en trois groupes selon leur niveau d'habilité, haut, milieu et bas L'analyse des variances a démontré qu'il y avait des différences significatives dans les résultats obtenus au questionnaire (SEV) dû au niveau d'habilité, ce qui demontre la valeur et la sensibilité du questionnaire à différencier les niveaux d'habilité. Même si cette étude était descriptive, il a été démontré qu'un programme d'instruction a eu un effet positif sur les résultats obtenus par les étudiants

ACKNOWLEDGEMENTS

I would like to express my appreciation to the following people who have played important roles in the completion of my thesis

First and foremost, I wish to thank Dr A E Wall for all his encouragement, guidance and support in the completion of this study His patience and insight has helped me to become a better student and researcher, and gave me the confidence to finish what I had started

I would like to thank Dr D Marisi and Dr R Bracewell for giving me direction, help and a sound foundation from which to conduct my research

Many thanks to Debby Adelman for her assistance in the presentation of the graphs and to Bill Holt for all his hard work and help in the printing of my thesis

I would like to express my gratitude to the principals of Sacred Heart High School and Lindsay Place High School for allowing me to do my research in their schools A sincere thanks to Dawn Cumming and Sue Paquette for their willingness to participate in this study and to all the other physical education teachers and volleyball coaches, for their valuable feedback concerning the Self Evaluation in Volleyball Questionnaire I am also grateful to all the grade eight girls who participated to the best of their ability, in order to make the research worthwhile and educational

I am most appreciative for the financial support provided by Fonds FCAR, in support of my research project

Finally, I would like to express a most sincere "Thank you!" to my family and friends for all their faith, support and understanding Together, we have all succeeded

TABLE OF CONTENTS

PAGE

LIST OF TABLES

CHAPTER ONE

INTRODUCTION

Teachers of physical education continually make judgments about the sport performance of children, the appropriate time to introduce new skills and refine old ones, and how to enhance learning Throughout the years, physical education teachers have evaluated children's progress in motor skill learning in particular sports by observing children practising and playing games, giving them knowledge tests on rules and specific strategies, and administering skill performance tests

Very often in the past, teachers assessed students' expertise in sport simply by using norm-referenced tests The emphasis that educators placed on skill performance assessment in the evaluation of skill acquisition may well be due to the type of research that has been conducted in the sport domain Most researchers before the seventies centered their motor skill learning studies on the physical attributes of performers and their skill performance In 1972, Singer commented on this narrow focus and cited two studies that served as examples of this problem The two studies examined the factors that differentiated expert volleyball players from novices both studies concluded that physical attributes were the major determinants of volleyball performance Slaymaker (1966) reported that expert volleyball players were significantly better in vertical jump and grip strength than the average person, while Bakker (1968) concluded that reaction time and jumping ability correlated very highly with volleyball skill However, as Singer pointed out, key factors underlying sport expertise such as decision making, problem solving, planning, self-evaluating, knowledge about the use of tactics and strategies, were often not included in these early studies of sport expertise.

Later on some researchers, such as Barrow and McGee (1971), argued that the best way to assess ability and skill acquisition in volleyball was by using specific skill tests such as the modified Brady volleyball test, the high wall volley test and the Petry serve test Evaluation of skill and task performance in the research laboratory carried over into the gymnasium and influenced the assessment of children's motor skill learning.

The physical education teacher can usually assess if improvement in a skill has occurred by the use of skill tests before and after a unit of instruction. However, the tests must be valid and administered correctly for a proper appraisal But what does this actually tell the teacher or student? Does skill improvement measured in this way actually reflect the types of learning that are taking place? For example, are the students able to use their "learned" skills in a game effectively? There are many times when the physical educator and/or student is frustrated because either no skill improvement seems evident but at the same time, the student feels he or she, in fact, has learned something The teacher and especially the student want to know how this may happen One possibility may be that a major component of skill learning has not been assessed that may be critical for the acquisition of sport skills

In an important paper in 1974, Salmela observed that one reason for the physical skills performance focus in volleyball, or in fact, any sport, was that the sport was often ". .characterized as a 'non-intellectual' or purely physical game that required no special demands on the input or decision mechanism of the player" (p 59)

Physical skill proficiency is clearly an integral part of sport expertise, however within the last twenty years the importance of higher level cognitive skills has begun to be addressed in sport situations An important distinction exists between the cognitive demands in closed and open motor skills It is important to discuss these differences sc as to appreciate the cognitive differences which underly expert sport performance

Closed skills are performed in a consistent, relatively stable environment, while open skills are usually performed in a moving, changing environment Open skills often involve an opponent, while closed skills usually involve competitors taking turns in sport environments Allard & Starkes (1991) state that "for closed skills, motor patterns are the skills, it is critical that the performer be able to reproduce consistently and reliably a defined, standard movement pattern For open skills, it is the effectiveness of a motor pattern in producing a particular environmental outcome that constitutes the skill" (p.127). The cognitive demands for closed skills are usually not as great because external monitoring is less important due to the relatively constant environmental conditions In general, the demands are mainly internal, that is, the athlete is trying to perform and reproduce the technical skill and pattern perfectly On the other hand, open skills demand the involvement of a broader range of processes due to the changing spatial-temporal demands of the key stimuli in the environment In such situations, the performers must attend to both external and internal information The athletes are still trying to perfect and perform a consistent movement skill but must now appropriately apply this movement pattern within an ever-changing environment. In doing so, they must be able to understand their capabilities to effectively accomplish this selection

In the past these factors were of interest to researchers, but only recently has the study of the development of skill acquisition explicitly noted the relationship between the knowledge base of the learner and the skill-to-be-learned A cognitive sport expertise approach to skill acquisition takes an overall view of skill learning that may be beneficial in developing a more realistic assessment of children's skill development. This approach stresses that the knowledge gained through experience and practise is very specific to a given sport Each sport has its own set of skills, strategies and knowledge that must be learned (Allard & Starkes, 1980; Borgeaud & Abernethy, 1987, Chase & Simon, 1973; Chi, 1978; Feltz, 1988; Lindberg,1980, Thomas, French, Thomas & Gallagher, 1988; Wall, 1986, 1990).

Domain-specific knowledge about action has been broken down into five broad categories Wall (1986) defines them as procedural, declarative, affective, metacognitive knowledge and metacognitive skills Procedural knowledge refers to the perceptual, decision-making and response processes that underly skilled action. Declarative knowledge refers to the storage of conceptual information that can influence skilled action, for example, knowledge of the rules of the game. Affective knowledge refers to the feelings stored about oneself in various activity settings and situations Metacognitive knowledge refers to what a person knows or does not know about their own knowledge. It is the " capacity for self awareness or accurate knowledge and understanding" of one's strengths and weaknesses (Campione, Brown & Ferrara, 1982, p.433) Metacognitive skills refers to the higher-level control of cognitive activity, including the use of strategies Metacognitive skills allow for the analysis of a skill, practice, use of feedback, etc. They include modifying, planning, monitoring and evaluation during or after the learning or performance of a skill. Wall and his colleagues (1985, 1986, 1990) suggest that children should be taught how to manage their own learning, including the control of their emotions, and the ability to focus their attention and recognize their strengths and weaknesses

An area that needs more study is the interaction between children's skill development and metacognition. Wall (1986) states that very few motor development studies have looked at the role metacognition plays in skill acquisition or the interaction between metacognition and declarative, procedural and affective knowledge Metacognitive awareness has been defined as the conscious awareness which can be recognized, recalled and expressed regarding one's metacognitive knowledge of procedural, declarative and affective knowledge as well as metacognitive skills.

In recent years, students have been taking a more active role in the evaluation of their learning Students appreciate the opportunity to express what they think and feel about their skill level, their knowledge of concepts, their level of effort, their strengths and weaknesses, and their attitudes about learning Self report instruments have been a popular method for giving students that opportunity

Bandura (1986) contends that carefully constructed self report instruments can be used to assess some aspects of cognitive processing. However, there are a number of concerns about using self report instruments, especially with children. One main concern about self report tests or questionnaires is that they may be inaccurate. This could be due to a lack of knowledge about the questions asked, wanting to answer in a socially desirable manner or a lack of experience in self evaluation. The process of self evaluation requires exposure and practice In fact, a number of researchers report that the more opportunity students have to use self report techniques, the more accurate they will become as their knowledge of how to self evaluate grows (Baranowski, 1988, Feltz, 1988; Horn &

Hasbrook, 1987; Klesges, Eck, Mellon, Fulliton Somes & Hanson, 1990, Ruble, Boggiano, Feldman & Loebl, 1980, Shaklee & Tucker, 1979)

Duda (1987) states that more research is needed in the area of children's perceived competence in actual sport and physical activity settings Nicholls (1984) and Horn and Hasbrook (1987) contend that the process by which children determine their abilities changes with age and they also stress that more research is needed Feltz (1988) concludes that even when appropriate self report techniques are used in the physical education or sport domain, they often are too general and do not assess appropriate domain-specific knowledge In fact, Feltz contends that studying perceived ability in children must be more task and situation-specific so that it reflects accurately the sport in which the child is participating Many other researchers also stress the importance of using domain specific instruments when studying children's perceived competence or skill acquisition (McAuley & Gill, 1983, Ornstein & Naus, 1985, Robinson & Howe, 1989, Thomas, French, Humphries, 1986, Weiss, Wiese & Klint, 1989)

When one examines the literature in this area, it is clear that it is essential to focus investigation on sport specific domains At the same time, given the interactive nature of the various types of knowledge about action that underly sport expertise, it may be beneficial to examine self evaluation processes in a sport from a more holistic knowledge-based perspective. (Wall, 1986, 1990; Wall, McClements, Bouffard, Findlay &

Taylor, 1985, Wall, Reid & Paton, 1990). The development of a more holistic self-report instrument may give students the means by which to examine what they have actually learned or are trying to learn Self evaluation clearly involves a variety of cognitive and metacognitive processes Researchers have used a variety of terms to identify certain aspects of this process, such as perceived self efficacy, perceived competence, perceived ability, movement confidence, self concept or performance expectancies

This study is concerned with the development of self evaluation techniques that students can readily use to complement the teachers' overall evaluation of their performance and learning in a sport situation It has been argued that we need to collect more information from a more coherent perspective to begin to see the patterns and relationships that might be operating in skill learning situations (Wall, 1986, 1989, 1990; Wall, McClements, Bouffard, Findlay & Taylor, 1985) The development of this self evaluation instrument was based on the five relatively broad categories described in a knowledge based approach to motor development (Wall, 1986) Hence, the self evaluation instrument covers the five domains of knowledge procedural, declarative, affective, metacognitive knowledge and metacognitive skills

Another major purpose of this study is to examine the development of metacognitive awareness across different levels of beginning volleyball skill through the use of summated rating of selected items designed to reflect different aspects of volleyball expertise The conscious awareness and expression of such metacognitive knowledge by the students is operationally assessed by the various sections of the Self Evaluation in Volleyball Questionnaire (SEV) For the purposes of this study, it has been labelled metacognitive awareness Metacognitive awareness is the conscious awareness and expression of one's strengths and weaknesses in a given domain In making this distinction between metacognitive knowledge and metacognitive awareness, it is recognized that one may have tacit metacognitive knowledge about one's strengths and weaknesses but one may not be able to access or express them consciously Thus, this study is limited to the assessment of metacognitive awareness in volleyball, that is, the consciously expressed metacognitive knowledge a person has in this distinct sport domain Metacognitive awareness may well be enhanced with physical development and the concomitant development of related knowledge bases within a domain The SEV questionnaire includes six sections designed to help students evaluate their metacognitive awareness in these different areas and through its use, perhaps help them to develop a more accessible and organized appreciation of their overall developmental skill level.

Ultimately, evaluating students from a knowledge based perspective may help teachers understand more about how their students learn and the effectiveness of their own teaching The teachers may also be able to use the questionnaire as a tool to help adapt their teaching methodology to meet the different needs of all students. The Self Evaluation in Volleyball Questionnaire could potentially be a very valuable teaching and learning tool for teachers and students.

The following questions will be addressed in this study

1. What sections of the Self Evaluation in Volleyball Questionnaire (SEV) were the most readily understood by the students?
2. Did volleyball skill level differentially affect the ease with which students understood each section of the SEV?
3. What SEV sections did the students indicate that they perceived to be the most difficult to answer?
4. Did volleyball skill level of the students differentially affect the students' perceived difficulty in answering each section of the SEV?
5. Does the volleyball skill level of the students affect their SEV scores and are the scores on each section influenced by their skill level?
6. What effect did a programme of volleyball instruction have on the SEV scores and were the change scores differentially affected by the skill level of the students?

Delimitations of this Study

This study is a descriptive study with a focus on the development, implementation and evaluation of the SEV Questionnaire in a school setting Teacher, class, time, and administrative constraints made the use of appropriate control groups impossible. Hence, the results of this study must be viewed with these constraints in mind. Nevertheless, valuable descriptive information should emerge from this study which may well guide further research in this field.

CHAPTER TWO

REVIEW OF THE LITERATURE

Introduction

The review of the literature is divided into four sections The initial section discusses the basic skills that children need to acquire in the sport of volleyball. The next section reviews relevant research in the area of sport expertise from a cognitive perspective The subsequent section examines the literature related to the rationale behind developing the items and the format used in presenting them While the final section discusses the accuracy with which children can assess their developmental skill level.

A Discussion of Basic Skills that Children Need to Acquire in the Sport of Volleyball

The sport of volleyball has become very popular in the last ten to fifteen years It is played by children and adults, boys and girls and novices and elite players. Volleyball has also become one of the most popular coeducational recreational sports Performing the sport looks easy, but in actual fact, it is highly challenging and demanding The challenge of the game is due to the fact that the players' responses are made in an unpredictable environment The environment, which includes relationships between the player, the ball, teammates and opponents, is constantly moving and changing To add to this difficulty, the players must anticipate in order to make decisions and react to unexpected demands quickly (Allard & Starkes, 1980, Borgeaud & Abernethy, 1987).

Recognitions, decisions and responses must be made in many time-stressed situations. These constraints make the sport of volleyball very challenging and in certain instances discouraging or frustrating for young people trying to learn the game as they will make many mistakes in the initial phases of learning Novices will be slower in their decisions and reactions due to their lack of experience, but with practice they will improve Kich (1978) states that as beginners improve their skill, they will be able to " . select that information from the display which will enable him (them) to determine the speed of the ball, the angle of the ball, the path of the ball and the relative positions of teammates The earlier a performer can make these predictions, the more time the performer will have to make the movements and therefore the greater potential for making successful movements" (p 2)

Skills that must be mastered to play volleyball well, according to experts such as Bratton & Lefroy, 1980, Cox, 1980, Gozansky, 1983; Kich, 1981; Sawula & Valeriote,1981, Scates, 1976 and Tennant, 1976 are proper body position (waiting to react before the ball comes over the net, moving to the ball when it does cross the net and actually playing the ball), proper footwork and movement either forward, sideways, backward or upwards, how to react to and play a moving ball (using the correct technique to play the ball, correct application of force on the ball so it will travel the correct distance, passing the ball in the correct direction), performance skills such as serving, forearm pass, overhead pass, spike, block and recovery skills (digging, diving, rolling), court positioning and strategy, team play concepts (offense, defense and transition); as well as the emotional and social aspects involved in playing the game effectively

These skills must be taught in a progressive way with certain concepts emphasized in the beginning stages so children can learn and acquire the skills successsfully to enjoy playing the sport According to Sawula and Valeriote (1981) it is best to concentrate throughout on the basic skills needed to play the game, that is, skill development is more important than team play However, they do state that the concepts of team play should be introduced relatively early so that children understand and appreciate the constraints under which they are expected to play the game of volleyball

The questions of the types of volleyball skills that should be taught to different age groups has been discussed by many different educators and coaches (Bratton & Lefroy, 1980, Cox, 1980, Gozansky, 1983 Kich, 1978, Scates, 1976, Tennant, 1976) For example, Kich (1978) states that body position and footwork are the "fundamental prerequisites for all the other skills" (p 4). Since volleyball is a fast moving game, players who have mastered the basic movement skills will be able to handle the fast pace of the game Sawula and Valeriote (1981) summarize in a very clear and informative way what should be introduced to children In fact, they provide a volleyball development model which recommends for each age group the skills, concepts, strategy, and rules and game modifications that can be made for a variety of age groups At the Cycle 1 level in high school (children aged 11 to 13), Sawula and Valeriote state that the emphasis should be on the acquisition of fundamental game skills such as footwork and posture, overhead pass, forearm pass, the concept of setting, serving (underhand & overhand) and an introduction to game concepts such as three hits, rotation, service reception and players' roles in different court positions

Alnwick, Leighton & Staniforth (1983) used the above ideas to develop a volleyball instructional manual for physical educators to use at the grade seven and eight level. They stress four areas that should be covered in a volleyball unit skill development, psychomotor, cognitive and socio-affective.

The skill development area should emphasize the introduction and review of basic skills such as proper positioning, footwork, court movement, serve, overhand pass, forearm pass and ball control In the psychomotor area the concepts of receiving a slow ball as opposed to receiving a fast ball, setting a ball, the idea of using three hits, reception of serve and proper court postioning should be stressed In the cognitive area communication, anticipation and recognition of certain events, areas of responsibility for serve reception, serving team's side and during the play should be emphasized The socio-affective area should include factors such as cooperation, class conduct, game conduct, team play, participation and effort

The volleyball skills mentioned above may be presented in many different ways, using different teaching methodologies, but the majority of physical educators in fact, emphasize these basic skills when teaching a volleyball instructional unit for grade seven and eight physical education classes The teacher's role is to help children develop and build on their sport specific knowledge bases, in this case volleyball In the following section a knowledge-based model of skill acquisition and how it applies to volleyball will be described

A Cognitive Model of Sport Expertise

Motor development is influenced by the interaction of the anatomical and physiological potential with which an individual is endowed as well as the knowledge gained by that individual through experience A number of models of sport expertise have been developed, for the purposes of this study a knowledge-based approach to motor development developed by Wall and his colleagues will be used (Wall, 1982, 1986, 1990, Wall, McClements, Bouffard, Findlay & Taylor, 1985, Wall, Reid & Paton, 1990) Wall (1990) refers to this acquired knowledge as knowledge about action As individuals learn or practise a skill or set of skills, three major types of knowledge about action are acquired. procedural knowledge, declarative knowledge and affective knowledge. Once individuals have acquired sufficient knowledge in these three domains, their higher-level metacognitive knowledge and metacognitive skills emerge and develop (Wall, 1990)

Many studies on expert/novice differences have shown that experts have access to more extensive and better organized knowledge bases, acquire and store additional knowledge more readily and have better developed problem solving strategies than novices These studies also emphasize that knowledge about action is domain-specific, that is in the physical activity domain they are sport-specific

The following sections will discuss the different types of knowledge about action along with the findings of the various studies in greater detail.

Declarative Knowledge About Action

Declarative knowledge about action refers to the conceptual knowledge stored in memory that influences the development and execution of skilled actions within a sport (Wall, 1990) Individuals gradually acquire and organize, that is, label and categorize information related to their bodies, the environment around them and objects in the environment For example, in sport situations, athletes learn to understand the objectives and rules of the game, key principles and patterns of play, the pros and cons of using different techniques, skills and strategies With increasing physical proficiency and declarative knowledge, athletes learn to evaluate the changing patterns of play during a game so that they can more effectively select the appropriate response in any given situation

Anderson (1982) suggests that there are two major stages in the development of a cognitive skill a declarative stage and a procedural stage. He based his approach on Fitts' (1964) three stages of development in skill acquisition. Anderson refers to Fitts' cognitive stage which is an initial encoding of the skill as the declarative stage This stage has also been called "the getting the idea of the movement" stage which Anderson suggests is "a propositional network of facts" During the declarative stage the learner categorizes and sorts key concepts about the skill being learned and stores them for ease of access and recall The category labels act as cues for accessing the appropriate conceptual networks to solve the problem or to perform a certain movement in a specific situation. Labelling is important at the time of encoding because it provides a more meaningful association between the movement and something already known by the learner, which helps in the learner's performance and in lessening the learner's rate of forgetting (Anderson, 1982, Ho & Shea, 1978, Magill, 1984, Stelmach & Hughes, 1984) Several researchers have suggested that a good declarative knowledge base may be essential for the development of a more complex procedural knowledge base (Allard & Burnett, 1985, Anderson, 1982, Chi & Rees, 1983, Gallagher, 1984; Starkes & Deakin, 1984, Wall, 1990, Wall, McClements, Bouffard, Findlay & Taylor, 1985)

Declarative knowledge has often been modelled as "propositional networks" consisting of many nodes and links in a specific domain Each node represents a different concept and the links are the associations between the concepts The concepts stored in this manner are used when particular nodes are activated and the activation spreads quickly to related nodes through the links in the network The recall and understanding of certain concepts and information relies heavily on the structural organization within the conceptual network in a particular domain (Anderson, 1982, Chi & Glaser, 1980, Chi & Rees, 1983, Ennis, Mueller & Zhu, 1991, Glaser, 1989, Jonassen, 1987; Whiting, 1982) Chi and Glaser (1980) state that knowing more means that such networks are much better organized and larger, with more nodes and more defining features on each node, and more links connecting the various nodes Larger and better structured conceptual networks allow individuals to access more information in a shorter period of time, as well as being able to add new and more complex concepts to the already existing networks more efficiently.

Early researchers in the field of sport expertise tried to explain that certain individuals are more skilled than others in a particular sport because of their superiority in reaction time, depth perception, or strength to name a few. In recent times these explanations have fallen short and many researchers now feel that the differences between skilled and unskilled individuals is in the cognitive domain Recent work on domain specific knowledge, skill acquisition and knowledge restructuring, as well as the study of the differences between novices and experts, has demonstrated the effects that differences in skill have on the organization and use of declarative knowledge and vice versa.

The differences in the declarative knowledge structures are in the quality and the quantity of the chunks or knowledge categories each person has and uses in the performance of a skill Allard and Burnett (1985) suggest that experts are able to take in more information in a single glance than are less skilled individuals because their knowledge allows them to chunk the information into meaningful units French and Thomas (1987) note that "when asked to recall information from the knowledge domain, the expert has the distinct advantage of access to more and better organized information, which arises in retrieval of information" (p.16). Experts have a faster and more accurate pattern recognition than novices in their specific sport domain (Allard, Graham & Paarsalu, 1980, Allard & Starkes, 1980, Borgeaud & Abernethy, 1987, Chase & Simon, 1973, French & Thomas, 1987, Starkes & Deakin, 1984)

One of the first studies to look at the cognitive aspect of expertise was Chase and Simon's (1973) study of novice and expert chess players They found that chess game structure is encoded differently by the expert Chase and Simon suggest that experts store this information in coherent chunks in long term memory They assume that experts organize their chunks of information better and have larger and more chunks than novices. Allard and Burnett (1985) contend that the chunking ability of the expert is a function of experience in a particular environment

Chi, Feltovich and Glaser (1981) state that the novice often has a poorly formed, qualitatively different or nonexistent system for the chunking of information Experts can quickly establish a link between what they see in their environment and the appropriate information from within themselves Chi and her colleagues, in the verbal domain, found that novices grouped problems on the basis of surface similarity, while experts often group by significance and meaning In the sport domain, Bard and Fleury (1981) also found that experts categorize information at a higher level while novices just grouped them according to surface characteristics Murphy and Wright (1984) report that "experts see the underlying similarities in a variety of problems while the novice sees a variety of problems that they consider to be dissimilar because the surface features are different" (p 153) Allard and Burnett (1985) found experts sorted skills into more categories of significance, that is, they see below the surface, while novices do not

Since novices usually key on the surface characteristics, while experts make inferences, it may be assumed that the perceptual anticipation of experts would also be different than novices Many studies have shown that experts are able to predict events before they are completed much better than novices (Bard & Fleury, 1981, Fleury, Goulet & Bard, 1986; Jones & Miles, 1978; Salmela & Fiorito, 1979, Starkes, 1987, Starkes & Deakin, 1984) Jones and Miles (1978) showed that elite tennis players were able to predict where a tennis serve would hit the court much better than novice tennis players. Salmela and Fiorito (1979) found that skilled hockey goaltenders used advanced cues much better to determine when and where a player would shoot on goal Bard and Fleury (1981) stated that experts fixate on different cues and that these skilled players are able to make use of the advanced visual cues to anticipate and make the appropriate decisions about the movement to perform It seems that the choice of visual cues depends upon the level of expertise of the athlete

Athletes in different sports develop distinct ways in which to use visual cues. For example, Allard and Starkes (1980) and Borgeaud and Abernethy (1987) found that volleyball players must be skilled searchers rather than skilled pattern recognizers. Volleyball players must ignore certain visual cues such as offensive patterns because volleyball offensive plays are designed to fool the defence about where the point of attack will occur. In volleyball, skilled players have learned to locate the ball quickly and then make fast decisions.

Researchers suggest that, in general, individuals must develop a declarative knowledge base within a specific domain before they can develop good skill proficiency and decision making skills (Anderson, 1982, Chi & Rees, 1983, French & Thomas, 1987, Wall, 1990, Whiting, 1982). This is an important consideration when teaching skills to children. When children are introduced to a sport they usually lack the sport specific declarative knowledge and so they make many mistakes. Sport-specific declarative knowledge includes such things as rules, objectives of the game, player positions and different defensive and offensive strategies. This type of knowledge is very important when making quick decisions in time-stressed game situations. The decision to select the correct skill and when to use the skill is as important as the performance of the actual skill. A variety of experts contend that differences in sport performance may be due to deficient declarative knowledge bases, such as poorly labelled or smaller chunks of stored information, or poorly structured information, as well as to deficiencies in motor skill (Gallagher, 1984; French & Thomas, 1987; Thomas, French, Thomas & Gallagher, 1988; Wall, 1990).

According to Carey (1985) children begin with a few basic conceptual structures which they restructure to form new concepts. Vosniadou and Brewer (1987) feel children integrate current ideas from the adult world with their own experiences Thus, prior knowledge is important in the acquisition of the new knowledge The incoming information is related to what is already known They suggest that existing conceptual networks cannot be improved unless they are first identified and labelled by the children

Preschool children develop a nonverbal declarative knowledge base through all their movement experiences in their environment. However, as children get older and develop language capabilities, they start to attach labels to the cues and information they have learned (Bruner, 1983, Winther & Thomas, 1981, Weiss, 1983) As children acquire more knowledge, the information is labelled, grouped and coded or recoded into relevant chunks which are stored in memory Gallagher (1984) feels that the more sophisticated grouping and coding of chunks of information appears in children around the age of 11 With the appropriate categories and cues in place, children are more likely to be able to select the correct skill and know when to use that skill.

Volleyball is different from other open skill team sports. Volleyball teams are separated from each other by a net. The pace of the game can only be controlled by the team that has possession of the ball and this possession of the ball must be given up when the ball is returned to the other team. The boundary lines in volleyball are more flexible as the ball can be played within or outside the lines. As in most other sports, volleyball has defensive and offensive formations and plays Defensive formations are designed to cover as much of one's own court as possible so the ball will not land on the floor, while the offensive formations and plays are designed to trick the defensive team so as not to be able to predict from where the ball will be attacked Volleyball players, when on offense, must be able to recognize the formation of the other team's defense so as to know where to hit the ball When on defense, players must be able to recognize and avoid the deceptions of the offensive team and key on the ball to determine where the ball will be landing Since volleyball is such a quick game, as noted before, good players rely very heavily on quick reactions, ball detection speed and good anticipation by reading the right cues, as well as recognizing game situation patterns.

One way for children to become more adept at the game of volleyball, may be in the systematic development and use of sport-specific conceptual knowledge which may facilitate the development of their physical skills Children must learn to understand the very basic objective of the game which is to be able to control the ball on their side of the net so as to set up an attack that the other team cannot control. This key objective requires the child to understand how to be ready to receive a ball, which skill is the appropriate one to use, how to control the ball's force so as to make accurate passes to other teammates, to know where your own teammates are as well as how the opponents are positioned for proper ball placement when attacking and how to communicate with your own teammates Throughout all of this, different roles are assumed by the players such as setter, spiker, server or receiver which are concepts that also must be understood Other concepts that the players need to understand are the merits of using different skill techniques and strategies and when to use them

The teacher must help the novice understand and develop these key concepts through practical opportunities but also through encouraging the students to think about the game. Since it has been shown that language is important in labelling key concepts in the development of a well-structured declarative knowledge base, teachers should use the correct terminology when teaching and demonstrating key ideas. As children become more adept through practice, these terms take on more meaning The use of the sport-specific language, such as bump, two man block, set, rotation, W formation, ready position, helps children communicate and understand what is expected of them by both the teacher and other classmates

Children who are inexperienced often make many errors in volleyball. They may have developed the physical skills adequately but they become frustrated when they cannot perform these same skills in a game. As their declarative knowledge base develops, these frustrations may soon become successes. They start to recognize certain events and to recognize them more quickly. As a result, they know where to move on the court, how to receive the ball, they know their responsibilities and their teammates' roles. Teachers must also help children to learn how to focus on the ball better and not to be easily distracted by other players' actions The development of declarative knowledge by the physical educator is an essential part of skill development in volleyball or any other sport As Wall (1986) states "a rich declarative base in a given sport might enhance the learning of specific skills simply because such knowledge might provide a better context for learning and problem solving" (p.41)

Procedural Knowledge About Action

Procedural knowledge about action refers to the processes that underlie the performance of a specific task or skill. While declarative knowledge is the storage of conceptual information about a specific task or skill, procedural knowledge is "the storage of the action schemas that control the execution of the skilled actions" (Wall, 1986, p 34)

As mentioned previously, Anderson (1982) proposed a model for the acquisition of skill, based on Fitts' (1964) three stage model of skill acquisition, that included a fact-based initial declarative stage, a second knowledge compilation stage which translates the declarative knowledge to procedures (actions) and a final procedural stage in which procedures are adapted to match the environmental needs Anderson refers to Fitts' autonomous or third stage, that is, "gradual continued improvement in skill performance", as the production stage which Wall (1986) refers to as automatized procedural knowledge

Anderson (1982) and Chi and Rees (1983) state that the the production system processes the propositional network of facts (declarative knowledge), then using the visual cues and references interprets the situation and chooses the appropriate action In the sport domain, Wall, McClements, Bouffard, Findlay and Taylor (1985) state that procedural knowledge "underlies all aspects of an action including the perceptual, cognitive, response initiation and execution phases" (p.29).

Since procedural knowledge involves the actual performance of physical skills, there is an information processing aspect that must be considered For example, volleyball players must perceive what is happening in their environment, that is, where the players are on the other side of the net, where the ball is, where it is going, the type of flight path the ball is taking, and be aware of what deceptions to ignore from the other side's attack and where they should be and what their responsibilities are during play The players must then decide on the actions to be taken, that is, how to be ready to receive the ball, which skill is the appropriate skill to use, how to control the ball's force using that skill, etc , and then perform the skill or skills It is assumed that all these action sequences involve and are controlled by the procedural memory banks (sets of schemas) present in the player's procedural knowledge base The sets of schemas are activated when an appropriate set of conditions are present The more practice and experience the individual has, the more extensive and automatized the action schemas are Hence, as individuals become more skilled, they learn to focus on the key cues in the environment and decide on the appropriate strategies and suitable actions in response to what is happening around them The more quickly and accurately they can accomplish these processes, the more time they will have to execute and control the required actions

Wall and his colleagues use Norman and Shallice's (1980) theory of action to discuss automatized action and the role that attention plays in the control of an action Norman and Shallice contend that actions are controlled by sets of schemas that become more organized for a particular skill through practice Well-learned actions require minimal deliberate attentional control. They are controlled by sets of knowledge schemas linked together in order to control action

Norman and Shallice suggest that when learners do not have an appropriate set of automatized schemas, they must use conscious control to access information from other schemas to develop appropriate new action sequences, however, this is done at the cost of losing processing speed which is of crucial importance in competitive sport situations This procedure is influenced by the higher level strategies which bias the selection process to create new action sequences As the task becomes well learned, it requires less use of these higher level strategies and comes under more automatic control Developmentally, Norman and Shallice contend that " the whole action system refines itself through experience, developing and adjusting ...to minimize the need for deliberate attentional control" (p.12).

An efficient, more extensive and better organized procedural knowledge base is developed through experience and extensive quality practice. A skilled person who possesses a large number of automatized skills will have to use deliberate attentional control much less often and so will perform actions more readily and efficiently than a novice This allows the expert to switch attention rapidly from the performance of the skill to the game and back to the skill being used, so as to alter or adapt the action for the best tactical outcome Hence, experts are able to handle a wider variety of challenges with more proficiency than novices

There have been many studies that have looked at sport expertise These studies show that experts structure their visual search of the environment in systematic and effective ways Experts use advance cues accurately and effectively Jones and Miles (1978) found that expert tennis players were able to predict where the ball would land in the court from a tennis serve Salmela and Fiorito (1979) report that skillful young hockey goaltenders use advanced cues very well and focus on relevant cues to react quickly in preparation for a save, that is, these goalies seemed to know when and where the puck would be shot before or just after it was released Bard, Fleury and Carriere (1975), Bard and Fleury (1981) and Starkes and Deakin (1984) also found that experts and novices fixate on different cues The skilled athletes were able to make use of advanced visual cues in order to perceptually anticipate what was going to happen The choice of visual cues depended upon the level of expertise of the athlete Allard and Starkes (1980) looked at the use of advanced cues in volleyball players using a signal detection strategy Volleyball players must avoid some visual cues used by the opponents to fool the other team, by concentrating more on where the ball is at all times Allard and Starkes, supported by Borgeaud and Abernethy's findings in 1987, found that expert volleyball players were able to locate the volleyball much faster than the novice when shown slides of various volleyball situations for brief moments of time. The study showed that rapid visual search and response speed are key factors in volleyball skill. Allard and Burnett (1985) state that different sports develop different types of perceptual strategies and that these strategies are a function of the complexity, speed and visual arrays presented by the game

Weiss and Bredemeir (1983) and Gallagher (1984) state that selective attention helps perceptual encoding of task-appropriate cues and the ignoring of irrelevant information, that is, deceptions in the case of volleyball. They both stated that response selection time and the resultant response programmes are different for the expert and the novice. Thomas, French, Thomas and Gallagher (1988) also state that experts were better able to predict what would happen in an action before it was completed. They report that experts can recognize movement patterns much faster and more accurately They state that expertise in sport takes considerable time to develop and is sport specific. Experts who possess high levels of skill also have the knowledge of how to use these skills in the context of that specific sport.

Children often lack sport specific declarative or procedural knowledge when they enter a sport This lack of knowledge reduces the quality of the decisions to be made in a game As a result an inappropriate decision may be made concerning the choice of action to be performed during the game, that is, procedural knowledge. French and Thomas (1987) studied the relationship of sport specific knowledge to the development of children's skills in basketball The results of the study showed that the link between cognitive and motor skill is very important in the development of skilled sport performance in children. Thomas, French, Thomas and Gallagher (1988) state that " the decision concerning what skill to execute and when to execute a skill is as important as the actual quality of the movement pattern used to execute the skill" (p 187) Therefore cognitive skills and motor skills must be closely linked in support of a skillful performance outcome.

Since volleyball is a game based on locating the ball and reacting quickly to the ball, the faster and more accurately the child can process these cues and the more automatic the action sequences become the faster the child will be able to choose the appropriate skill which, in turn, should result in more consistent and successful performance outcomes To achieve this stage of proceduralization, children must systematically practise the necessary sport-specific volleyball skills The teacher can help guide the student in this endeavour by providing the necessary feedback and the opportunities for practice and refinement.

Affective Knowledge About Action

Affective knowledge about action refers to the feelings individuals form when they are involved in various activity situations (Wall, 1990) Whatever activities people experience, either through play, physical activity or sport settings, subjective feelings are attached to them. Many researchers have suggested that feelings, especially self perception of ability plays an important role in the acquisition of skills (Bandura, 1977; Feltz, 1984, 1988; Fisher, 1984; Griffin & Keogh, 1982, Harter, 1981, 1982, Nicholls, 1984, Rovegno, 1991, Smith, 1978, 1988, Vealey, 1986, Wall, 1986, 1990). Rovegno (1991) states that acquiring knowledge and skills is more than just a cognitive process, there is a strong " .affective thread woven throughout the knowledge change" (p.210)

Bandura's (1977) self efficacy theory has been used by many researchers to study the feelings and attitudes of athletes in sport situations He indicated that self efficacy is one of the factors that determine people's motivation and behaviour Self efficacy expectations influence individuals' choice of activity, the amount of effort used, their persistence to complete the task and their emotional reactions in difficult or stressful situations. The quality of previous performances influence people's efficacy expectations which, in turn, influence their future performances.

Harter (1981, 1982) suggests that the feelings children develop influence their learning and performance in the physical domain According to Harter, positive feelings develop from successfully meeting challenging tasks in one's environment as well as the positive reinforcement received from others High perceived competence and pleasurable feelings motivates the child to practice and become even more competent in a given domain Not all children develop positive and happy feelings about being physically active Less-skilled children often experience failure and may develop negative feelings about themselves and the activity in which they are involved. The perceived competence of less-skilled children is low and so they tend to have minimal motivation to continue with an activity in which they are involved Nicholls' (1984) model is similar to Harter's, she emphasizes that the athletes' perceived ability level is a deciding factor for the continuation or discontinuation of participation in an activity Athletes who perceive themselves as not having enough ability to be successful very often will withdraw from the activity

Griffin and Keogh (1982) proposed that the positive attitudes that people have towards physical activity is due to the development of movement confidence. They state that individuals evaluate their movement competence, that is, perception of personal skill in a particular task, in relation to the demands of the task and their movement sense which involves physical and emotional sensations If individuals have high movement competence, then it is assumed their movement confidence is high for that particular task, which positively influences their activity choices, participation modes, persistence as well as their performance

Vealey (1986) developed a more sport-specific model for self efficacy. She called it sport confidence, that is, the degree of certainty an individual has about performing a given sport task successfully It is composed of trait and state components The trait component represents the long-term perceptions that individuals have about their ability to be successful in an activity, while the state component represents the feelings the individuals have at a particular moment about their ability to be successful in the activity Vealey states that cognitive change is due to how individuals perceive their behaviour in specific situations and over time. Positive subjective outcomes such as perceptions of success and feelings of competence, satisfaction and pleasure will help develop sport confidence Improved sport confidence will lead to increased participation and persistence in the physical activity. Negative subjective outcomes create feelings of inadequacy, embarrassment and dissatisfaction which can hinder sport confidence Vealey contends that low sport confidence may well eventually lead to a withdrawal from the activity

Attributions related to success or failure in performing physical tasks are due to four main factors personal effort, ability, task difficulty or luck (Bandura, 1977, Feltz, 1984, Smith, 1978). Smith (1978) states that people who have positive self concepts attribute success to their personal effort and ability or to an activity which was within their capability. Their failure is due to an insufficient amount of effort Individuals who have negative or low self concepts do not know what to attribute their success in an activity to, except maybe luck. Their failures are attributed to a lack of ability so they do not see any point in persisting because it will not change their ability level As a result these individuals will probably withdraw from the activity

Fisher (1984) stated that good feelings about oneself encourages participation while bad feelings hinders participation or may limit the individual's attention or scanning behavior. Limiting attention causes the person to miss important cues and experiences in the environment which may lead to improperly processed cues or the absence of cues altogether which hinders the development of the procedural and declarative knowledge domains

The general theme throughout all these models is that the feelings people experience through physical activity are of considerable importance in the motivation to participate and persist in these activities As can be noted, affective knowledge about action is a very important domain in the development of sport expertise. Wall (1986,1990) has stated that educators must be more aware of the key role the affective domain plays when offering children opportunities to learn. People with positive feelings about themselves and the activities they are involved in, will usually persist, gain more expertise through continued practice, seek more challenging tasks and build a better knowledge base in that particular activity. On the other hand, individuals who have negative feelings about themselves and the activities in which they are participating usually put little effort into practise, often do not persist in it and may withdraw from the activity As a result, their acquisition of procedural and declarative knowledge about the sport in question will be negatively influenced.

To help children acquire and improve skills in a classroom situation, teachers must be very aware of the many different needs and feelings that students have For children to persist at a task to build and improve their knowledge base in various physical situations, they must have positive feelings about the activities Children with negative feelings will tend to withdraw from the activity, therefore limiting the opportunity to develop competency in the sport. A vicious circle results, where these children may never develop their skills properly and so they will have even a lower physical self concept of themselves which may lead to a strengthening of learned helplessness characteristics

Many different emotions are experienced by students learning a sport such as volleyball in a physical education class. Feelings of fear of being physically hurt, anxiety about making mistakes in front of others, frustration about their own abilities or the abilities of others, excitement of being involved in a physical challenge, joy of performing a skill successfully are just a few of the emotions children may experience Lesser-skilled students often feel frustrated, anxious and embarrassed when learning new sport skills If something goes wrong when these children practice their skills, they think something is wrong with them, that they are not good enough. High ability students have needs as well.

If these students are not challenged properly, they will feel frustrated and bored and may come to the conclusion that they can succeed with minimal effort

Physical education is one of the few environments in a school where children's successes and failures are visible for all to see If the physical educator is insensitive to students' feelings, a threatening environment is the result Lesser-skilled students will be unwilling to try new activities for fear of showing their inadequacies and failures to their peers That is why it is so important for physical education teachers to be aware of their students' feelings, anxieties and needs and to provide a non-threatening environment where maximum learning can take place for students of all abilities and needs

Metacognition

Metacognition has been referred to as the executive control of an individual's cognitive information processing skills Relating this concept to an action context, Newell and Barclay (1982) suggest that metacognition can be defined as one's "knowledge of the process controlling one's own motor behaviour" (p 202) Following other cognitive learning research, Wall (1982, 1986, 1990) has indicated that metacognition may be made up of two components metacognitive knowledge and metacognitive skill

Metacognitive Knowledge

Wall (1990) refers to metacognitive knowledge about action as an awareness of what one knows or does not know, that is, knowing about knowing how to move Campione, Brown and Ferrara (1982) suggest that the important part of a functioning system is the "capacity for self awareness or accurate knowledge and understanding of its own weakness and properties" (p 433) If people are aware of their knowledge and skills, they can adopt and modify other actions appropriate for the many different movement situations that they will experience, if unaware, they will be less able to perform the correct actions in order to anticipate or recover from difficult or unexpected events.

Wellman (1984) contends that metacognitive knowledge develops as children get older. In essence, children develop an organized set of concepts related to how their mind operates. They understand how different cognitive processes affect each other and how they can work together to handle task demands in a variety of settings, that is, how declarative, procedural and affective knowledge bases interact. Clearly, their knowledge, understanding and use of their physical action system is an important component of their overall development Hence, it would be expected that children can realistically judge their physical skills and appreciate their level of understanding of the activity or sport in which they are involved They know they can perform some skills better than others, they know what they understand in the way of rules, defensive or offensive strategies and they come to know what the key cues are when learning a new skill Even young children realize, at least to some extent, what skills they have acquired and when and where it is appropriate to use them They have the ability to predict when they are ready to try more difficult actions, take sensible chances in games or use a new strategy or skill to try and fool opponents. Children also understand their feelings about performing certain skills, with experience they develop techniques to control their feelings during practice or game situations

Glaser (1989) states that good students know their weaknesses which helps them learn better. Such children work on their weaknesses while poor students are often not able to or willing to take such action Glaser's comments remind us of the close relationship between metacognitive knowledge and metacognitive skill People who have demonstrated expertise in volleyball, have probably practised for many hours to enhance their physical skill level but they have also come to understand the importance of working on their weakest skills This is probably due to the fact that more skilled players have been able to develop a coherent understanding of their strengths and weaknesses and are able to modify their performance with the help of this self knowledge (Bouffard, 1986, Proudfoot, 1990, Thomas, French, Thomas & Gallagher, 1988, Wall, 1986, 1990, Wall, McClements, Bouffard, Findlay & Taylor, 1985). Novice volleyball players may not yet have developed such accurate awareness about their strengths and weaknesses They are just trying to build a knowledge base procedurally, declaratively, affectively and metacognitively in the sport of volleyball, that is, they are attempting to acquire the necessary skills through systematic practice and learning opportunities

Elite volleyball players look at the tendencies of the other team, evaluate their own strengths and weaknesses in a given situation by accessing consciously or unconsciously their repetoire of volleyball skills and strategies. Novices are still consciously trying to learn the skills and so do not accurately know where their strengths and weaknesses are in relation to different game situations As a result, novices will probably make many mistakes in the choice of the appropriate action to take Furthermore, their lack of metacognitive awareness is the central reason why teachers are needed to guide the learning process of novices

The extent and coherency of metacognitive knowledge depends upon the quality and quantity of the knowledge children have acquired in a specific domain In other words, few physical skills, minimal declarative knowledge and negative feelings toward participation or learning will lead to a much less-developed metacognitive knowledge base (Glaser, 1989, Thomas, French, Thomas & Gallagher, 1988, Wall, 1986, 1990) In such situations, teachers can help their students by encouraging them to develop self-knowledge by discussing weaknesses and strengths with their students and offering ways to understand, evaluate and improve their personal skill development

Metacognitive Skill

Metacognitive skills have been viewed as the executive control of one's cognitive processes which influence a person's learning and performance Brown (1977) states that higher level metacognitive skills are needed if a learner is to develop an accessible knowledge base in a given domain She suggests that learners must know what their limitations are so that they can decide what they can and cannot do, know when and how to use useful and efficient problem solving strategies and know their effectiveness in different situations, identify the demands of a given task and relate these task demands to their own knowledge of that task so as to select the appropriate problem solving strategies and to monitor and control the operation of the selected strategies, and to evaluate the success or failure of the strategies that were used in the given task or tasks

The development of such higher level metacognitive skills is dependent upon the knowledge base of the individual, the demands of the task and the individual's repetoire of planning, monitoring, and problem solving skills.

Recent studies of sport expertise (Abernethy, 1988, Allard & Burnett, 1985, Borgeaud & Abernethy, 1987, French & Thomas, 1987, Jones & Miles, 1978, Starkes, 1987, Starkes & Deakin, 1984) show that experts have much more knowledge at their disposal than lesser-skilled individuals and they are able to use problem solving strategies much better than novices during practice and game situation Furthermore, in action situations, the expert who has developed more automatized physical skills is able to focus more fully on higher level metacognitive strategy development when learning or participating in practice or game situations, while the less-skilled player may well be overwhelmed by simply trying to perform the physical skills required in the situation, and so cannot as readily develop, use or evaluate appropriate metacognitive strategies (Glaser, 1989, Wall, 1990)

For example, elite volleyball players waiting on defense will focus on how and where the other team will attack the ball By the way the opposing team moves on offense, the body positions of the setter and attackers, the location of the ball and the type of defensive coverage their own team uses, elite players determine the probable net location of attack, where the ball may be sent and the probable type of attack that will be used By the use of these cues, skilled players will be able to place themselves in the right location and prepare to use the correct physical skill to receive the ball Novices would be more inclined to focus on how to receive the spiked ball correctly, that is, proper body positioning and technique and so they would be less able to place sufficient attention on the recognition of the cues given by their opponents in order to select the most effective and efficient responses and strategies In other words, less-skilled individuals will not be able to anticipate the probable attack and so may be late moving to the correct location or may be totally unprepared to receive the ball As a result, novices, who may be relatively overwhelmed, have only minimal opportunity to develop a repetoire of action strategies if they are continuously in competitive situations that are above their skill level Quite simply, the novice learner's repetoire of metacognitive skills will not be as extensive as that of the elite player and so their selection of performance and learning strategies will be severely limited

With age and experience, individuals develop metacognitive skills for problem solving and monitoring their performance (Abernethy, 1988, Allard & Starkes, 1991, Glaser, 1989, Wall, 1990) These metacognitive skills vary in individuals and seem to be less developed in individuals with performance difficulties Glaser (1989) suggests that experts systematically check their progress toward finding solutions to the problems that confront them They are more accurate at judging problem difficulty, assessing their own knowledge base and predicting the outcomes of their performance Glaser also contends that experts have superior monitoring skills They have the ability to switch from the performance of the skills, to monitoring their performance and choice of strategies and then switch back again As a result, they have the ability to modify or completely change unsuccessful strategies in a game situation. As Magill (1985) suggests, expert athletes are more flexible, being able to adapt to all types of situations, while novices tend to operate on very specific rules that are not very adaptable to the changing demands of the game.

Expert athletes have a repetoire of strategies that they can use to plan for future situations or events. This reduces the number of choices that need to be made so that they only need to respond to a more constrained set of given stimuli Hence, there is a reduction in the response time required to react to the situation Volleyball has many pauses between rallies which affords the use of preplanned cognitive strategies Such cognitive processes allow skilled athletes to assess previous actions and responses and determine actions and strategies for future situations A knowledge of the offensive and defensive tendencies of the opposing team will usually reduce response time during a given rally In such situations, experts anticipate and react quickly to the play while beginners are too involved in the execution of basic volleyball skills and so are unable to focus attention on the key cues of the opposing team Hence, novices will generally not be able to anticipate or react as quickly to the play.

The evaluation of performance also is important The expert understands the key variables that underlie task demands, remembers the key plays, analyzes why a strategy succeeded or failed then either stores the strategy, modifies that strategy or eliminates it As the knowledge of the effect of a strategy increases, so does the likelihood of using that strategy again This may lead to efficient and consistent performance (Allard & Burnett, 1985; Bouffard, 1986, French & Thomas, 1987, Gallagher, 1984, Gallagher & Thomas, 1986, Glaser, 1989, Thomas, French, Thomas & Gallagher, 1988, Wall, 1990).

In general, children have minimal metacognitive strategies when learning a new skill or sport For children to learn these higher level metacognitive skills, they must have a basic procedural and declarative knowledge base upon which to draw (Bouffard, 1986, Gallagher, 1984, Gallagher & Thomas, 1986, Thomas, French, Thomas & Gallagher, 1988, Wall, 1990) Gallagher and Thomas (1986) state that "the implementation of a deliberate organization strategy is not content free, but depends upon the nature of the to-be-remembered information to which the strategy is applied" (p 124) At the beginning, the teacher must focus on developing a fundamental base of sport-specific procedural, declarative and affective knowledge

As Glaser (1989) states, higher level metacognitive skills are important for learning and should be introduced and discussed throughout the instructional process However, as Wall (1986) stresses, metacognitive strategies must "be matched to the developmental skill level of the learner if they are to be of any value" (p.42-43) As Gallagher (1984) found, once children were taught the appropriate sport specific strategies, their performance improved even more.

Gallagher felt that many of the differences between children's performance and adult's performance is due to the children's adoption of deficient strategies It should also be noted that, the learner must also be willing to use the strategies that are taught Motivated learners are more likely to improve their learning by working on these strategies and increasing their repetoire, while learners who are not willing to try these strategies will stay at that level of performance, not able to improve beyond a certain level

The effective use of metacognitive skills allows the student to monitor learning and performance Teachers play an essential role in guiding children to develop metacognitively Teachers should encourage children to learn how to learn by teaching them how to practice effectively, how to use feedback, how to watch others perform, how to recognize their own strengths and weaknesses and how to improve them, as well as how to control their emotions in difficult situations and to learn to focus their attention on the task at hand

To summarize, learners must develop metacognitive knowledge and skills in a specific sport domain so that they can enhance their learning and performance The improvement noted by the students will allow them to enjoy being physically active and to participate more successfully in their chosen sport or sports

During the course of this research project, a new way of thinking about the metacognitive aspect in cognitive sport expertise situations emerged In conjunction with information provided through discussion with cognitive learning experts, the author contends that individuals may also develop a metacognitive awareness of their overall ability to assess their knowledge, skills and attitudes.

Using Wall's (1986) schematic portrayal of types of knowledge about action (p.35), a new schematic portrayal of the types of knowledge about action has been developed.

As Wall's initial diagram (presented in Figure 1) shows, the knowledge based approach identifies procedural, declarative and affective knowledge as well as metacognitive knowledge and skill.

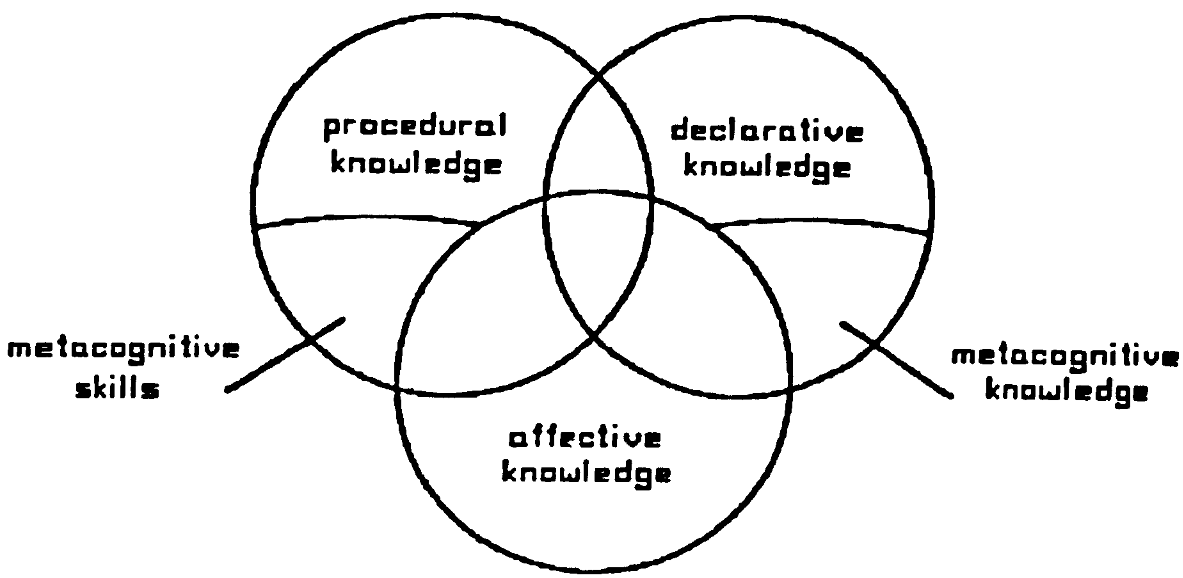


Figure 1. Types of knowledge about action.

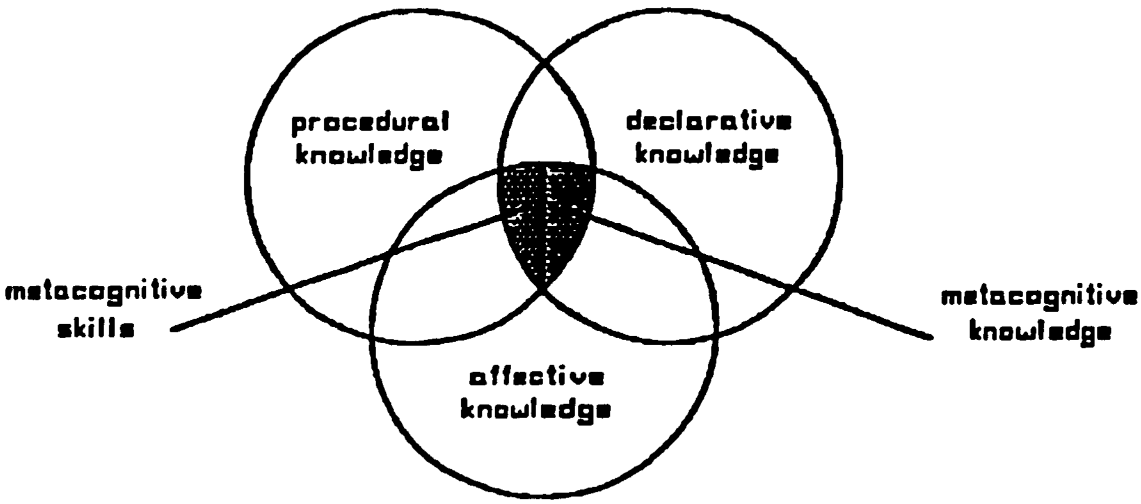


Figure 2. Metacognitive awareness and executive control of the performing self.

While Figure 1 highlights the overlapping of the declarative knowledge, procedural knowledge and affective knowledge and emphasizes the declarative nature of metacognitive knowledge and the procedural nature of metacognitive skill; the shaded area in Figure 2 underscores the central role of metacognitive awareness which also acknowledges the close interplay between metacognitive knowledge and the metacognitive skills that underly the executive control of learning and performance.

In Figure 2, the shading emphasizes the interplay between metacognitive awareness and the executive control of the performing self, that is, the idea that learners can assess their declarative knowledge, procedural skills and feelings in a specific domain in a systematic and coherent manner.

Questionnaires Their Use and Construction

Researchers often need to ask subjects questions that confirm findings that cannot be determined through observation Tuckman (1978) eloquently states the need for questionnaires in research by indicating that by providing " access to what is 'inside a person's head', these approaches make it possible to measure what a person knows (knowledge or information), what a person likes and dislikes (values and preferences) and what a person thinks (attitudes and beliefs) Questionnaires and interviews can also be used to discover what experiences have taken place (biography) and what is occurring at the present" (p.196-197)

Questionnaires are easy to administer, especially when large groups are involved They facilitate the compilation of results and they allow for the comparison of answers among subjects or comparison of answers with other answers for the same subject The types of response formats and measurement scales used in questionnaires, along with the advantages and disadvantages will now be discussed

Response Formats

There are three types of response formats that a researcher can use in designing a questionnaire closed response (forced choice), open response (open ended), or a combination of the two.

Closed responses provide subjects with possible answers that they must select from for each question The subjects are more likely to respond to this type of questionnaire since less effort is involved. It is also more efficient in the collection and analysis of data (Anderson, 1990) Open responses require that the subjects write out the answer to each question in their own words. This response format allows subjects to express their own opinions and allows them to explain why they hold these views Open responses facilitate the identification of key factors in the situation or trends that may not have been anticipated Subjects, especially children, tend not to effectively answer open response questions because it takes them too much time and effort. In recent years, many researchers use a combination of the two response formats This practice allows the researcher to find out pertinent information about the subjects which may explain some of the answer selections (Henerson, Morris & Fitz-Gibbon, 1978)

The main types of questionnaire rating scales that are used in the field are ordered or rank scale, the Thurstone scale, the semantic differential and the summated rating technique (Anderson, 1990; Borg & Gall, 1989; Henerson, Morris & Fitz-Gibbon, 1978) In general rating scales differentiate the subject's response on a positive or negative continuum. Such a scale allows for a broad range of replies within the two responses.

The ordered scale provides the subject with a list of items from which they are asked to rank the items in order of importance. Henerson, Morris and

Fitz-Gibbon (1978) state that the ordered scale format is useful if a limited number of items are listed (probably no more than 5) They suggest that this format has limited application as it considerably constrains the subjects' responses.

The Thurstone scale has the subject select one of two possible choices, that is, approve or disapprove Sometimes a third choice "no opinion" is offered The tabulation of results is very easy Tittle and Hill (1967) feel the Thurstone scale may reduce issues too simplistically so that important information which is related to the intensity of the judgment may be lost

The semantic differential scale is made up of a list of adjectives and their opposites with blank spaces in between them At the top of the list is the item, word or phrase to be judged The subject responds by placing a mark on the continuum between two opposite adjectives that are relevant to the meaning of the key construct According to Henerson, Morris and Fitz-Gibbon (1978) the semantic differential gives only a vague, general impression " without information about their source, it is not often worth the effort expended" (p.89)

The summated rating scale technique is the most commonly used of all the scales and the most useful A statement or question is given and the subject chooses from a series of attitude or judgment words on a numbered scale (it may be a five, seven or ten point scale) This scale offers the researcher an excellent tool to gather opinions and attitudes and provide a great deal of information in a short period of time Anderson and Burns (1989) conclude that the Likert scale, a form of the summated rating scale technique, is one of the best response formats to use in evaluating students' self perceptions because it makes the identification and recording of their choices a little easier and provides for a range of intensity of response

Edwards and Kenney (1946) conducted a study that compared the effectiveness of both Thurstone and Likert scales and found that there was a high correlation (r= 92) between the use of both scales and they were equally effective In 1967, Tittle and Hill indicated that many early studies on the effectiveness of measurement scales may not have been conducted properly due to design problems or inadequate analysis of results. They did their own study on the effectiveness of different measurement scales in predicting measured attitude and behaviour The study showed that the degree of correlation between measured attitude and actual behaviour varied with the rating scale used They observed that significant or lack of significant differences found in many studies looking at attitude and behaviour may have been partially due to the measurement technique used They examined the effects of using four types of measuring scales Thurstone, Semantic Differential, Likert and Guttman scales The same questionnaire with the four different scales was given to 300 college students. The researchers reported that the Likert scale was the best predictor of behaviour (r=.543), they noted that the correlation could have been higher if even more care and time had been taken in the construction of the questionnaire that was used. They also reported that the Likert scale shows the greatest reliability while the Thurstone scale was the poorest predictor and the least reliable of all the scales The summated rating technique was excellent for determining the intensity and specificity of feelings Tittle and Hill (1967) strongly suggest using a summated rating scale such as the Likert scale for measuring attitudes and opinions More recent opinions confirm these important findings (Borg & Gall, 1989, Gronlund, 1971; Henerson, Morris & Fitz-Gibbon 1978, Irwin & Bushnell, 1980)

Reliability and Validity of Questionnaires

Research using questionnaires has many advantages Anderson (1990) states " if well constructed, a questionnaire permits the collection of reliable and reasonably valid data relatively simply, cheaply and in a short space of time" (p.207) Also if done thoroughly a questionnaire will help facilitate the analysis of results after the data collection is completed

A number of problems must be addressed prior to using a self report questionnaire The quality of the questions asked plays a major role in the reliability and validity of the data collected Numerous studies confirm that the lack of reliability and validity in questionnaire research is often due to poor question design (Allen, 1966; Anderson, 1990, Anderson & Burns, 1989, Baranowski, 1988, Berdie, Anderson & Niebuhr, 1986, Best, 1981, Borg & Gall, 1989; Hanrahan, Grove & Hattie, 1989, Hansford & Hattie, 1982, Henerson, Morris & Fitz-Gibbon, 1978, Marjoribanks, 1976, Tuckman, 1978) Baranowski

(1988) states that questions must be clear, designed for the particular objective to be researched and detailed instructions of what is expected of the subjects must be given

Another problem is that of the subject's knowledge base and expertise in the area that is being assessed Allen (1966) found that the inaccurate results in survey research was often related to the knowledge base of the subject He also noted that the more education a subject had, the less likely the subject would lie or guess on an item. Other researchers confirmed these findings (Baranowski, 1988, Klesges, Eck, Mueller, Fuliton, Somes & Hanson, 1990, Tittle & Hill, 1967) In sport situations, Baranowski (1988) brings up a very interesting point about the influence of the knowledge base of the researchers who are developing a questionnaire He states that improvements in questionnaire design will come through a deeper understanding of the information processing mechanics underlying physical activity experiences, that is, as we know more about how subjects process information, the types of questions researchers develop will be much more accurate

Self report questionnaires also have the problem of the accuracy with which the subjects report their behaviour or opinions. Borg and Gall (1989) state that self report measures are as accurate as the self perceptions of the person and to the degree to which the person is willing to express them honestly. Factors which may affect the truthfulness or honesty of respondents is summarized best by Tuckman (1978) He lists the factors as social desirability (trying to put oneself in a good light), concealing one's ignorance about the subject, or being deviant in one's responses just to give crazy answers on purpose or through carelessness

One method used to try to improve the accuracy of self reports is questionnaire anonymity Researchers feel subject anonymity is necessary to get accurate replies because the subjects may be more open and honest if the researcher does not know their identity (Best, 1981, Butler, 1973, Speltz, 1976, Tuckman, 1978) However, researchers are not always able to guarantee anonymity Scores may have to be compared to previous scores Francis (1981) conducted a study with 300 ten and eleven year olds to determine whether guaranteed anonymity is an essential factor for accurate measurement of attitudes and feelings (in this case towards religion) There were three groups, each of which received the same questionnaire which included a lie detection scale One group wrote their names on the questionnaire, another group wrote their initials on the top corner and folded the corner down and the third group did not put their names down at all All subjects were told that their answers would be confidential Results showed no significant differences between the three groups Francis states that anonymity is not an important factor in affecting the accuracy of responses to questionnaires She feels other factors may affect the accuracy of responses such as age, sex, trust and rapport with the researcher, as well as the content and purpose of the questionnaire

Holden and Jackson (1981) looked at honesty in questionnaires Rather than anonymity, they concentrated on many researchers' methods of hiding or disguising the test items in the test, so that the subject does not know what is being assessed Holden and Jackson found that disguising the test items is not essential for accurate self assessment It is much better to be obvious than subtle for test validity, but not to the point where the researcher is emphasizing desirable or undesirable characteristics They found in their study that one of the best ways to receive honest self measures is to encourage honesty with the subjects before they answer the questionnaire This was also confirmed in Leslie's study in 1981

The problem of faking answers or answering carelessly on questionnaires was addressed by O'Dell (1971) In his study he compared the ability of different carelessness scales to detect if a questionnaire was completed with care or not He found that none of the scales were very effective O'Dell states that an effective method for weeding out problems is to ask questions in the test about the respondent's honesty, whether the subject understood the questions and whether the subject checked to see if any questions had been accidently omitted

Allen (1966) examined the problem of faking answers on questionnaires through the use of filter questions, such as a bogus item that asks for an opinion to check on the validity of responses in the test If the subject expresses an opinion on this imaginery item, then it may be possible that the subject's other responses are also false He found that this technique was not very good because the subject may have answered all other questions honestly but may not have understood the bogus question properly

Looking at the disadvantages of questionnaire research through the many studies done and cited here, all the researchers come up with the same suggestions. If the questionnaire is well constructed, is worded appropriately for the sample that is being tested, clear instructions are given, honesty in the sample's responses is stressed at the beginning, questions are asked based on the knowledge base of the sample, a pilot test is given and revisions are made the results collected for the research are more likely to be valid and reliable This will be discussed again in the next chapter in relation to the design of the questionnaire that will be used in this study

Children's Accuracy in Assessing their own Developmental Skill Level

An important question to consider is the accuracy with which children can assess their actual skill level in sport situations

Shavelson, Hubner and Stanton (1976) stated that children's perceptions of themselves are formed through their own experience with and interpretation of the environment in which they are operating Such judgements are influenced by many sources According to Harter (1982) and Roberts (1984) these sources may include evaluative feedback from significant people such as parents, teachers, coaches or peers, performance comparison with other children, internal criteria such as personal goals or the perceived degree of skill improvement, and actual performance outcome The variation in the sources that influence children's self assessments may also, in part, be due to age

Parsons and Ruble (1977) found that preschool age children (4,5,6 year olds) did not use performance outcomes to make their assessments In general, they found that at this age children's assessments were not very realistic Parsons and Ruble suggest that this may be due to the children's cognitive immaturity and limited social experience Other studies also found preschool age children's judgement of their performance to be unrealistically high In other words, younger children seemed to have an exaggerated view of their own abilities (Harter, 1982, Nicholls, 1978, 1979, Nicholls & Miller, 1983, Stipek, 1981, Stipek & Hoffman, 1980, Stipek & Tanatt, 1984)

Nicholls and Miller (1983) found that very young children do not seem to be able to differentiate between effort, ability or task difficulty For example, when children expend a great deal of effort trying to perform a task, they feel they have been very successful, no matter what the outcome As children get older (6,7,8 years old), Nicholls and Miller report that they now start to use the performance of peers as a basis for making self assessments and are, generally, now able to differentiate between effort, ability and the difficulty of the task. As a result, this age group is considerably better able to accurately judge their own knowledge and skill

Stipek and Tanatt (1984) found that at ages 6,7 and 8 there were important changes in the children's cognitive processing abilities These changes influence the processing and integration of the evaluative feedback received from others and the comparisons they make with the performance of their peers in determining their own self evaluations Stipek and Hoffman (1980) and Stipek (1981) found that at this age, children were able to use past performance more effectively to assess their own skills in a systematic manner Harter (1982) states that children begin to put peer comparisons into a larger context and integrate this data with information from other sources to more appropriately judge their own knowledge and skills

Around the age of 10 and older, Harter (1982) reports that a cognitive maturation often occurs which results in children developing an "internal set of performance criteria or standards" that they can use in particular situations to make fairly accurate assessments of their own knowledge and skills Horn and Hasbrook (1987) support Harter by stating that the internalization of achievment or performance standards and the effective use of these standards for self evaluation can only occur with a certain level of cognitive maturity, which they found develops around age ten

Many studies have shown that children from the ages of 9 and older provide reliable and realistic self assessments of their abilities (Nicholls, 1978, 1979, Sanguinetti, Lee & Nelson, 1985, Shaklee & Tucker, 1979, Stipek, 1981, Stipek & Tanatt, 1984) Shaklee and Tucker (1979) found a significant difference in ability to judge their own skills as age increases The older children were more accurate in asssessing their skills Stipek (1981) and Stipek and Tanatt (1984) found very significant and positive relationships between third grade children's self perception and the teachers' assessment of the children's skills Sanguinetti, Lee and Nelson (1985) report correlations of 89 and higher for older children, aged 8 and up, when comparing their self assessments with those of their teachers Hence, children in grade 7 and higher are expected to be able to judge their own knowledge and skills quite realistically and accurately

Specifically, in the sport field, to increase the accuracy and reliability of self assessment, researchers such as Hansford and Hattie (1982), Feltz (1988) and Baranowski (1988) stress that children need to be asked sport-specific questions using a terminology that is appropriate for their knowledge base.

One interesting observation from some of the studies is that as children grow older they tend to underestimate their abilities (Klesges, Eck, Mellon, Fuliton, Somes & Hanson, 1990, Nicholls & Miller, 1983, Parsons & Ruble, 1977; Ruble, Parsons, & Ross, 1976, Stipek & Tanatt, 1984) Parsons and Ruble (1977) suggest that this phenomenon may be due to the social unacceptability of seeming to be sure of success or showing overconfidence

Another factor that may affect the accuracy of self reporting in sport domains, may be gender Many studies have found that females tend to underestimate their skill levels in comparison to males (Corbin & Nix, 1979, Corbin, Stewart & Blair, 1981, Feather & Simon, 1973, Frieze, Parsons, Johnson, Ruble & Zellerman, 1978, Griffin, Keogh & Maybee, 1984, Harter, 1982, Klesges, Eck, Mellon, Fuliton, Somes & Hanson, 1990, Maccoby & Jacklin, 1974, Parsons & Ruble, 1977, Sanguinetti, Lee & Nelson, 1985, Stein, Pohly & Mueller, 1971, Stipek & Hoffman, 1980, Thomas, French, Thomas & Gallagher, 1988) However, there is some equivocation in this area Lenney (1977) feels that some factors tend to cause females to have lower expectations than males such as the task being gender appropriate (i e considered a male sport, therefore it may not be thought of as socially acceptable for a female) or females comparing their abilities to males rather than other females These findings were supported by Wylie (1979) and Hansford and Hattie (1982) However, Sanguinetti, Lee and Nelson (1985) found that even in a gender appropriate sport, girls rated themselves lower than the boys The evidence that females may underestimate their own skill abilities must be considered when examining self assessment results

In summary, many studies have shown that by the age of ten, children can make fairly accurate and realistic self assessments of their skills, especially when asked sport-specific questions using words and terminology with which these children are familiar

CHAPTER THREE

METHODS AND PROCEDURES

As stated previously, it seems important to give students an opportunity to learn about what factors may contribute to developing expertise in a given sport Recent studies have shown that the knowledge athletes have about themselves and about the demands the sport makes on them are important factors in the skill development process

The initial section of this chapter describes how the Self Evaluation Questionnaire (SEV) was developed, based on cognitive learning principles of skill acquisition Later sections describe the procedures that were used to administer, assess and evaluate this instrument

Selection of the Unit of Instruction

The choice of volleyball as the unit of instruction was made because of the researcher's expertise in the area through personal playing experience at an elite level, as a level 3 coach in volleyball, and as an experienced teacher of 19 years who co-authored a Volleyball Teaching Manual for high school teachers This expertise was extremely important in the development of the items which were included in the questionnaire

Selection of Subject Sample

The sample for this study was taken from all 12, 13 and 14 year old girls in all three grade eight physical education classes, totalling 80 girls, at Sacred Heart School in Montreal The intelligence level of the subjects was within the normal range based on school criteria and no subjects with known neuromuscular impairments were included in this study

The age level of 12, 13 and 14 year olds was used because these students have physical education every other day as part of the Cycle I Physical Education programme This pattern of instruction gives the students more exposure to the unit of instruction and so offers more opportunity for skill learning

It should be noted that considerable time was spent identifying a suitable setting for this study Attempts were made to find additional settings which would meet the criteria set for the study, however, it was impossible to find an experienced teacher of physical education who was teaching a well-planned volleyball unit with sufficient numbers of students at the same time to increase the subject pool Given the need to identify a range of skill in volleyball, control for gender, as well as the number and quality of lessons, administrative feasibility, and time constraints, it was impossible to increase the study to include appropriate control groups.

One concern with the use of 12, 13 and 14 year olds in grade 8 might be their ability to effectively evaluate themselves However, as noted in the review of the literature, many studies have shown that by the age of 11 or 12, the majority of children can accurately assess their skills in relation to their actual performance in school (Feltz, 1988, Harter, 1982, Horn & Hasbrook, 1987, Nicholls, 1979, Parsons & Ruble, 1977, Ruble,1983, Stipek, 1981, Stipek & Hoffman, 1980, Stipek & Tanatt, 1984)

The selection of the grade 8 girls was not a random selection It was not possible or feasible to randomly assign students to groups as the school did not allow intact classes to be disrupted or divided for the purpose of this study Since intact classes were used, it was very important to describe their characteristics This was done by referring to the school records of the students in the respective classes for levels of intelligence, socio-economic backgrounds and maturity levels The equivalency of the different physical education classes was also examined by the teacher who was involved in the study, as well as through statistical analyses which included class as one of the factors

Selection of the Teacher

As the subject selection involved intact classes, it was very important to consider another important variable, the teacher The teacher is an important consideration in this study as she is responsible for the rating and placement of the students into high, medium or low volleyball skill groups as well as the instruction of the unit of volleyball in the class The teacher involved in this study has been recognized as an excellent teacher by her Principal and by her colleagues As she has coached volleyball in her extracurricular and physical education programme and has taught for twenty-three years, it is assumed that she has a good knowledge base in volleyball

Recent research has shown that the ability to recognize, analyze, categorize and give accurate feedback for skill correction is dependent on the teacher's experience and familiarity with the skill (Armstrong & Hoffman, 1979; Biscan & Hoffman, 1976, Imwold & Hoffman, 1983, Locke, 1972, Osborne & Gordon, 1972, Rink, Werner, Hohn, Ward & Timmermans, 1986) Imwold and Hoffman (1983) state that skill in analyzing movement like skill acquisition " depends upon an elaborate repetoire of task specific knowledge requiring practice over a protracted period of time for its development" (p 154) In fact Armstrong and Hoffman (1979) state that analytical skills are gained through teaching experience rather than through actual playing experience

Gusthart and Kelly (1991) conducted an extremely interesting study that assessed the relationship between teachers' skills in volleyball and the students' learning of those skills They found no relationship between the volleyball skill performance of the teachers and learning in volleyball of their students. In other words, the effectiveness of the unit of volleyball instruction, did not depend on the skill proficiency of the teacher but rather on how well she organized and managed her classes, motivated and gave helpful feedback to her students This ability seemed to improve with experience

Since the teacher who agreed to participate in this study is an experienced physical educator, follows a well-defined unit of instruction supplied by the physical education consultant that was developed in consultation with experts in the field, and she has quite an extensive volleyball knowledge base through her teaching and coaching experience, it is assumed that the class differences due to teaching should be at least somewhat minimized

Development of the Instrument

Determination of the Questionnaire Response Format

One of the objectives underlying the development of the Self Evaluation Questionnaire was to create an instrument that would be easy and relatively quick to administer to large groups and which would allow for comparisons of a student's performance before and after a unit of instruction Considerable thought went into the choice of the response format and rating scale to facilitate the efficient collection of the data A closed format was used in the design of the questionnaire in order to make it as easy as possible for the students to respond to each of the items

A ten point summated rating scale was used as it offers one of the best response formats to use in assessing students' self perceptions (Anderson, 1990, Berdie, Anderson & Niebuhr, 1986, Borg & Gall, 1989, Henerson, Morris & Fitz-Gibbon, 1978, Tittle & Hill, 1967) The summated rating scale is easy to understand and provides for a range of intensity of response (Anderson & Burns, 1989) This response format makes the use of the questionnaire less time consuming which is an important consideration as teachers and students do not enjoy giving up their whole class time to complete tests

At the end of each section two questions were asked, one about the difficulty in answering the questions in the particular section and one about the students' understanding of the questions in the particular section One reason for including these questions was to determine if there were certain sections that were more difficult to complete than others Another purpose for including those two questions was to prevent or at least control the tendency of students to carelesssly fill out their questionnaires O'Dell (1971) suggested the inclusion of these types of questions is an effective technique to curb carelessness

Each item scale contains both a midpoint for an "average" answer and a "do not know" category to encourage students to answer every question and not to leave blanks Both Holdaway (1971) and Anderson (1990) suggest these two additions in the summated rating scale to increase the validity of the instrument

Development of the Volleyball Questionnaire

As was stated in the last chapter, in designing a valid and reliable questionnaire, a number of important factors must be considered The questionnaire must be well constructed and worded appropriately for the sample that is being tested Only questions that are appropriate for the knowledge base of the sample should be included Clear instructions must be given and honesty in answering each item must be stressed The instructions should indicate that there are no right or wrong answers A pilot test of the instrument should be completed and revisions made All of these recommendations were followed in developing this instrument

As discussed in the review of the literature, a number of researchers have recommended that sport-specific questionnaires be developed to help teachers and students in the skill acquisition process (Feltz, 1988, McAuley & Gill, 1983, McAuley & Duncan, 1990, Ornstein & Naus, 1985, Robinson & Howe, 1989, Thomas French & Humphries, 1986, Wall, 1986, Weiss, Wiese & Klint, 1989) Acquired knowledge developed over a period of time is a major determining factor in skill performance, especially in cognitively-demanding sports such as volleyball It has been suggested that such acquired knowledge is developed in five domains procedural, declarative, affective, metacognitive knowledge and metacognitive skill An important aspect of acquired knowledge is metacognitive knowledge, that is an awareness of one's entire knowledge base in a specific domain Given the fact that expertise is categorized by more sophisticated organization and use of knowledge, it was assumed that developing a self evaluation instrument that would help students systematically evaluate their knowledge base might ultimately contribute to the development of sport-specific expertise in volleyball As a result, it was decided to develop a Volleyball Self Evaluation Questionnaire based on cognitive skill learning principles

The skills, concepts and strategies in each section of the questionnaire are based on key fundamental aspects of volleyball that experienced teachers have agreed should be taught to students aged 12 to 14 years The initial selection of items was based on the author's knowledge and expertise in volleyball The selection of items was also guided by the Volleyball Developmental Model (1981) of Sawula & Valeriote published by the Canadian Volleyball Association

To determine the face validity, eight experienced high school physical education teachers, of whom two were level three volleyball coaches and one was a level four volleyball coach, were asked to answer the following questions

1. Do you understand the rating system and instructions used?
2. Do you understand the questions and their intent?
3. Do you feel that all aspects of learning volleyball at the grade 8 level have been covered? If not, what is missing?

From the feedback that was received the questionnaire was modified to include both game and practice situations in the assessment of students' volleyball skills. Modifications were also made to correct some ambiguous questions and instructions The same individuals reviewed the modified questionnaire and all of them were satisfied with its content

A pilot test was then conducted involving six grade 8 students randomly selected from Lindsay Place High School, three girls and three boys The author met these students in pairs and they were asked to read the instructions and questions These students read the questions, noted any problems and then discussed these problems at the end of the session All discussions were recorded with the students' permission. The author discussed the meaning of each question and asked if there were difficulties or confusions in understanding the words, instructions or intents of the questions. The reactions of the students were interesting as they had never thought about learning a sport from such a holistic perspective The questionnaire was again modified to correct terms and instructions that were too difficult for the students to understand Two questions were completely rewritten as the students found them confusing

Another pilot test was conducted at the same school with four different students selected at random (two boys and two girls) using the modified questionnaire Again recorded interviews were completed with pairs of students On this occasion, students were asked to read the questionnaire and jot down any problems or misunderstandings they might have as they answered each of the items on it At this time the author timed how long it took each student to complete the questionnaire (approximately 20 minutes was the average time for completion) At the end of this session, the students were again asked specifically about the questionnaire, such as the intent of the questions, their wording, any difficulties in understanding the items or using the rating scale All the students suggested that all the questions with the same descriptive labels be positioned together so there would be less confusion The students also suggested drawing a solid line from the end of the question to the rating scale so that the correct rating scale number would be readily circled The students also suggested that the game and practice context be clarified

As a result of the interviews and feedback of all the students involved, it was determined that the final questionnaire was appropriately worded for the sample being tested and the items appropriately assessed the knowledge base of the students A copy of the Self Evaluation Questionnaire (SEV) can be found in Appendix A-1

Procedure

An inital meeting was held with the Principal of Sacred Heart School to ask her permission to conduct this study in her school, to inform her about the purpose and the procedures of the study and to make final arrangements for this research The teacher who was involved in the study was selected on the basis of the criteria outlined previously As a result, the Principal, teacher and students agreed to participate in the study.

A meeting with the teacher took place before the study started to inform her of the procedures that would be carried out in her classes The author explained how to use the skill ranking form, a copy of which can be found in Appendix A-4 The administrative procedures for the questionnaire were then discussed, a copy of which can be found in Appendix A-3

The SEV questionnaire was given to all students in the grade 8 girls' physical education classes involved in the study just prior to the volleyball instructional programme The investigator stressed the importance of honest answers and the importance of answering exactly how they felt about each item The students were informed that their answers on the questionnaires were confidential To ensure anonymity each student was given a numbered questionnaire, only the researcher knew who belonged to each questionnaire. Instructions on how to answer the questionnaire were given to the whole class before the questionnaires were distributed

After the second volleyball class, the teacher was asked to rank her students according to their volleyball skill level using the Volleyball Skill Ranking Form She was then asked to complete the Volleyball Skill Ranking Form two days later to test for her reliability in ranking the students

A five week volleyball unit of instruction took place in which each class received instruction every second day Hence in five weeks the students had approximately thirteen lessons

During the second to last physical education class in volleyball, the teacher completed another Volleyball Skill Ranking Form on each student. At the end of the unit of volleyball, the questionnaires were given again to only those students who had completed the first questionnaire. The same emphasis and instructions were given to the whole class before they answered the questionnaires. At the same time, the teacher completed the final Volleyball

Skill Ranking Form in order to check again on the reliability of the skill ranking completed on the students

The Pilot Study

The main purpose of the pilot study was to test the procedures and techniques of the proposed study and determine if they worked satisfactorily It was also used to examine if there were still any problems in the questionnaire design

The pilot study was conducted at Lindsay Place High School using two grade 8 girls' physical education classes, totalling 54 students Both classes were taught by the same teacher The teacher was informed about the procedures and was given the questionnaire and the evaluation form a week in advance, so as to become familiar with it The procedures for the pilot study were those explained in the procedure section of this chapter

Feedback from the students and teacher involved in the pilot study helped to confirm that there did not appear to be any problems in the procedures or in the evaluation instrument Most of the students thought the questionnaire was interesting, however, some thought the questionnaire was difficult because it made them think! Some of the girls commented that they had never thought about some of the ideas that were mentioned in the questionnaire when they were practising a skill The teacher also commented on the questionnaire She thought that it had increased her awareness about skill learning, as she was introduced to some new ways of thinking about traditional ideas concerning teaching and learning

The pilot data were used to determine the internal reliability of the questionnaire by the use of the split half reliability estimate, i e , the Spearman-Brown formula The reliability was found to be 0 903 which is very good It must be noted that a small sample was used The reliability estimate, however, does serve as an indicator that the questionnaire probably has relatively good internal reliability

Design

Due to the constraints of the intact groups that were used, the developmental nature of this study, the extensive involvement of both students and the teacher, as well as professional ethics that prevented the use of control groups, a quasi-experimental pre-test post-test design was employed The reason for the use of a pre-test is twofold One reason is to check for the relative equivalency of groups before the treatment and to allow for the appropriate blocking of the students into skill groups (Anderson, 1990, Anderson & Burns, 1989, Best, 1981, Borg & Gall, 1989) The pre-test provided an indication of the degree to which the various intact classes are equivalent Such information was helpful in the interpretation of the changes that occurred due to the instructional programme.

When using intact class samples, researchers often recommend using the student as the unit of analysis, but include the variable "class" in the design (Anderson & Burns, 1989, Borg & Gall, 1989; Glass & Hopkins, 1984, Hopkins,

1982) This strategy enables one to determine if class had a significant main effect on the results and if there was a significant interaction between the students and the class unit in which they were taught Since the students are being observed and tested twice, a repeated measures analysis of data was used to examine the effect of the treatment

The independent variables of the study are the students, the skill level of the students of which there are three levels (high, medium and low skill), the class of the student of which there are three in this study and the time of testing pre-test and post-test It must be noted here, that the Volleyball Skill Ranking Form asked the teacher to determine five skill groupings However, only three levels of skill were used in analyzing the data as it was thought that this would increase the diversity of skill groups for the purposes of this study The subject variable was nested within the skill and class factors, and crossed with the test time factor, while the factors of skill, class and test time are crossed Using Lee notation, the design study was

$$s_{18} (A_3 \times C_3) \times T_2$$

where s is the subject, A is the skill group, C is the class unit and T is the test time.

The dependent variables were summed scores for each section of the SEV questionnaire. Different subtotal sums were also used representing the different knowledge domains (metacognitive awareness of procedural practice knowledge, procedural game knowledge, declarative knowledge, affective practice knowledge, affective game knowledge and metacognitive skill) as well as a total score for the overall metacognitive awareness of volleyball skill.

Data Analysis

The data were collected and inputed onto the SYSTAT programme for IBM compatible computers

The Spearman Rank Order correlational analysis was used to evaluate the teacher's consistency in ranking her students' volleyball skill level, to examine the relationship between the teacher's ranking of student's skill levels and the students' scores on the various sections of the SEV, and to determine the relationship between the students' perceived skill levels as assessed on the SEV and that of the teacher's ranking of the students' skill, as well as with the total score on the SEV In addition, the Spearman Rank Order correlational analysis was used to examine the relationship between the total SEV score and the scores the students obtained on each of its sections

Multivariate, univariate and univariate repeated measures analyses of variance were used to examine the differences due to skill level in each section of the SEV as well as the overall total score and determine if there were changes in the SEV scores as a result of the instructional programme of volleyball.

CHAPTER FOUR

RESULTS AND DISCUSSION

In order to systematically present the results of this study, this chapter is divided into five major sections The initial section provides a brief overview of the development of the SEV Questionnaire, its structure into six sections and its overall purpose of assessing the metacognitive awareness of students' volleyball knowledge The second section, entitled Skill Ranking and the SEV Questionnaire, describes the sample of students used, the skill rankings of the students and how the skill level of the students relates to their performance on the items in the SEV questionnaire. The third section, entitled Understanding of the SEV Questionnaire, addresses the following two questions that were posed in the introductory chapter, namely

1. What sections of the SEV were the most readily understood by the students?

2. Did volleyball skill level differentially affect the ease with which students understood each section of the SEV?

The fourth section, entitled Perceived Degree of Difficulty in Answering the SEV, attempts to ascertain more fully the task demands students faced when answering the items on the questionnaire This section addresses the following two questions that were posed in the introductory chapter, namely.

1 What SEV sections did the students indicate that they perceived to be the most difficult to answer?

2 Did the volleyball skill level of the students differentially affect the students' perceived difficulty in answering each section of the SEV?

The final section, entitled Skill Level and Results on the SEV Prior to and After Instruction, attempts to answer the following two questions that were posed in the introductory chapter, namely

1 Does the volleyball skill level of the students affect their SEV scores and are the section scores influenced by their skill level?

2. Wnat effect did a programme of volleyball instruction have on the SEV scores and were the change scores differentially affected by the skill level of the students?

A Brief Overview

The Self Evaluation in Volleyball (SEV) Questionnaire was designed to assess the metacognitive awareness of grade eight students in volleyball As stated in Chapter Three, a 10 point summated rating scale was used for each item in the SEV, as this scale was easy for the students to understand and it provided a wide range of response for the students When determining the results for each section of the SEV, the numerical responses on each of the items in the six sections were added together to generate a mean that reflected an overall section score out of 10 The total SEV score was based on the scores in each section and a total mean score was generated out of ten

Each section of the SEV purported to assess a different aspect of the metacognitive awareness of the students' knowledge of volleyball Thus, as noted in the Methods Chapter, the mean score on each section reflected the students' metacognitive awareness of their procedural knowledge in practice situations, procedural knowledge in game situations, metacognitive skill, declarative knowledge, as well as affective knowledge in game and practice situations It was assumed that the total score on the SEV was a relatively good indication of the overall metacognitive awareness of the students' knowledge base in volleyball Thus, there were six subsection scores and one total score that were used as dependent variables The independent variables were skill level and class unit. The mean scores on the SEV for each individual were calculated for each section and then a mean was generated for the 18 students at each skill level The same procedure was used with the total SEV score Two questions were posed at the end of each section The first question assessed how difficult the students perceived the answering of each question in each section and the second question was related to the degree to which the students understood the questions in each section of the SEV These results along with the standard deviations are presented later in this chapter Furthermore, univariate and multivariate ANOVA's were conducted on these two questions for each of the seven dependent variables The results will be discussed in the appropriate sections

As stated in the previous chapter, multivariate and univariate analyses of variance with class as a factor were completed in order to determine if there was a difference in SEV results due to the Physical Education class unit in which each student was assigned As Appendices B-1 to B-12, C-1 and C-2, E-1 and E-2, and H-1 and H-2 show, the MANOVA and ANOVA results indicated that there were no significant differences between the three classes and that there were no interactions between class and skill level Thus class unit did not have an effect on the results, and so it was not included in further analysis

Skill Ranking and the SEV Questionnaire

As described in Chapter Three, the subjects in this study were 80 grade eight girls from Sacred Heart High School in Montreal who had relatively little volleyball playing experience The mean age for the group was 13 90 years with a standard deviation of 0 33 The girls were grouped into three volleyball skill levels based on the completion of the Volleyball Skill Ranking Form by the teacher As indicated above, the volleyball skill ranking process was completed both before and after the instructional volleyball unit As described in the Methods section, five skill groups were identified in each physical education class, however, as reported earlier, for the analysis of the results only three skill groups were used, the top, middle and bottom group in each class Each of the three skill groups had 18 students in it Table 1 shows the mean age and standard deviation of the students in each skill group, there was no significant difference in age among the groups

Table 1

Mean Age and Standard Deviations of Subjects in each of the Three Skill Groups (N=54)

Skill level	Mean age in yrs	Standard deviation
Top	13 80	0.27
Middle	13 97	0 30
Bottom	13 86	0 43

The teacher involved in the study taught all three grade eight classes. As a result, it is assumed that the criteria for ranking the students into skill levels remained relatively constant across the three classes The teacher had 22 years of teaching experience and held a Level 3 Coaches' Certificate in volleyball Hence, based on past studies, it was assumed that the teacher could accurately assess and rank her students into volleyball skill groups (Armstrong & Hoffman 1979, Biscan & Hoffman, 1976; Gusthart & Kelly, 1991, Imwold & Hoffman,1983, Locke, 1972, Osborne & Gordon, 1972, Rink, Werner, Hohn, Ward & Timmermans, 1986)

An initial concern in this study was the accuracy with which the teacher could assess the skill level of each student prior to the instructional programme given the fact that she had not taught them volleyball before Hence, the teacher completed the Skill Ranking Form on all of her students before and after the volleyball programme to assess at which time she was the most accurate In the pre-instructional situation, a Spearman rank order correlation of 0 753 was obtained between her initial ranking and the one completed after two intervening days In the post-instructional situation, a correlation of 0.830 was obtained on this ranking/reranking exercise Clearly, the teacher was more accurate in her skill rankings in the post-instructional situation. Table 2 shows the Spearman Rank Order correlation obtained when teacher rankings are correlated with the Total Score obtained by each student on the SEV Again, it is clear that the post-instructional rankings and ratings are the most appropriate to use This information provides further evidence that the post-instructional teacher rankings are clearly better than the pre-instructional ranking and so should provide the most accurate results in the analysis of the data collected Hence, the skill groups were based on the post-instructional rankings

Table 2

Spearman Rank Order Correlations of Teacher Rankings of Students' Skill Levels on the Pre and Post Instructional Subsection and Total SEV Score Results

	Correlation of pre-instructional SEV scores with		Correlation of post-instructional SEV scores with	
	pre-instructional teacher rankings	post-instructional teacher rankings	pre-instructional teacher rankings	post-instructional teacher rankings
Procedural practice knowledge	0 13	0 235	0 323	0 562
Procedural game knowledge	0.098	0.256	0 317	0 519
Metacognitive skill	0 221	0.271	0 361	0.556
Declarative knowledge	0.385	0.404	0 371	0.541
Affective practice knowledge	0.386	0 471	0.405	0.631
Affective game knowledge	0.365	0.516	0.375	0.509
Total SEV score	0 362	0.314	0 459	0.706

The above relatively strong correlations between the section scores and the total score of the SEV and the teacher's rankings of the skill level of the students provides considerable support for the content validity of the questionnaire Further support for the content validity of the SEV is derived from the students' own perceived volleyball skill rankings and how they correlate with their total score on the SEV. As Table 3 shows, the correlations range from 0 59 on the pre-instructional results to 0 66 on the post-instructional results. Given

Table 3

Correlation of Students' Rankings on Their Perceived Ability with the Teacher's Ranking of Students' Skill Level and with their Overall Total Score on the SEV

	Pre Instructional	Post Instructional
Student/teacher correlation using Spearman Rank Order correlation	0.314	0.532
Student/overall total score correlation using Spearman Rank Order correlation correlation	0.592	0.664

the relatively low volleyball skill level of the students this is quite an acceptable correlation and indicates that the students seem to be fairly accurate in the assessment of their metacognitive awareness of their volleyball knowledge.

As Table 4 shows, as expected, all of the sections of the SEV correlated relatively highly with the total score The range of the correlations being 0 72 to 0.81, again these results lend further support for the content validity of the SEV questionnaire

Table 4

Spearman Rank Order Correlations of Each SEV Subsection with the Total SEV Score

		Procedural practice knowledge	Procedural game knowledge	Metacognitive skill	Declarative knowledge	Affective practice knowledge	Affective game knowledge
Total SEV score	Pre	0 651	0 651	0 618	0.811	0 705	0 831
	Post	0.771	0 747	0 813	0.803	0.785	0.719

Understanding of the SEV Questionnaire

What Sections Of The SEV Were the Most Readily Understood By the Students?

As the results in Table 5 show, it is clear that the students readily understood each section of the SEV In fact, all of the means were above 7, with the range being 7 07 to 8.82 for the pre-instructional results and 8.67 to 8 96 for the post-instructional results Clearly, the majority of the students reported that they understood the questions which adds further credibility to the use of the SEV questionnaire with this age group

The sections on metacognitive awareness of affective knowledge in practice and game situations were the most easily understood with means of 8 59 to 8 96 One would expect this would be the case as most students are aware of how they feel about themselves in various action situations and so would be more familiar with the terminology and the way the questions were phrased in the affective area Therefore, it was not surprising that they found these questions very understandable

The students found the section that assessed their metacognitive awareness of their declarative knowledge in volleyball to be the most difficult to understand The means being 7.07 for the pre-instructional results and 8.67 for the post-instructional results This may be due to the fact that for most students the questions in this section introduced new ways of thinking about volleyball and used unfamiliar terminology As a result, the girls found these questions harder to understand than some of the other sections

Table 5

Pre and Post Instructional Mean Scores and Standard Deviations of Students' Understanding in Answering the Questions in Each Section of the SEV Questionnaire (N=80)

Section		Pre	Post
Procedural practice knowledge	mean s.d.	7 593 1.908	8 944 1 172
Procedural game knowledge	mean s d	7 611 1 867	8 871 1.347
Metacognitive skill	mean s.d.	7 833 2 353	8 871 1 579
Declarative knowledge	mean s.d	7 074 2 648	8 667 1 771
Affective practice knowledge	mean s d	8.931 1 986	8.889 1 586
Affective game knowledge	mean s d	8 815 2.181	8 963 1 541

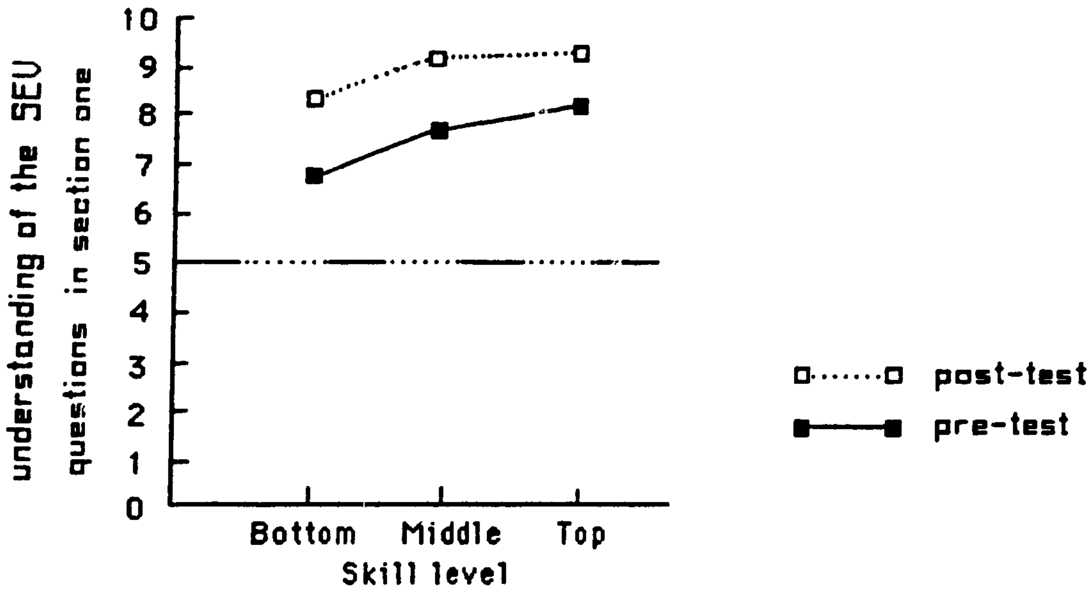
An interesting observation can be noted when considering the mean scores of the metacognitive awareness of procedural knowledge in practice and game situations. In the pre-instructional results the means are 7 59 and 7 61 which are not as high as the results obtained from other pre-instructional sections of the SEV. Students probably found it difficult to assess their volleyball skill before instruction as most of them had limited prior volleyball experience They may not have known the correct names of the skills or what the various situations meant, referring to the relatively low declarative knowledge means of 7.07, and so would find these questions a little more difficult to understand Looking at the post-instructional results, the means increase to 8 94 and 8 87. Since the students have now been exposed to volleyball, they reported that they understand the terminology and the situations even better and so they report that they found the questions quite easy to understand Clearly, the fact that it was impossible to have a control group in this study makes the interpretation of pre-post differences problematic However, given the developmental nature of this study, cautious interpretations of pre-post results will be discussed

Surprisingly the students indicated that they also found the questions on metacognitive awareness of metacognitive skill relatively easy to understand as the means were 7 83 and 8 87 Initially, it was thought that students would find these questions difficult to understand It appears that the students understand the concepts asked in this section They perhaps have been exposed to such ideas in other subjects and may have transferred these ideas to this section of the questionnaire, furthermore, the questions were posed in as user-friendly a manner as possible

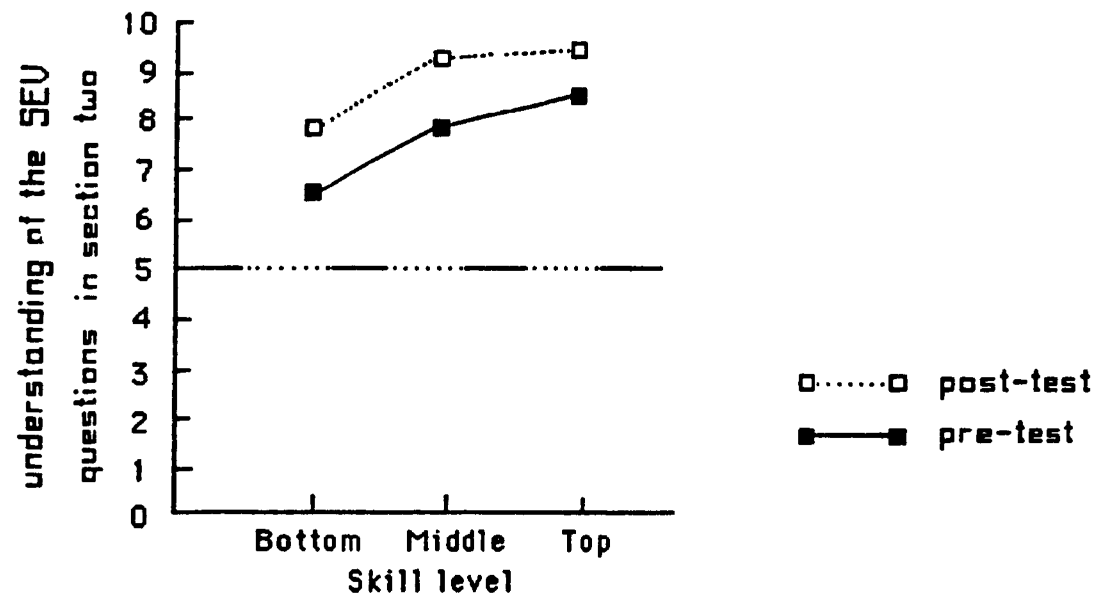
The students showed a definite improvement in understanding the questions in each section after the volleyball unit of instruction. This was to be expected as the students had learned about the concepts, situations, terminology and skills used in volleyball Additional observations on the pre-post effects of the instructional programme will be presented with caution in the next section

Did Volleyball Skill Level Differentially Affect the Ease with which Students Understood Each Section of the SEV?

Based on the SEV results presented in Table 6 and in Figures 3 to 8, all of the students were able to understand the SEV questionnaire relatively well However, as initial MANOVA's showed and the ANOVA's in Appendices C-1 and C-2 show, in general the top skill group found each section of the questionnaire easier to understand than the middle and bottom skill groups and in most cases the middle group understood the sections better than the bottom group Appendices C-3 and C-4 provide details on the exact group differences that were found based on Tukey HSD post-hoc contrasts



<u>Figure 3.</u> Students' understanding of the questions in the procedural practice knowledge section as a function of skill level.



<u>Figure 4.</u> Students' understanding of the questions in the procedural game knowledge section as a function of skill level.

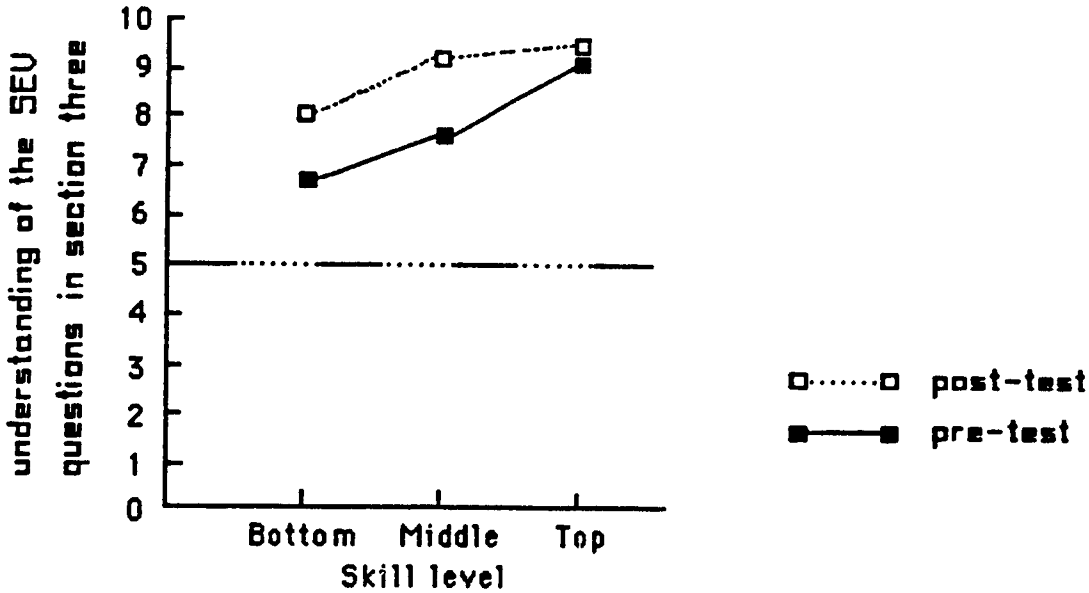


Figure 5. Students' understanding of the questions in the metacognitive skill section as a function of skill level.

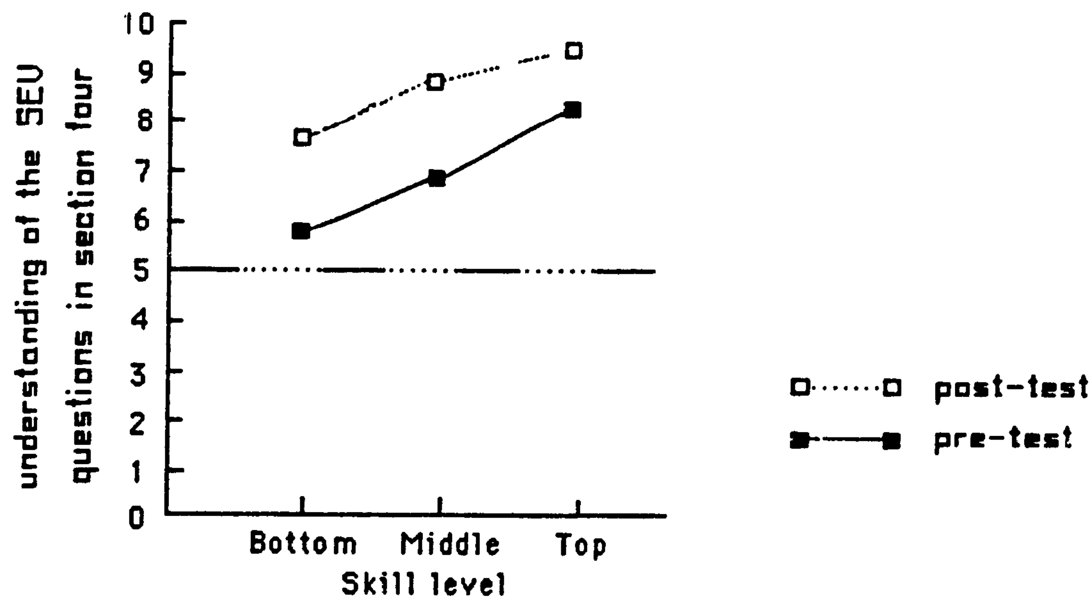


Figure 6. Students' understanding of the questions in the declarative knowledge section as a function of skill level.

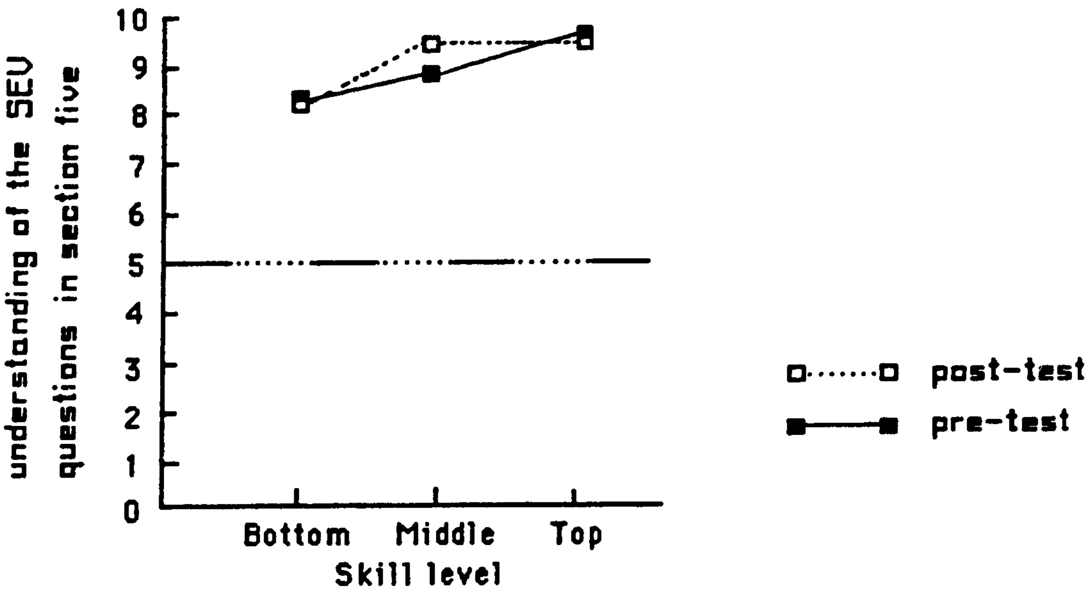


Figure 7. Students' understanding of the questions in the affective game knowledge section as a function of skill level.

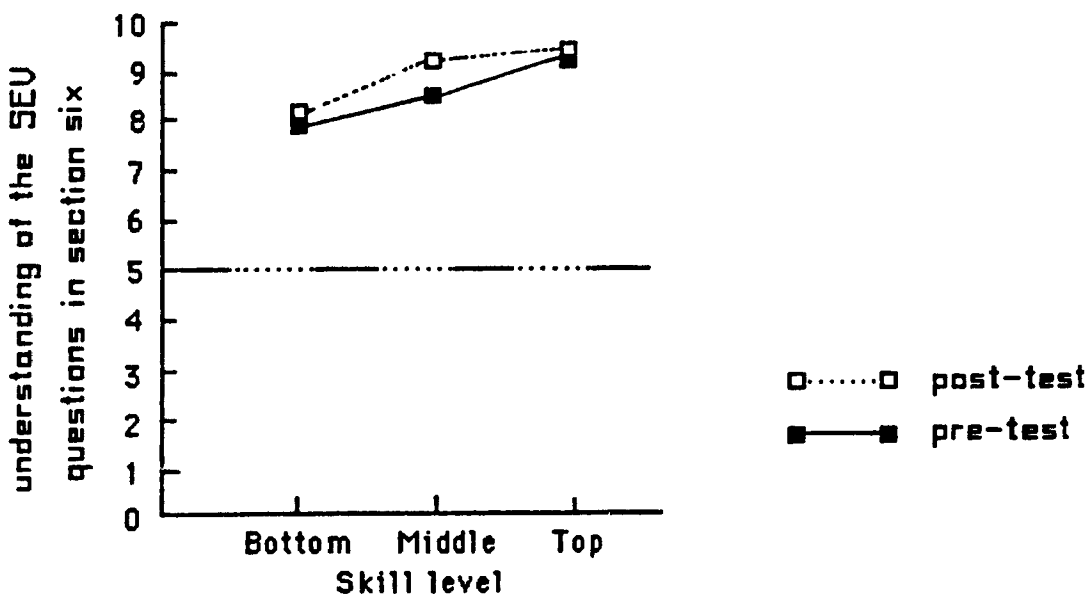


Figure 8. Students' understanding of the questions in the affective practice knowledge section as a function of skill level.

Table 6

Pre and Post Instructional Mean Scores and Standard Deviations of Students' Understanding, Across Three Skill Levels, in Answering the Questions in Each Section of the SEV Questionnaire (n=18/skill group)

Section		Bottom		Middle		Top	
		Pre	Post	Pre	Post	Pre	Post
Procedural practice knowledge	mean	6 833	8 333	7.722	9 222	8 222	9.278
	s d	2 065	1.609	1.565	0.732	1 896	0 752
Procedural game knowledge	mean	6.500	7 944	7 889	9.278	8 444	9.389
	s d	2 176	1 798	1 278	0 752	1.542	0.698
Metacognitive skill	mean	6 722	8 000	7 778	9 222	9 000	9 389
	s d	2 653	2 114	2 390	0 943	1 328	1 092
Declarative knowledge	mean	5 944	7.667	6 889	8 889	8 389	9 444
	s d	3 038	2 425	2 676	1 132	1 501	0 922
Affective practice knowledge	mean	7 889	8 000	8 611	9 278	9 278	9 389
	s d	2 763	2 114	1 501	0 958	1 179	1 092
Affective game knowledge	mean	8 278	8.111	8.611	9 333	9 556	9 444
	s.d.	2 761	2 083	2 404	0 907	0.705	1.042

(SKILL LEVEL spans Bottom, Middle, Top.)

Inasmuch as the cognitive learning literature indicates that more skilled students are expected to have a better metacognitive awareness of their knowledge base than lesser-skilled students, it was expected that the top skill group would understand the concepts, strategies and terminology far better than the bottom group and so would report that they found the questions asked in each section easier to understand than the bottom group

Referring back to Table 6 and Figures 3 to 8 there appears to be a definite improvement between the pre and post-instructional results in the students' understanding of the questions in each section of the SEV. Also, as expected, the improvement is differentially affected by the skill level of the students. Separate repeated measures ANOVA's of students' understanding of each section of the SEV were performed to determine if there were significant differences between the pre and post-instructional results and to determine the effects of skill level Appendices D-1 to D-6 present the findings

Significant differences were found between the skill groups on how they responded to all sections of the SEV as well as significant differences between the pre and post-instructional results for all sections except the sections on metacognitive awareness of affective knowledge in practice and game situations Paired t-tests were completed on the gain scores for each skill group to determine if the improvements were significant Table 7 shows that all skill groups made significant gains in procedural practice knowledge, procedural game knowledge and declarative knowledge, probably because the students understood their capabilities, the strategies and terms better through learning, practicing and playing the game of volleyball Very little improvement was seen in the affective sections of the SEV probably because the students already were relatively familiar with their feelings and the types of questions that were asked

Table 7

Paired T-tests of Gain Scores Between Pre and Post Instructional Results for Each Skill Group's Understanding of the Questions in Each Section of the SEV Questionnaire (n=18/skill group)

Dependent variable	SKILL LEVEL Bottom	Middle	Top
Procedural practice knowledge	t=-4.603, DF=17 p=0 0001 *sign *	t=-4 123, DF=17 p=0 001 *sign *	t=-2 365, DF=17 p=0 030 *sign *
Procedural game knowledge	t=-2 969, DF=17 p=0 009 *sign *	t=-4 415, DF=17 p=0 0001 *sign*	t=-2 464, DF=17 p=0 025 *sign *
Metacognitive skill	t=-2 097, DF=17 p=0 049 *sign *	t=-3 100, DF=17 p=0 007 *sign *	t=-1 162, DF=17 p=0 261 n s
Declarative knowledge	t=-2 447, DF=17 p=0 026 *sign *	t=-4 675, DF=17 p=0 0001 *sign *	t=-3 855, DF=17 p=0 001 *sign *
Affective practice knowledge	t=-0 203, DF=17 p=0 842 n s	t=-3 367, DF=17 p=0 004 *sign *	t=-0 489, DF=17 p=0 631 n s
Affective game knowledge	t=0 250, DF=17 p=0 806 n s	t=-1 759, DF=17 p=0 097 n s	t=0 697, DF=17 p=0 495 n s

An interesting observation is that it appears that game and practice results for both metacognitive awareness of procedural knowledge and for affective knowledge are very similar. At this age and skill level there may be no distinction between game and practice situations However, as the students get older and become more skilled in volleyball, practice situations and game situations may well have very distinct results

In summary, students' understanding of the questions in each section of the SEV questionnaire is very good, the easiest sections to answer being the affective knowledge sections, however, in general students reported that all sections were quite easy to understand

The section that the students found a little difficult to understand was the declarative knowledge section Again this is not surprising as most of these students are relatively inexperienced in volleyball and novices usually have less extensive and less organized declarative knowledge in a given domain as has been previously stated in the review of the literature (Allard & Burnett, 1985, Anderson, 1982, Chi & Rees, 1983; Gallagher, 1984, Starkes & Deakin, 1984, Wall, 1990, Wall, McClements, Bouffard, Findlay & Taylor, 1985). As a result, as the students read the questions in the declarative knowledge section, they may not have been sufficiently familiar with the terminology used or the concepts being discussed and so reported having problems understanding the questions It is assumed but clearly not proven due to the constraints on the design of this study that learning and, probably, some test sensitization did take place due to the instructional programme However, as mentioned above, it was expected that the students would be more aware and have a better understanding of the concepts and terms used in volleyball following instruction.

Even though all students showed a good understanding of the questions, significant differences were found between the skill groups In general, the more skilled students have larger knowledge bases, and hence, can understand more concepts, strategies and perform more actions than lesser-skilled students Hence, the top group's understanding was shown to be higher than the bottom group's understanding

Perceived Degree of Difficulty in Answering the Questions of the SEV

What SEV Sections did the Students Indicate that they Perceived to be the Most Difficult to Answer?

Students reported that they found the process of answering the questions in some sections more difficult to answer than others, as shown in Table 8. The mean section scores ranged from 6 33 to 8 74 In the pre-instructional situation, the students reported that the most difficult sections to answer were the questions on metacognitive awareness of procedural knowledge in practice and game situations, metacognitive skill and declarative knowledge In regard to procedural knowledge, most students were inexperienced in volleyball and so they may not have been sufficiently aware of their capabilities in various volleyball skills to readily answer these questions In regard to the metacognitive skill and declarative knowledge questions, the students who were relative novices, were probably unfamiliar with the strategies, concepts and terminology used in volleyball However, as the post-instructional results show, the mean post-instruction section scores in this area of the SEV are much higher, ranging from 8 33 to 8 74 Such improvement would be expected with instruction and practice in volleyball, however, familiarity with the questions might also have had an effect Clearly, even though these students were exposed to a five week volleyball instructional programme, they still gained only

Table 8

Pre and Post Instructional Mean Scores and Standard Deviations of Students' Perceived Difficulty in Answering the Questions in Each Section of the SEV Questionnaire (N=80)

Section		Pre	Post
Procedural practice	mean	6.389	8.333
knowledge	s.d.	2.616	2 189
Procedural game	mean	6.667	8 741
knowledge	s.d.	2.355	1.519
Metacognitive	mean	6 666	8.444
skill	s.d.	2.347	1.656
Declarative	mean	6.704	8.352
knowledge	s.d	2.703	1 662
Affective practice	mean	7.815	8.741
knowledge	s.d.	2.348	1.556
Affective game	mean	7.759	8 519
knowledge	s.d.	2.635	1.871

limited expertise in this sport. They may well have improved but their knowledge base in volleyball is still somewhat limited. New ways of thinking about how one performs in a sport take time to develop. Based on the entire sample, in this study, it is clear students feel, on average, quite comfortable about answering these questions However, as the next section will show, the skill level of the students directly affected how difficult they perceived the questions.

Did the Volleyball Skill Level of the Students Differentially Affect the Students' Perceived Difficulty in Answering Each Section of the SEV?

As Table 9, Figures 9 to 14 and Appendices G-3 and G-4 show, the skill level of the students did affect the degree of difficulty with which the students perceived answering the questions in each SEV section In general, the top skill group of students found each section of the questionnaire easier to answer than the middle and bottom skill groups and the middle group found the questions easier to answer than the bottom group

Separate univariate ANOVA's were completed on the results of each section of the questionnaire in both the pre and post-instructional situations to determine if there were statistically significant differences between skill groups as illustrated in the graphical representations (Figures 9-14).

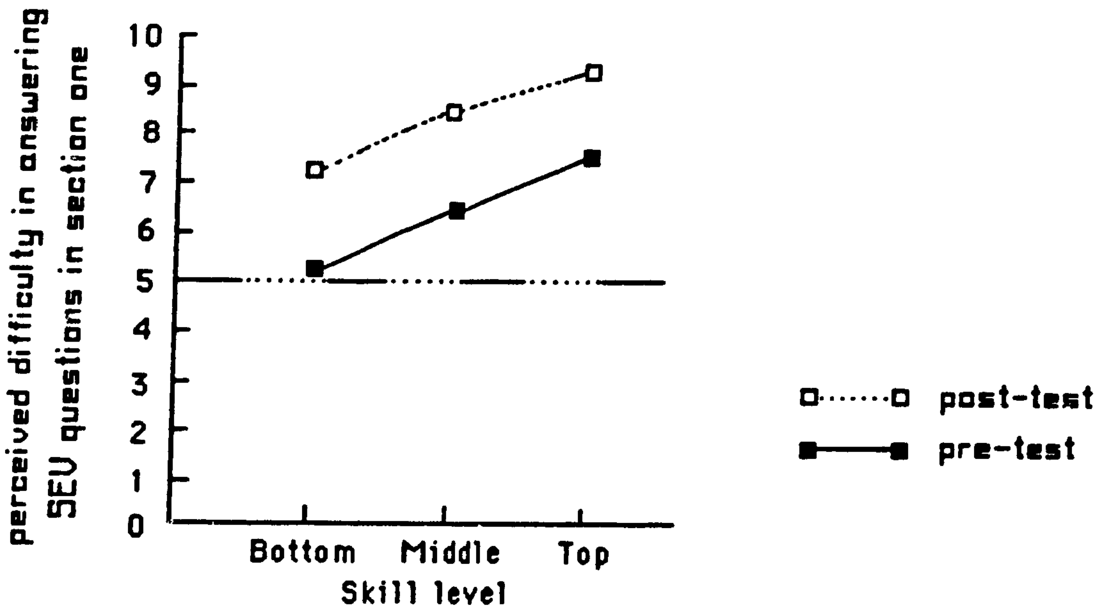


Figure 9. Students' perceived difficulty in answering the questions in the procedural practice knowledge section as a function of skill level.

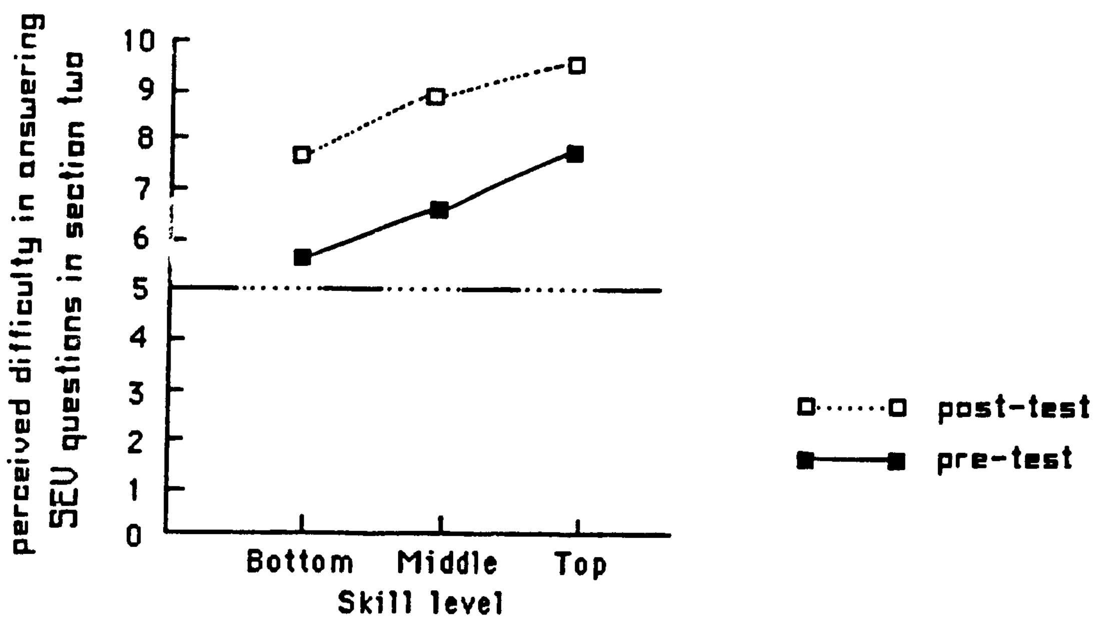


Figure 10. Students' perceived difficulty in answering the questions in the procedural game knowledge section as a function of skill level.

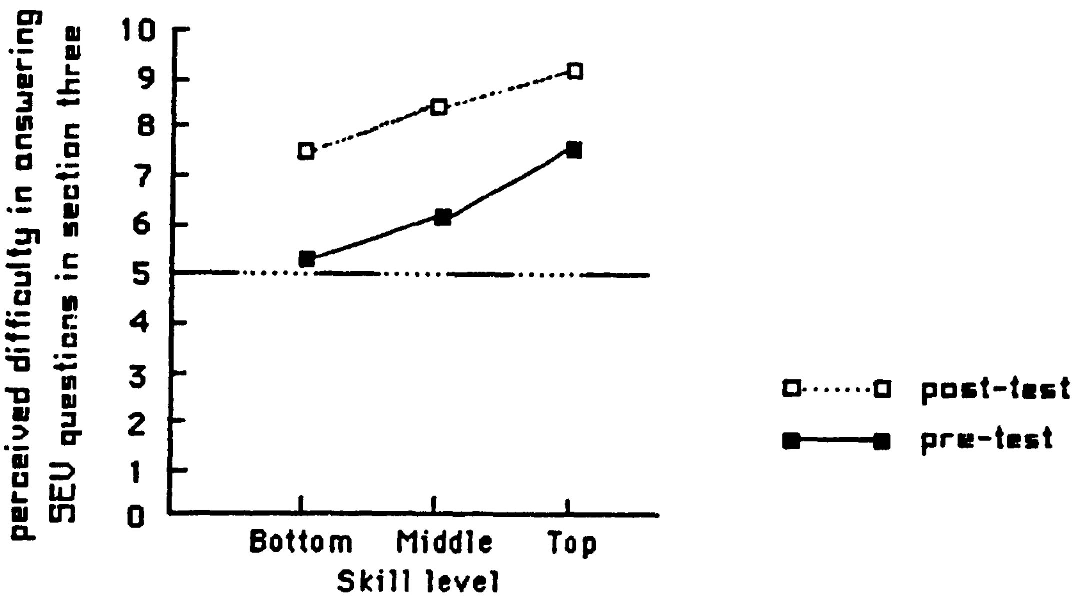


Figure 11. Students' perceived difficulty in answering the questions in the metacognitive skill section as a function of skill level.

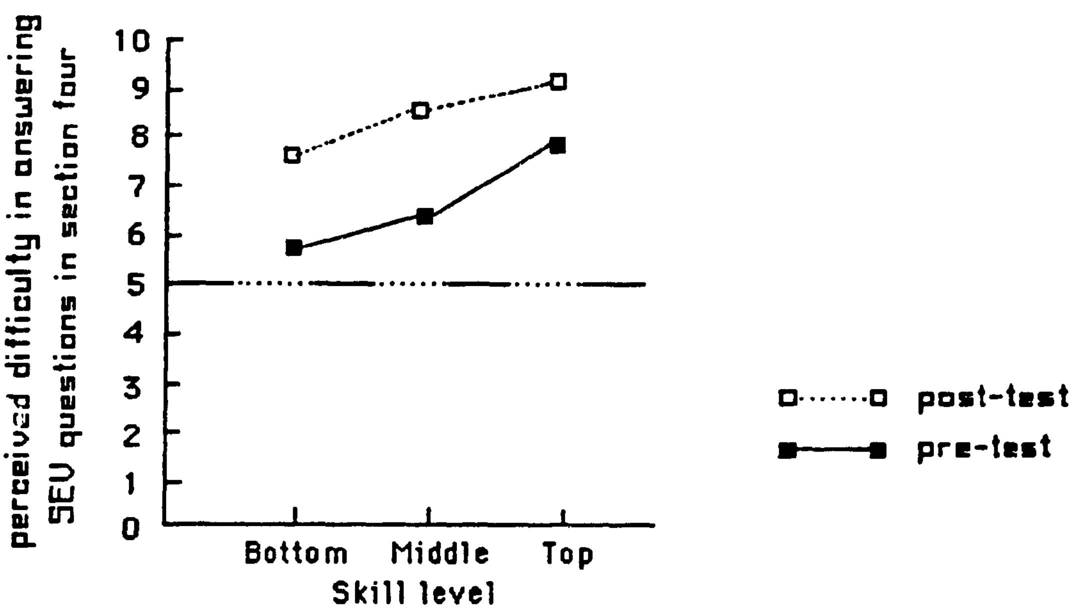


Figure 12. Students' perceived difficulty in answering the questions in the declarative knowledge section as a function of skill level.

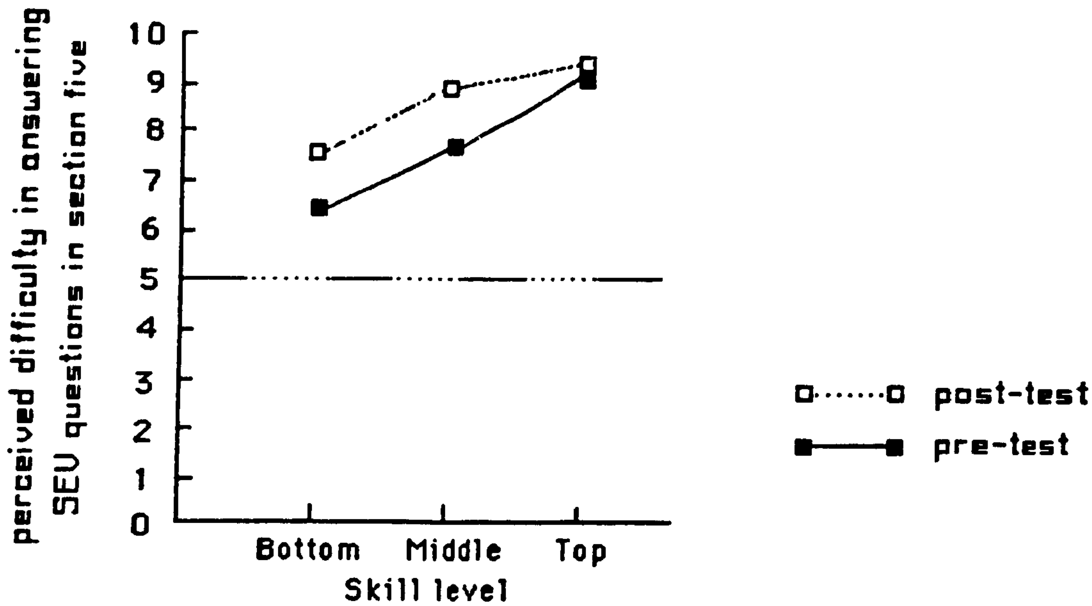


Figure 13. Students' perceived difficulty in answering the questions in the affective game knowledge section as a function of skill level.

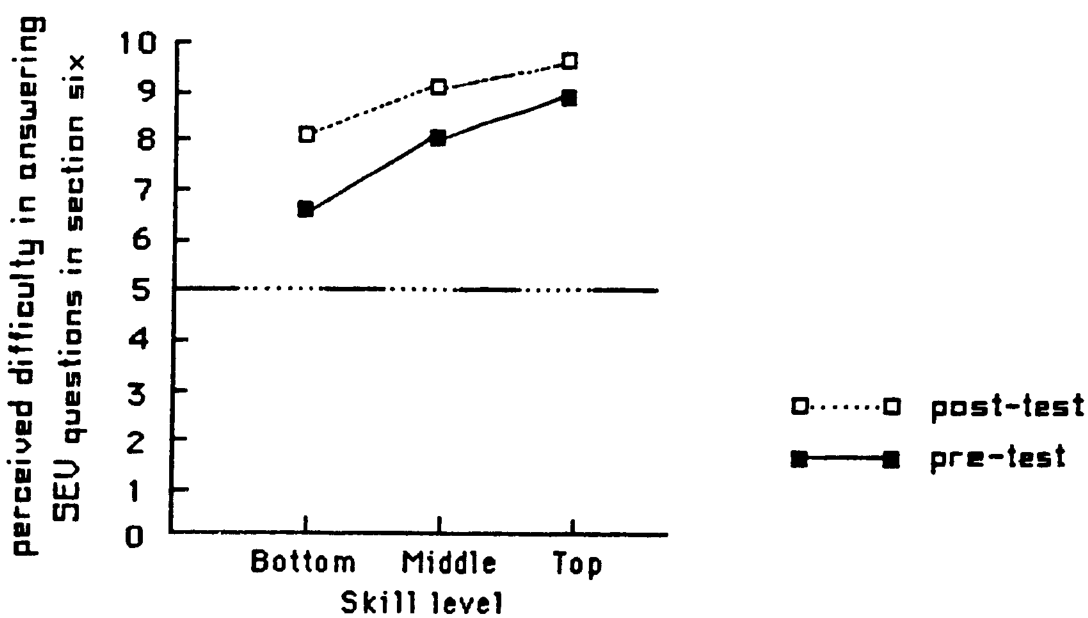


Figure 14. Students' perceived difficulty in answering the questions in the affective practice knowledge section as a function of skill level.

Table 9

Pre and Post-Instructional Mean Scores and Standard Deviations across Skill Levels for Perceived Difficulty in Answeiing the Questions in Each Section of the SEV Questionnaire (n=18/skill group)

		SKILL LEVEL					
Section		Bottom		Middle		Top	
		Pre	Post	Pre	Post	Pre	Post
Procedural practice knowledge	mean	5.278	7 167	6 500	8 611	7 389	9 222
	s d	2.469	2 854	2 792	1 914	2 253	0 878
Procedural game knowledge	mean	5 667	7 833	6 611	8 889	7 722	9 500
	s.d	2.351	2 036	2 524	0 963	1 776	0 786
Metacognitive skill	mean	5 167	7 611	6 111	8 611	7 722	9 111
	s.d.	1 855	2 146	2 541	1 145	1.934	1.183
Declarative knowledge	mean	5.833	7 667	6 333	8 389	7 944	9 000
	s d.	3 312	2.114	2 301	1 290	1 984	1.237
Affective practice knowledge	mean	6 722	8 056	8 000	8 889	8 722	9 278
	s.d.	3 102	1 893	1 815	1 183	1 447	1 320
Affective game knowledge	mean	6 556	7.500	7.667	8 944	9.056	9 111
	s.d.	3 417	2 503	2.401	1 110	0.938	1 323

As Appendix E-1 shows, in the pre-instructional situation, significant differences were found in the mean scores for the three skill groups in all sections of the questionnaire. However, as the Tukey HSD post hoc comparison results in Appendix E-3 show, the significant differences were only between the bottom and top skill groups

As Appendix E-2 shows in the post-instructional situation, significant differences for skill level were found in the metacognitive awareness of procedural knowledge in practice situations, metacognitive awareness of procedural knowledge in game situations, metacognitive awareness of metacognitive skill and metacognitive awareness of affective knowledge in game situations but not in the metacognitive awareness sections of declarative knowledge or affective knowledge in practice situations Again, the Tukey HSD post hoc comparisons in Appendix E-4 shows the differences were between the bottom and top skill groups

The bottom skill group probably had great difficulty in answering questions about their skill performances probably because they did not have the background knowledge, experience or confidence in which to predict their skills. The top skill group, assuming that they had more general sport expertise, probably found it easier to answer the questions because they used their experience and knowledge in other sport areas to estimate what their volleyball skill performance would be

Again, as expected, the top skill group had a larger declarative knowledge base and a better understanding of their metacognitive skills than those with less skill

In the affective area, the results indicate that the least skilled group reported that they were less able to answer these questions probably because they were not as familiar with their own feelings in volleyball situations as the more skilled groups Students in the lower skill group had much less opportunity to develop a context in which to judge their feelings due to their not having very much sport experience

An interesting finding in the post-instructional situation is the lack of a significant difference between skill groups in the metacognitive awareness of declarative knowledge section [F(2,45)=2 883, p=0 066] and the affective knowledge in practice situations section [F(2,45)=3 096, p=0 055] Perhaps, this lack of difference may be due to the fact that all groups are more familiar with the concepts, strategies, and descriptors because they have had more experience in the sport through participation in the volleyball instructional unit This would help the bottom group feel that the process of answering the questions was now a little easier than before, in the pre-instructional situation The top group, already were familiar with the ideas in these sections and so would still find the questions easy to answer, therefore they could not score much higher, in other words, a ceiling effect may well have resulted.

As Table 9 and Figures 9 to 14 indicate, after instruction, there appears to be a definite improvement in how the students assess the difficulty in answering each section of the SEV questionnaire and the skill level of the students differentially affects the degree of improvement

To facilitate data analysis, separate repeated measures ANOVA's were performed on the students' rating of the difficulty they perceived in answering each section of the SEV questionnaire Appendices F-1 to F-6 show the different skill groups perceived the degree of difficulty they had in answering each section of the SEV quite differently, the top group being significantly different from the bottom group.

Table 10

Paired T-tests of Gain Scores Between Pre and Post Instructional Results Across Skill Levels for Perceived Difficulty in Answering the Questions in Each Section of the SEV Questionnaire (n=18/skill group)

	SKILL LEVEL		
Dependent variable	Bottom	Middle	Top
Procedural practice knowledge	t=-2.074, DF=17 p=0 054 n s	t=-2.436, DF=17 p=0 026 *sign *	t=-3.137, DF=17 p=0.006 *sign.*
Procedural game knowledge	t=-2 853, DF=17 p=0.011 *sign *	t=-4 118, DF=17 p=0.001 *sign*	t=-4.115, DF=17 p=0 001 *sign.*
Metacognitive skill	t=-4.599, DF=17 p=0 0001 *sign.*	t=-4.547, DF=17 p=0.0001 *sign *	t=-2.616, DF=17 p=0.018 *sign.*
Declarative knowledge	t=-2.122, DF=17 p=0 049 *sign.*	t=-3.856, DF=17 p=0.001 *sign *	t=-3 217, DF=17 p=0.005 *sign.*
Affective practice knowledge	t=-2 078, DF=17 p=0.053 n.s.	t=-2.298, DF=17 p=0 035 *sign *	t=-3.007, DF=17 p=0 008 *sign *
Affective game knowledge	t=-0.937, DF=17 p=0.362 n.s.	t=-2.679, DF=17 p=0.016 *sign.*	t=-0.236, DF=17 p=0.816 n.s.

Even though a single group was used in this descriptive study, Table 10 shows that there was a significant difference between the pre and post-instructional results in all sections, except for the metacognitive awareness of affective knowledge in game situations section which was very close to significance [F(2,45)=3 915, p=0 054] for all these groups

In summary, all students seemed to find the SEV questions moderately easy to answer After instruction in volleyball, the students found the SEV questionnaire much easier to answer probably because of their exposure to the concepts of the game and having been able to participate and gain some experience with the skills they had learned Overall, the procedural and the declarative knowledge sections were the hardest to answer because of the students' lack of experience and volleyball knowledge base However, after instruction the students reported that they perceived that it was easier for them to answer even these sections

There were definite differences in the way each skill group responded to the degree of difficulty of the various sections of the SEV. Clearly, the more skilled students have a better volleyball and sport knowledge base in general to work from, as a result they probably found the questions easier to answer because they had a more coherently organized set of basic concepts related to sport expertise. If it is assumed that the bottom group has a smaller knowledge base, they should find the ideas and concepts not as familiar and so perceive that the metacognitive awareness questions were, in fact, more difficult to answer The bottom and middle groups improved significantly from the pre-instructional to the post-instructional situation which seems to indicate that their knowledge base became a little more developed due to the instructional programme, however, it must be stressed that the descriptive nature of this study limits the strength of this observation.

Again no significant differences were found between the top and middle groups or the bottom and middle groups This may again be explained by the fact that when dividing the classes into skill groups, there may really be only two skill groups; a novice and a more skilled group. All these students really are just beginners with some girls being better skilled, but they certainly do not have the knowledge and skills of competitive high school volleyball players.

Skill Level and Results on the SEV Questionnaire Prior to and After Instruction

Does the Volleyball Skill Level of the Students Affect their SEV Scores and are the Scores on Each Section Influenced by their Skill Level?

and

What Effect did a Programme of Volleyball Instruction have on SEV Scores and were the Change Scores Differentially Affected by the Skill Level of the Students?

The answer to these questions will be addressed by an initial overall analysis of the influence of the skill level of the students on the six major sections of the SEV questionnaire This initial section will be based on a multivariate analysis, however, a more complete univariate analysis of the effects of skill level on each of the six sections of the SEV follows

Overall Analysis

In general, looking at the results in Table 11 of the pre and post-instructional mean scores and standard deviations for each skill group, it appears that the skill level of the students does affect their SEV scores. The means of the bottom skill group range from 2 32 to 5 30 for the pre-instructional results and 2 79 to 6 18 for the post-instructional results. The middle skill group's scores range from 3 05 to 6 31 and 4 74 to 7.51 for the pre and post-instructional results respectively The top skill group's pre-instructional means range from 3 88 to 7 91 and the post-instructional means range from 5 99 to 8 51 As can be noted, there does seem to be different groupings of scores for the three skill groups

Table 11

Pre and Post Instructional Mean Scores and Standard Deviations of Students' Average Results in Each Section of the SEV Questionnaire (n=18/skill level)

		SKILL LEVEL					
Section		Bottom		Middle		Top	
		Pre	Post	Pre	Post	Pre	Post
Procedural practice knowledge	mean	2.583	3 130	3.481	5 176	3 944	6.083
	s.d	1.531	1.228	1.322	0.976	1 886	1.964
Procedural game knowledge	mean	2 324	2.787	3 046	4 741	3.880	5 991
	s.d.	1 605	1 343	1 366	1.076	2 053	1 984
Metacognitive skill	mean	4 865	5 119	5.754	6 238	6 429	7 648
	s.d.	1 587	1 622	0 883	0.954	1 831	1 366
Declarative knowledge	mean	2 798	4.606	4.020	6 702	5 343	7 515
	s d	1 980	1.983	1.456	0 998	1 912	1 199
Affective practice knowledge	mean	5.296	5.639	6.306	6 991	7 519	8 296
	s d.	1.780	1.232	1 021	1 125	1 500	0 855
Affective game knowledge	mean	5 300	6 178	5 733	7 506	7 906	8 511
	s d	1 770	2 022	1 707	0 714	1 416	1 319
Total score	mean	3.884	4 731	4.640	6 389	5 976	7 476
	s.d	1 279	1 243	1 115	0 519	1.068	0.992
Total score affective removed	mean	2.050	2.652	2 684	3 845	3 277	4 543
	s.d	0.862	0.846	0 642	0 411	0.790	0 764

To determine if these observations were significantly different, multivariate and univariate ANOVA's were completed A multivariate analysis of variance of the pre-instructional results, found in Appendix G-5, was used specifying metacognitive awareness of procedural knowledge in practice situations, procedural knowledge in game situations, metacognitive skill, declarative knowledge, affective knowledge in practice situations and affective knowledge in game situations as the six dependent variables The test for the effect of differences in initial skill was calculated The Wilks' Lambda was 0.489 and the resulting F ratio was $F(12,80)=2.869$, $p=0.002$ This finding shows that, in general, the skill groups did respond differentially to the various sections of the SEV in the pre-instructional results The multivariate analysis of variance of the post-instructional results, found in Appendix G-6, was also completed using the same dependent variables and testing again for the influence of initial skill level. The Wilks' Lambda was 0.221 with a resulting F ratio of $F(12,80)=7.520$, $p=0.0001$ The post-instructional finding was also significant, which again indicates that skill groups did respond differently on the various sections. The results of these two MANOVA's demonstrates the overall effect of skill level on the scores of the students across all sections of the SEV questionnaire.

To determine the location of these significant differences, separate univariate ANOVA's were performed for each section of the SEV questionnaire on the pre and the post-instructional results. The findings are listed in

Appendices H-1 and H-2

Before beginning the discussion of the results on the effects of the instructional programme, it must be clearly understood that the findings are from a descriptive study The fact that a set of control groups was not employed in this study limits the impact of the results obtained, however, a number of initial observations can be made that should be helpful to those conducting research in this area A visual analysis of Table 11 shows that the students in all three skill groups seemed to increase the ratings of their metacognitive awareness of their knowledge and skills in volleyball after the instructional programme Repeated measures ANOVA's were used to determine if there were significant differences on each of the SEV sections The dependent variables for each ANOVA were the pre and post-instructional results on each particular SEV section while the independent variables were skill and class. A discussion of the effects of the instructional programme on the metacognitive awareness of procedural, declarative, metacognitive skill and affective knowledge in volleyball follows.

Analysis of Results by SEV Sections

The influence of skill level on the students' results on each of the six sections of the SEV will be examined under both practice and game conditions when appropriate and under pre and post-instructional conditions for all six dependent variables.

Metacognitive Awareness of Procedural Knowledge

Pre-instructional Practice Condition

As Appendix H-1 shows, the SEV scores for the metacognitive awareness of procedural knowledge in practice situations under the pre-instructional condition were significantly different across the skill groups [$F(2,45)=3\ 343, p=0\ 044$], however, the Tukey HSD post hoc comparisons, Appendix H-3, show that the significant differences were only between the top and bottom skill groups Referring to Figure 15, one can note that all groups rated themselves very low in their metacognitive awareness of procedural knowledge in practice situations, that is, scores of 4 or below This seems to indicate that all groups realized that they were not as skilled in volleyball even before they completed an instructional condition As expected those students who were rated as being more skilled than their classmates by the teacher scored relatively higher on this section of the SEV

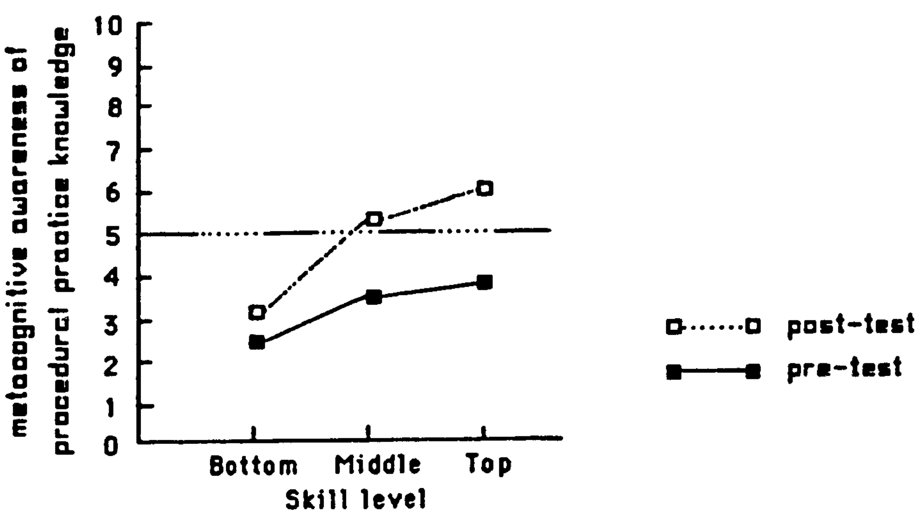


Figure 15. Students' metacognitive awareness of procedural knowledge in a practice situation as a function of skill level.

Post-instructional Practice Condition

As Appendix H-2 shows, the SEV scores for the metacognitive awareness of procedural knowledge in practice situations under the post-instructional condition were significantly different among the skill groups [F(2,45)=21.133, p=0 0001] The Tukey HSD post hoc comparisons presented in Appendix H-4 show significant differences between the top and bottom, and the bottom and middle groups. As Figure 15 shows, even after the instructional programme the less-skilled students still rated their metacognitive awareness of procedural knowledge in practice situations very low, that is, below the mid point of the scale, while both the middle and top groups now evaluate themselves a little higher in this domain The means being 3 13 for the bottom group, 5 18 for the middle group and 6 08 for the top group The results are still relatively low which seems to indicate that students in all groups realize that their procedural skills in volleyball are still somewhat lacking

Effect of Instruction on the Metacognitive Awareness of Procedural Knowledge - Practice Situation

In the metacognitive awareness of procedural skill in practice situations, there was a very significant difference between the pre and post-instructional results [F(1,45)=62 442, p=0.0001]. Furthermore, as Appendix I-1 shows, the programme of instruction differentially affected the three skill groups [F(2,45)=12.129, p=0.0001]. As Figure 15 clearly indicates,significant improvement only occurred for the middle and top skill groups. The paired t-tests of gain scores, as presented in Table 12, confirm this pattern of results

Table 12

Paired T-tests of Gain Scores for Pre and Post Instructional Results for Each Skill Level in Each Section of the SEV Questionnaire (n=18/skill group)

Dependent variable	Bottom	Middle	Top
Procedural practice knowledge	t=-1.616, DF=17 p=0 125 n s	t=-7 117, DF=17 p=0.0001 *sign *	t=-5.454, DF=17 p=0 0001 *sign*
Procedural game knowledge	t=-1 273, DF=17 p=0 220 n.s.	t=-5 769,DF=17 p=0 0001 *sign*	t=-5.171, DF=17 p=0.0001 *sign*
Metacognitive skill	t=-0 815, DF=17 p=0 427 n.s	t=-1 903, DF=17 p=0.074 n s	t=-3.516, DF=17 p=0.003 *sign*
Declarative knowledge	t=-5.701, DF=17 p=0.0001 *sign *	t=-8.614, DF=17 p=0.0001 *sign.*	t=-5.958, DF=17 p=0.0001 *sign*
Affective practice knowledge	t=-0.880, DF=17 p=0.391 n.s.	t=-2.245, DF=17 p=0.038 *sign *	t=-2 793, DF=17 p=0.012 *sign*
Affective game knowledge	t=-2.807, DF=17 p=0.012 *sign.*	t=-4.466, DF=17 p=0.0001 *sign.*	t=-3.421, DF=17 p=0.003 *sign*
Total score	t=-4.630, DF=17 p=0 0001 *sign *	t=-7.927, DF=17 p=0.0001 *sign.*	t=-6.836, DF=17 p=0 0001 *sign*
Total score affective component removed	t=-5 115, DF=17 p=0.0001 *sign.*	t=-8.550, DF=17 p=0.0001 *sign.*	t=-6.825, DF=17 p=0.0001 *sign*

As Figure 15 shows, the results of the ANOVA indicate that the volleyball instructional programme differentially affected the skill groups [F(2,45)=6.596, p=0 003] As the figure indicates and the post hoc t-tests reported in Table 12 confirm, only the middle and top groups improved in their metacognitive awareness of procedural knowledge in practice situations One might conclude that the improvement in metacognitive awareness of procedural practice knowledge in the middle and top skill groups was due to the students practicing, developing and learning how they perform key volleyball skills; however, the descriptive nature of this study prevents making such a firm conclusion One might also ask why did the middle and top groups improve significantly and the bottom group did not improve? The bottom skill group may well have overestimated their pre-instructional procedural practice skills because of their lack of awareness of their capabilities, while the two other groups may have been more aware of their initial skill performance capabilities. Linked to this explanation, as noted above, the large improvement in the top and middle groups' declarative knowledge base and better metacognitive skills may well have influenced the results in this area According to cognitive learning principles, one would expect that individuals with more extensive procedural knowledge bases should have better declarative and metacognitive skills, and, generally, vice versa As Table 12 shows, the fairly large improvements shown by the top and middle groups in the declarative knowledge section and by the top group in the metacognitive section of the

SEV, supports the plausibility of this explanation These findings will be discussed shortly

Pre-instructional Game Condition

The ANOVA on the pre-instructional results of metacognitive awareness of procedural knowledge in game situations showed a significant difference between the skill groups [F(2,45)=3 780, p=0 030] Again the Tukey HSD post hoc comparisons show a significant difference between the top and the bottom skill groups. Looking at Figure 16, the same pattern is noted as in Figure 15 As in the practice condition, all students in each of the skill groups rate themselves very low in their metacognitive awareness of procedural knowledge in game situations, that is, well below the midpoint of the scale. The same reasons can be cited to explain this finding as were noted for procedural knowledge in practice situations

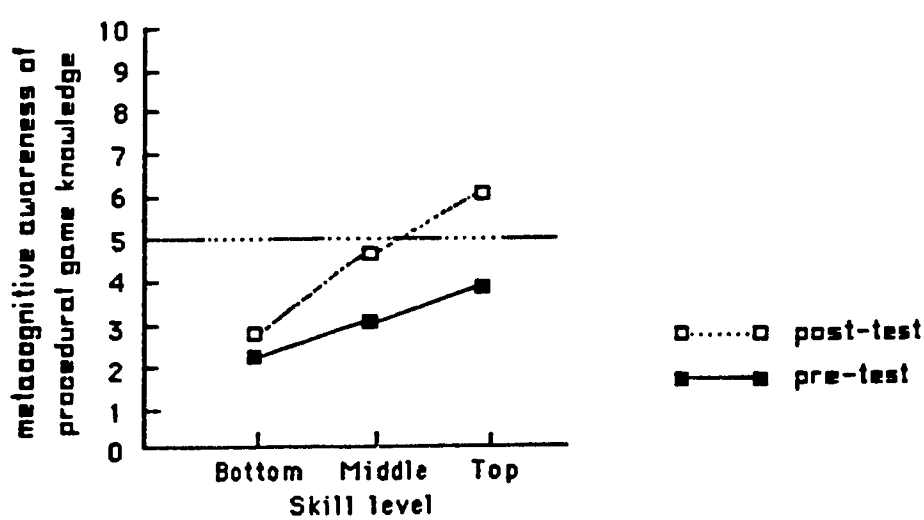


Figure 16. Students' metacognitive awareness of procedural knowledge in a game situation as a function of skill level.

It appears that there is very little difference between how students perceive their metacognitive awareness of procedural knowledge in practice and game situations at this age level However, a greater differentiation between procedural knowledge in game and practice situations might have been more evident if older students or more skilled volleyball players had been included in the study

The relatively low results of the students on the metacognitive awareness of procedural knowledge in both the practice and game situations for all three skill levels shows that the students realize that their volleyball skills are not highly developed at this stage and that they do, in fact, honestly report their opinion Also, as noted in the review of the literature, girls tend to underestimate their physical proficiency and this phenomenon may be operating here, however, no definitive conclusion can be given on this question at this time (Corbin & Nix, 1979, Corbin, Stewart & Blair, 1981, Feather & Simon, 1973; Freize, Parsons, Johnson, Ruble & Zellerman, 1978, Griffin, Keogh & Maybee, 1984, Harter, 1982, Klesges, Eck, Mellon, Fulliton, Somes & Hanson, 1990; Maccoby & Jacklin, 1974, Parsons & Ruble, 1977, Sanguinetti, Lee & Nelson, 1985; Stein, Pohly & Mueller, 1971; Stipek & Hoffman,1980, Thomas, French, Thomas & Gallagher, 1988).

Post-instructional Game Condition

The univariate ANOVA of results of the metacognitive awareness of procedural knowledge in game situations under the post-instructional condition also showed a significant difference between the skill groups [F(2,45)=22 753, p=0 0001] The Tukey HSD post hoc comparisons presented in Appendix H-4, show significant differences among all groups Again all skill groups rate themselves relatvely low, that is, the means being 3 13, 5 18 and 6 08 respectively However as expected, the middle and top groups evaluated their procedural knowledge in game situations a little higher When comparing the metacognitive awareness of procedural knowledge in practice and game situations the results in Appendices H-1 and H-2, and in Figures 15 and 16 seem to show that the skill groups rate themselves lower in game situations than in practice situations. However, in general, there does not appear to be any significant difference in the way students assess their procedural knowledge in practice and game situations

After the unit of volleyball instruction, the students in all skill groups had an opportunity to practice and gain some experience in learning and playing volleyball One can assume that the bottom skill group probably experienced fewer successful actions during the instructional programme as they were simply trying to improve their relatively sparse knowledge base, in other words, they were really trying to learn what was expected of them both conceptually and physically A host of unsuccessful actions would, over time, lead the bottom group to judge their physical skills in both practice and game situations lower than the middle and top skill groups who probably had more successful experiences. Inasmuch as the knowledge bases of students in the more skilled group are a little more developed, it would be expected that their assessments of their skill proficiency would be higher As noted before, this descriptive study cannot ascribe causes to these results, however, these initial observations should be helpful in the planning of future studies

Effect of Instruction on the Metacognitive Awareness of Procedural Knowledge - Game Condition

The same pattern of findings can be seen in the students' metacognitive awareness of procedural knowledge in a game situation In Appendix I-2 there is a significant improvement from pre to post-instructional results [F(1,45)=49 988, p=0 0001], however, as in the practice situation there are differences in the responses of the three skill groups in the pre and post scores on this section of the SEV questionnaire [F(2,45)=6 045, p=0 005] As Table 12 indicates, the paired t-tests of gain scores for each skill level showed that the middle and top groups made significant improvements, however, the bottom group did not improve significantly. There is a significant difference in the interaction between skill groups and the procedural knowledge in a game situation pre and post-instructional results The possible reasons for these differential amounts of improvement across skill groups after the instructional programme are the same as those outlined in the metacognitive awareness of procedural knowledge in practice situations

It should be noted that the pattern of improvement in procedural knowledge as measured by the SEV was similar for all three skill groups in both the practice and game situations

Metacognitive Awareness of Declarative Knowledge

Pre-instructional Condition

The univariate ANOVA results of the students' metacognitive awareness of their declarative knowledge base under the pre-instructional condition showed that there were significant differences in the responses of the students due to skill level [F(2,45)=9 258, p=0 0001] The Tukey HSD post hoc comparisons indicated that the differences were between the bottom and middle, and the bottom and top groups As Figure 17 shows, only the top skill group thought that their declarative

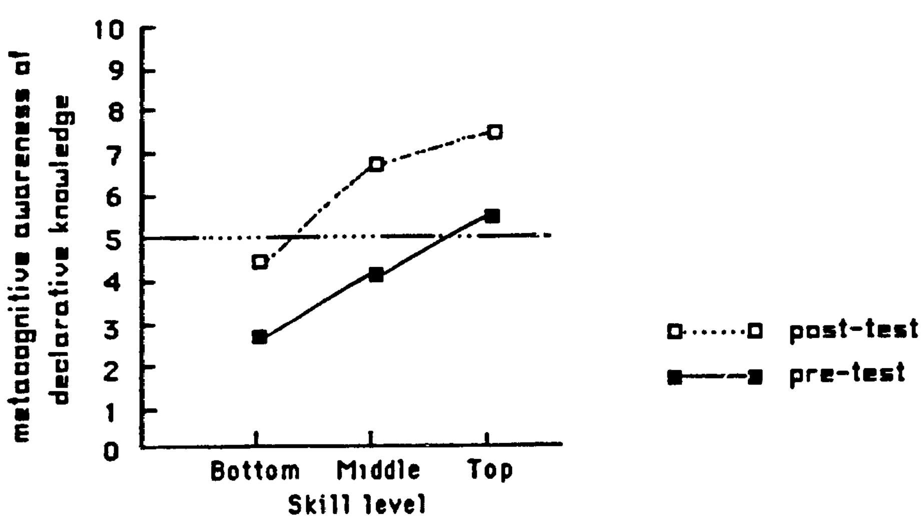


Figure 17. Students' metacognitive awareness of declarative knowledge as a function of skill level.

knowledge base was relatively good, that is, above the midpoint of the scale As mentioned in the review of the literature, along with the difference in procedural knowledge another key difference between more highly skilled athletes and novices is the extent and organization of their declarative knowledge base It is assumed, even in this study, that the more skilled students have more information stored in their declarative knowledge base and it is more coherently organized, in contrast, the novice usually has less information and it is often not categorized properly for easy access The fact that the bottom and middle groups reported that their declarative knowledge was relatively low, as Table 11 and Figure 17 show, is congruent with a major contention of cognitive learning theory that declarative knowledge improves with skill development More importantly, for educators and the development of effective teaching methods, even relatively novice students are aware of this fact and are able to rate themselves when presented with an appropriate evaluation instrument

Post-instructional Condition

The univariate ANOVA of the SEV scores for the students' metacognitive awareness of their declarative knowledge base under the post-instructional condition again shows a significant difference between skill groups [F(2,45)=19 759, p=0 0001], again, the Tukey HSD post hoc comparisons showed the significant differences were between the bottom and middle, and the bottom and top groups Again, referring to Figure 17, the bottom group still perceives their declarative knowledge base to be relatively low, that is, less than the midpoint of the scale, while the middle and the top groups perceived that their declarative knowledge was considerably better Even after an instructional programme, the bottom group still felt their metacognitive awareness of the declarative knowledge base was below average, which adds further support to the contention that less-skilled students are aware of the fact that they have a less developed and accessible declarative knowledge base than more skilled students Furthermore, all three groups are able to report that fact and the pattern of reporting their metacognitive awareness of that knowledge base is supportive of the developmental trend one would expect under cognitive learning theory

Effect of Instruction on the Metacognitive Awareness of Declarative Knowledge

As expected and as Figure 17 and Appendix I-3 clearly show, there were significant differences among the three skill groups in the pre-instructional and post-instructional conditions on the metacognitive awareness of declarative knowledge scores in volleyball as measured by the SEV [$F(2,45)=16\ 001$, $p=0\ 0001$], furthermore, as Table 12 reports and within the limits of this descriptive study, the paired t-tests on SEV gain scores support an initial conclusion that all three skill groups improved the metacognitive awareness of their declarative knowledge base with practice and instruction

Looking at Figure 17, in absolute terms, the bottom group still indicates that they are not that knowledgeable, that is, they rank their knowledge in this area at less than the midpoint of the scale, while both the middle and top groups both indicate that they have improved This is an important finding The lower rating of the metacognitive awareness of declarative knowledge results of the bottom group may well reflect the fact that they realize that they not only do not have sufficient physical skills but they also lack a coherent understanding of what is expected of them in volleyball situations and how they should perform and use basic volleyball skills Cognitive learning principles suggest that individuals with higher levels of procedural knowledge should have more extensive and better organized declarative knowledge bases, that is, they have more skills and they can use them more proficiently. Furthermore, a number of studies of skill acquisition contend that individuals usually acquire a declarative understanding of where, when and how physical skills can be used as they acquire proficiency in them (Allard & Burnett, 1985, Anderson, 1982, Chi & Rees, 1983; Gallagher, 1984, Starkes & Deakin, 1984, Wall, 1990, Wall, McClements, Bouffard, Findlay & Taylor, 1985). The findings in this descriptive study provide further support of these initial contentions and empirical observations.

Metacognitive Awareness of Metacognitive Skill

The univariate ANOVA results on the pre-instructional scores for the students' metacognitive awareness of metacognitive skill showed a significant difference for skill level [F(2,45)=5.060, p=0.010]. As the Tukey HSD post hoc comparisons in Appendix H-3 show, this was mainly due to the difference between the scores of the top and bottom skill groups. The ANOVA on the post-instructional results for the metacognitive awareness of metacognitive skill again showed a significant difference for skill group [F(2,45)=17.190, p=0.0001]; however, as Appendix H-4 shows, the Tukey post hoc comparisons indicated there were significant differences found among all three skill groups. These mean differences among the skill groups can be visually noted in Figure 18.

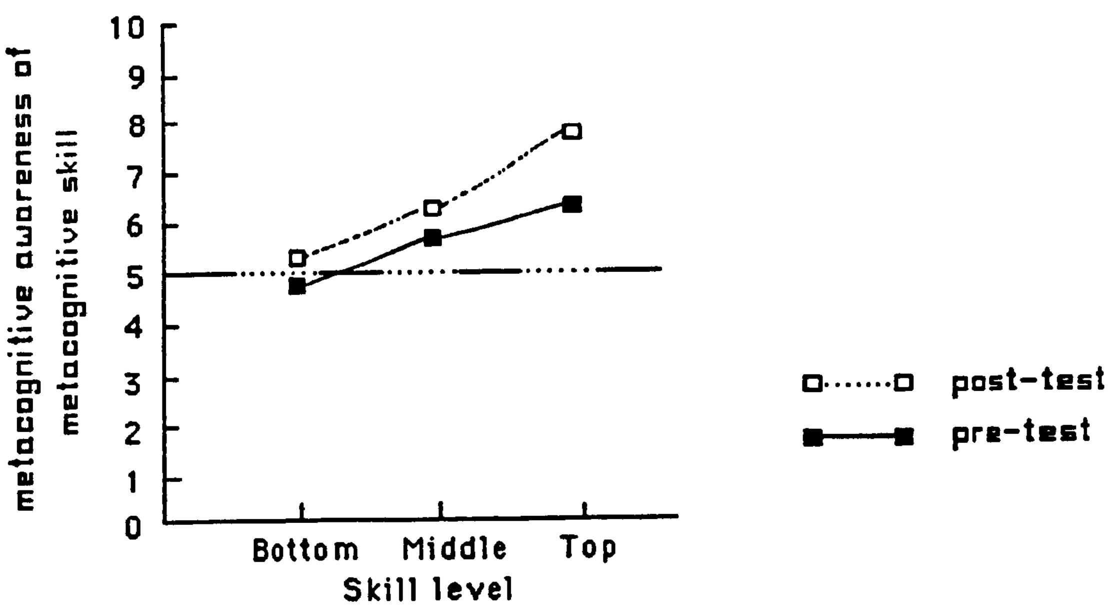


Figure 18. Students' metacognitive awareness of metacognitive skill as a function of skill level.

These results are congruent with the differences among skill groups in procedural, declarative and affective knowledge Clearly a definitive causal statement on the relationship between metacognitive awareness of metacognitive skill and the degree to which students have developed their declarative, procedural and affective knowledge bases in volleyball cannot be made in this initial descriptive study, however, higher level metacognitive skills seem to be related to the development of coherent and accessible declarative and affective knowledge bases and the mastery of physical skills within a sport

Effect of Instruction on the Metacognitive Awareness of Metacognitive Skill

As expected and as Figure 18 and Appendix I-4 clearly show, there were significant differences among the three skill groups in the pre-instructional and post-instructional conditions on the metacognitive awareness of metacognitive skill scores in volleyball as measured by the SEV [$F(2,45)=12\ 579$, $p=0\ 0001$], however, as Table 12 indicates the paired t-tests on SEV gain scores show that it was only the top skill group that actually reported that they had improved their metacognitive skill, while the other two groups did not indicate that they improved Again it must be emphasized that these findings were the result of a descriptive study As cognitive learning principles suggest, if the top skill group has better procedural and declarative knowledge bases, then it would be expected that they would be able to practice volleyball more effectively and they would use their knowledge and skills more frequently and appropriately in game or practice situations, hence, they would have more opportunities to use the metacognitive skill strategies that characterize expertise in sport situations. In contrast, those with limited declarative and procedural knowledge would be mainly concerned with getting the idea of the movement and when and where to use their developing skills, and hence, it would be much more likely that they would rarely use higher-level control strategies

Metacognitive Awareness of Affective Knowledge

Pre-instructional Practice Condition - Affective

The univariate ANOVA of students' pre-instructional ratings of their metacognitive awareness of affective knowledge in a practice situation as measured by the SEV showed a significant difference among skill groups [$F(2,45)=11.349$, $p=0.0001$] The Tukey HSD post hoc comparisons showed the significant differences were between the bottom and top groups and the middle and top groups. Figure 19 indicates that all skill groups report that they feel relatively comfortable in learning situations with, as was expected, the higher skill groups feeling even better about themselves in such situations.

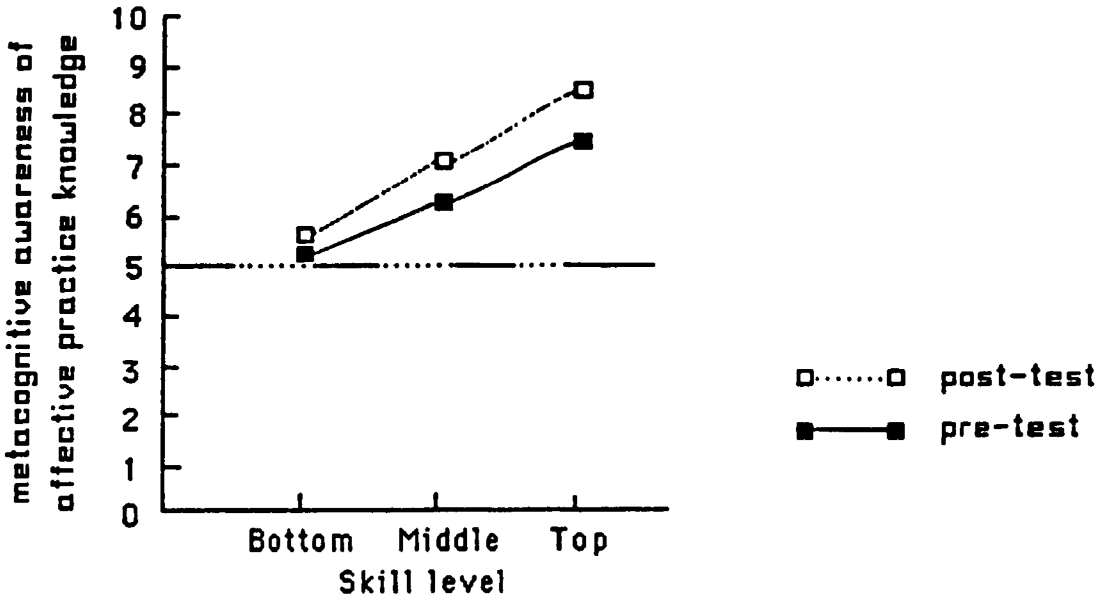


Figure 15. Students' metacognitive awareness of affective knowledge in a practice situation as a function of skill level.

Clearly, a conclusive statement on the cause of this result cannot be made at this time; however, if one assumes that the more highly skilled students will have had more success experiences in practice situations, then such success experiences may accumulate over time and so students would report developing more positive feelings about themselves on the SEV (Bandura, 1977; Bressan & Weiss, 1982; Feltz, 1988; Feltz & Doyle, 1981; Griffin, Keogh & Maybee, 1984; Harter,1982; Horn & Hasbrook, 1987; Lenney, 1977; Vealey, 1986).

Pre-Instructional Game Condition - Affective

The univariate ANOVA of students' pre-instructional ratings of their metacognitive awareness of affective knowledge in a game situation as measured by the SEV showed a significant difference among the skill groups [F(2,45)=12.481, p=0.0001]. The post hoc comparisons showed the same significant differences as in the metacognitive awareness of affective knowledge section for practice situations. Referring to Figure 20, the same observations

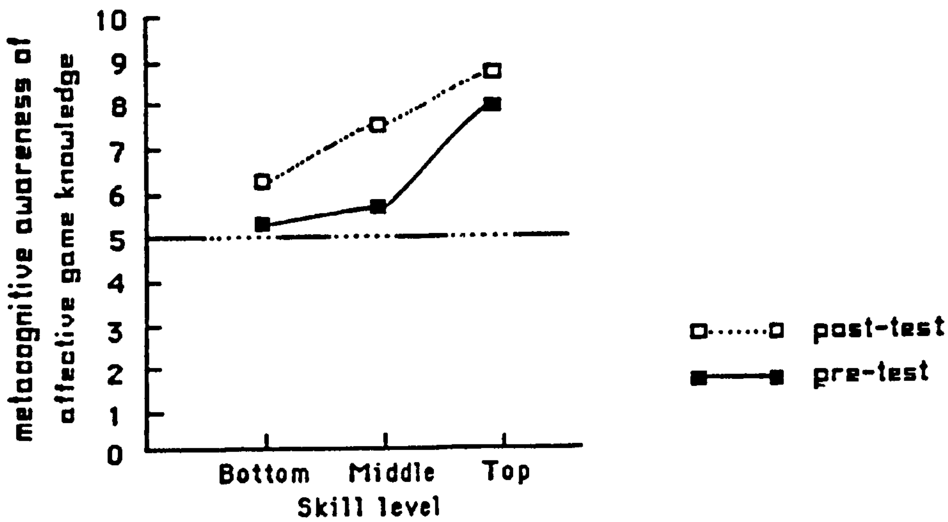


Figure 20. Students' metacognitive awareness of affective knowledge in a game situation as a function of skill level.

can be made as for metacognitive awareness of affective knowledge in practice situations. Individuals in the bottom skill group probably rate themselves lower than those in the other two groups because they do not feel as confident about their skills or about themselves in various volleyball situations simply because they may well have had more unsuccessful experiences than relatively more skilled students in the other groups However, it should be noted, that all groups still have relatively high affective metacognitive ratings in both game and practice situations which may reflect the fact that the teacher, on the whole, tried to make all students feel relatively comfortable in learning and game situations

As in the metacognitive awareness of procedural knowledge in practice and game situations, affective knowledge ratings were not differentially affected by whether they were in a practice or game situation at this age and skill level

Post-Instructional Practice and Game Condition - Affective

The ANOVA of students' post-instructional ratings of their metacognitive awareness of affective knowledge in a practice situation as measured by the SEV showed a significant difference among skill groups [F(2,45)=26 806, p=0.0001] with the post hoc comparisons showing significant differences among all three skill groups Again, as expected, the ANOVA of students' post-instructional ratings of their metacognitive awareness of affective knowledge in a game situation as measured by the SEV also showed a significant difference among skill groups [F(2,45)=14 340, p=0 0001] with the post hoc comparisons showing the significant differences were between the top and bottom groups and the bottom and middle groups

On average, students in the higher skill group rated how they felt about themselves higher than the students in lower skill groups, as indicated above, this was probably because they were more successful in play situations and so they reported that they felt more confident, while the lesser skilled students may have experienced more failures playing the game and while developing their skills causing them to feel less comfortable in these situations

Referring to Figures 19 and 20, and as noted before, the students' reporting of their metacognitive awareness of their feelings was relatively similar under both practice and game conditions, however, as the means of the groups show, the students do feel a little more comfortable in a learning situation, than in a game situation

Effect of Instruction on the Metatcognitive Awareness of Affective Knowledge - Practice Condition

Figure 19 presents the mean scores on the metacognitive awareness of affective knowledge in practice situations of the students in each of the three skill groups. The results of the ANOVA, Appendix I-5, on these scores indicates significant differences in the mean scores among the three skill groups [F(2,45)=23.106, p=0.0001] and significant increases in mean scores for each of the three skill groups between pre and post instructional situations [F(1,45)=11.788, p=0 001] However, post-hoc tests between the pre and post-instructional means for each skill group indicated minimally significant differences for only the middle and top skill groups. As children develop better skills and strategies about volleyball through practice and experience, it would be expected that they would be involved in more successful situations As a result, it would be expected that children would answer the questions on how they feel in practice situations in a more positive manner,hence, the expected improvement in the pre-post instructional condition was not present in the lowest skill group because they may have had less successful experiences In contrast, the scores of the more skilled groups reflected the fact that they were aware of more positive feelings due to their improved knowledge and skill base.

Effect of Instruction on the Metacognitive Awareness of Affective Knowledge - Game Condition

A similar pattern of results is found in the metacognitive awareness of affective game knowledge section. Figure 20 presents the mean scores on the metacognitive awareness of affective knowledge in game situations of the students in each of the three skill groups. As Appendix I-6 shows, there was a significant skill group X pre-post instruction interaction, $F=(2,45)=4.135$, $p=0.022$, however, it was an ordinal interaction as pre/post instructional means for each of the three skill groups resulted in significant differences Figure 20 graphically indicates that the interaction was largely influenced by the relatively large increase in affective knowledge scores obtained by the middle skill group, however, post-hoc t-tests confirmed that all three skill groups significantly increased their metacognitive awareness of affective knowledge in game condition as measured by the SEV As the students develop their procedural and declarative knowledge bases, they feel more confident about themselves, which helps all skill groups face the pressure to perform in game situations The development of skill and confidence gives the students a better feeling about themselves when placed in these pressure situations It is interesting to note that the lower skill group indicated that they felt better in game situations following instruction. This may have been due to the fact that they now knew something about the rules of the game, strategies of the game, the volleyball skills and what was expected of them. However, these speculations clearly require further study

In summary, the questions in all sections of the SEV seemed to effectively differentiate differences in metacognitive awareness of the students' knowledge bases among all three skill groups. However, it must be reemphasized that quite a few of the significant differences between skill groups were found only between the top and bottom groups. In fact, as mentioned previously, there may not really be a middle skill group The classes may have really included only novice and simply beginners who were more skilled as all students involved in the study were just starting their instruction in volleyball Nevertheless, even though the range of volleyball skill was relatively small, the questions in each of the SEV sections were sensitive to differences related to skill level.

Metacognitive Awareness of Overall Knowledge Base Scores

The average overall metacognitive awareness scores of the volleyball students as measured by the SEV demonstrates the effect that skill level has on the results. Univariate ANOVA's were done on the pre and post-instructional results across the three skill levels and significant differences were found for this factor [F(2,45)=13.873, p=0.0001 for the pre-instructional condition] and [F(2,45)=41.593, p=0.0001 for the post-instructional condition]. Post hoc comparisons showed significant differences between the bottom and top and the middle and top groups for the pre-instructional results, while the post-instructional results showed significant differences among all groups.

As Figure 21 shows, all groups, except the top skill group, in the pre-instructional situation indicated their metacognitive awareness of their knowledge base skills were below average. The students knew that their skills

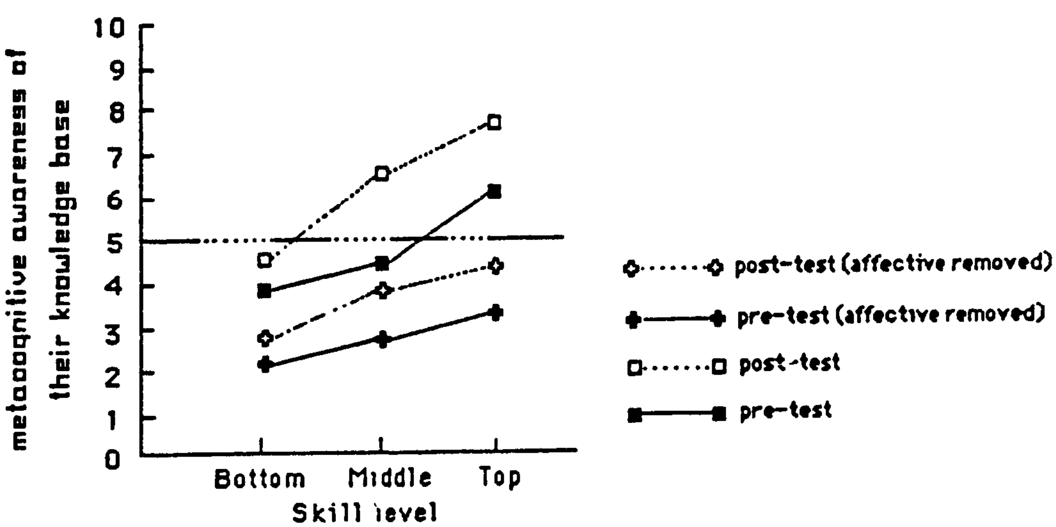


Figure 21. Students' metacognitive awareness of their knowledge base as a function of skill level.

and knowledge were lacking and they were willing and able to state their evaluation of that fact On the post-instructional results, the bottom skill group still indicated that metacognitive awareness of their knowledge and skills was below average, while both the middle and top groups reported that they felt they improved so that they were above average Within the limitations of this study, these results indicate that the higher skilled groups seem to have a better metacognitive awareness of their overall knowledge base, as measured by the SEV instrument, than those with less skill

A visual analysis of the overall SEV results indicates that the affective awareness of the students seemed to have a disproportionately high influence on the overall scores In order to examine the influence of the affective SEV scores on the overall metacognitive awareness score, the affective component of the SEV results was removed from the overall score to isolate the metacognitive awareness of procedural knowledge, declarative knowledge and metacognitive skill sections As Figure 21 shows, it is very evident that the affective knowledge scores had a disproportionately higher influence on the overall results How children feel about themselves in various learning and game situations is an important aspect of acquiring skill. It should be noted that the teacher seemed to have played an important role in this area The teacher tried to make the students feel comfortable about their learning and emphasized that mistakes were normal In this study, the teacher seems to have played a key role in the affective component by emphasizing to the students to accept their skill level and the skill level of others and to strive to improve their skills knowing that mistakes will be made along the way This is one plausible reason why the affective results for the students were so high

Looking at the overall results without the affective component, it can still be noted that there are differences in student responses due to skill level ANOVA's performed on the pre and post-instructional results without the affective component still resulted in significant differences between skill groups on their overall metacognitive awareness of their procedural knowledge, declarative knowledge and metacognitive skills [F(2,45)=10 335, p=0 0001] and [F(2,45)=34 935, p=0 0001] respectively Furthermore, the Tukey HSD post hoc comparisons showed significant differences among all groups

The interesting observation here is that in general the total SEV score for all three groups was clearly below the midpoint of the scale for both the pre and post-instructional results This provides considerable evidence that all students, top, middle and bottom skill groups, were aware that their knowledge and skills in volleyball are not strong For most of these students, this was their very first exposure to volleyball instruction As a result it certainly would be expected that their knowledge and skills in volleyball would not be high However, this pattern of results over three skill groups which were not markedly different in expertise in volleyball, demonstrates that the SEV is surprisingly sensitive to differences in metacognitive awareness of volleyball knowledge and skills Furthermore, even though the students are relative novices, the SEV questionnaire was able to elicit and assess clear differences in the students' metacognitive awareness of their knowledge and skills in volle,ball even across the relatively restricted range of skill in these classes

Effect of Instruction on the Metacognitive Awareness of the Overall Knowledge Base

Figure 21 presents the mean scores for overall metacognitive awareness of volleyball knowledge obtained by girls in each of the three skill groups under the pre and post-instruction conditions In order to highlight the relatively large effect of the inclusion of awareness of affective knowledge scores on the overall metacognitive awareness means, a plot of the overall scores without the awareness of affective knowledge scores has also been included Clearly, as Figure 21 shows, the absolute mean scale score is significantly reduced when this is done The means being 2 05 and 2.65 for the pre and post-instruction conditions respectively for the bottom group, 2 68 and 3 85 for the pre and post-conditions respectively for the middle group and 3 28 and 4 54 for the pre and post-conditions respectively for the top group As compared to the pre and post-condition means with the affective component included of 3 88 and 4 73 for the bottom group, 4 64 and 6 39 for the middle group and 5 98 and 7.48 for the top group respectively As Appendix I-7 and Table 12 show, there were significant differences in the overall metacognitive awareness means for all three skill groups when affective knowledge was included in the overall SEV score and when it was not included in the results Again, a significant ordinal interaction was found between skill level and pre-post instruction conditions [F(2,45)=5 720, p=0 006] As the post hoc comparisons in Table 12 show, it was due to the relatively large increases in the middle skill group

As shown in Appendix I-8 and Table 12, the exact same pattern of results was obtained when the analysis was completed without the metacognitive awareness of affective knowledge scores being included As Figure 21 so clearly indicates, the volleyball knowledge, skills and metacognitive skills of the girls in this study, even after an instructional programme, were quite low

What do these results indicate? The overall metacognitive awareness of the students' knowledge base seems to be different for each skill group Individuals learn and develop volleyball skill through practice and experience, their knowledge base improves and their metacognitive awareness of their knowledge base also improves Consequently with a better foundation and better metacognitive tools to work with, the students will be able to improve their skills even more and then seek more challenging situations to experience These students will probably be the more highly skilled students in the class The less-skilled students who have relatively poorly developed knowledge bases, are still learning volleyball skills and the declarative, affective and metacognitive knowledge and skills which lead to greater expertise The patterns of the SEV findings appear to support cognitive learning principles as they have been applied to sport expertise

In summary, it appears that a unit of volleyball instruction does affect the scores in each section of the SEV as well as the overall score of the SEV questionnaire and that skill level does differentially affect the results in each section as well as the overall score of the SEV The findings help lend initial support for the use of more broadly based measurement methods that attempt to assess the different types of knowledge that students develop in sport-specific instructional settings The results also indicate that skill instruction should be viewed in a broader way, not just the narrow focus of physical skill development Children need to learn how to learn and need to develop the means to improve their metacognitive awareness skills.

Recommendations and implications of this study will be presented in the following chapter

CHAPTER FIVE

CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

Over the past decade a series of studies, loosely called cognitive sport expertise studies, have demonstrated the nature and extent of various types of knowledge that develops as people acquire skill in sport A variety of theoretical frameworks have been used to describe the development of such knowledge, for the purposes of this study the framework developed by Wall and his colleagues was used In investigating the importance of domain-specific knowledge, the sport of volleyball was selected for examination The author of this study had considerable playing, teaching and coaching experience in this sport and had access to other experts in this field Furthermore, given her experience as a teacher, she was able to conduct this rather complex study through the cooperation of a variety of professional colleagues

Initially, the study included the design of a series of self-evaluation items within the five areas identified in a knowledge-based approach to skill acquisition Pilot tests and expert feedback provided guidance in the development and revision of these items Furthermore, in order to examine the effect of differences in levels of sport expertise in volleyball a teacher-based skill ranking system was developed, implemented and shown to be very reliable, especially when the post-instructional skill rankings of the students was used The skill ranking of the students into top, middle and bottom groups allowed the author to investigate the effects of such differences in volleyball skill The demonstration of expected differences across skill level in responding differentially to the SEV was assumed to be an important test of the face and content validity of the SEV This developmental pattern of results was evident even though there was a relatively restricted range of skill level in the physical education classes Hence, within the limits of this study, one can conclude that the SEV Questionnaire, is a sensitive, useful and reproducible self-evaluation instrument that could and should be used in the assessment of volleyball skill and knowledge

Another important method for evaluating the value and usefulness of the SEV Questionnaire was its use as a means to assess differences in volleyball knowledge and skills before and after a volleyball skill instruction programme Clearly, the major focus of this study was not related to pre/post-instructional differences inasmuch as student, teacher, class and programme availability prevented the use of control groups which would have been required. However, the pre-post design without a control, did allow for a descriptive examination of the potential value of the SEV as a means to assess the effect of an instructional programme Again, the expected differences were found and the effect of skill level on such pre/post-instructional evaluation was very evident

Given the above pattern of results, it can be concluded that

1. All sections of the SEV were readily understood by the students who used it, with minor variations found in the various subsections. The section most difficult to understand for most students was the one on metacognitive awareness of declarative knowledge This was probably due to the introduction of new concepts about thinking and unfamiliar terminology

2 The more highly skilled students, in general, found it easier to understand the SEV items than those with less skill The more skilled students may well have a better understanding of the concepts, strategies and terminology of the sport of volleyball than their counterparts, hence, they may have a better metacognitive awareness of their knowledge base

3. The students in the pre-instructional situation found the items in the following sections the most difficult to answer procedural practice and game knowledge, declarative knowledge and the items in the metacognitive skills section The procedural knowledge sections may have been difficult for the students to answer as most of the students were probably not sufficiently aware of their skill capabilities before instruction The metacognitive skill and declarative knowledge sections may have been perceived as hard to answer as this is a new way for the students to think about volleyball and their own learning

Quite simply, they probably are unfamiliar with how to answer these questions In the post-instructional condition the most difficult sections to answer, as perceived by the students, were the metacognitive skill and declarative knowledge sections Even though there has been improvement in the SEV results between pre and post-instructional situations, new ways of thinking about how one performs and learns in a sport, such as volleyball, takes time to develop However, most students were now familiar with their volleyball skill capabilities in both game and practice situations, and so reported that the procedural sections were now easier to answer.

4 In general, students in the top and middle groups found it easier to answer the SEV items There was an improvement in the SEV results between the pre and post-instructional conditions and this improvement seemed to be affected by the students' skill level.

5. The skill level of the students was clearly reflected in the higher scores obtained across all sections of the SEV, as well as the total SEV score, by those in the top group, followed by those in the middle group and bottom group. However, it should be noted that the magnitude of the total score on the SEV was highly influenced by the affective section, however, even after removing the affective section from the total SEV score the above pattern based on skill level was maintained.

6. Finally, the instructional programme did have a positive effect on the scores obtained by the students on the SEV In general, all skill groups showed an improvement and the change scores between pre and post-instructional conditions were directly affected by the students' skill level Unfortunately, the descriptive nature of this study limits the impact of this conclusion

In summary, cognitive learning principles, specifically a knowledge based approach to skill acquisition, appear to be supported in this study through the results of the SEV questionnaire

The Implications of this Study

The results of this study indicate that the SEV questionnaire is an effective instrument for assessing the breadth of knowledge and skills in the initial stages of volleyball skill acquisition The SEV Questionnaire differentiates quite clearly among individuals in the top, middle and bottom skill groups of a fairly typical grade eight girls' physical education class

The study also has implications for those teaching volleyball Its use may add to teachers' understanding of how students learn and where and why problems may occur in the students' skill learning process The SEV underscores the value of an overall view of skill learning, which reinforces physical educators' work on students' physical skill development, but focusses on other areas of development such as declarative knowledge, metacognitive skills and how students feel about themselves in learning situations The study may help teachers examine alternative teaching strategies to meet the different needs of their students The SEV's inclusion of items that require students to self-assess the management of their learning, focus their efforts, recognize their strengths and weaknesses and articulate their feelings about learning, opens up a variety of instructional possibilities The SEV may also offer teachers a different method of evaluating students' strengths and weaknesses which will guide teachers on how best to improve their students' skill learning

For the student, the SEV may be used as a learning tool that will introduce them to an overall view of skill learning The questionnaire has been shown to be easily understood by the students at this age level and the students' reported they enjoyed using the questionnaire. In the future, the questionnaire may help enlighten students about why their performance may not be as skilled as others, by making them aware that there are various knowledge domains involved in skill acquisition and that these domains are interrelated The SEV may also help the students to become aware of their strengths and weaknesses in these domains and help them identify means to improve them. The SEV may guide students in developing a metacognitive awareness of their knowledge base in volleyball and so with that knowledge and guidance from their teachers. students may be able to improve their skills and participate more successfully in the sport of volleyball.

Recommendations for Further Research

Based on the results of this study, the following recommendations are made:

1. The results obtained in this descriptive study justify the use of the SEV in larger studies designed to assess the effects of various instructional programmes on the knowledge base of students The additional costs of a suitable control group procedures would be merited given the results of this study
2. The SEV should be administered to different sample groups such as a boys' physical education class of the same age level, to an older group of students, to a high school team or to a public high school group, in order to determine the extent of its usefulness
3. A longitudinal study following a group of grade eight students until graduation from high school might also be enlightening as to the course of development in each of the types of knowledge and processes that underlie students' skill acquisition.
4. More extensive use of the structure of the SEV, for example in other sport domains, might facilitate a deeper understanding of what is learned within the various programmes of instruction.

BIBLIOGRAPHY

Abernethy, B (1988). The effects of age and expertise upon perceptual skill development in a racquet sport. Research Quarterly, 59(3), 210-221

Allard, F , & Burnett, N. (1985). Skill in sport Canadian Journal of Psychology, 39(2), 294-312

Allard, F , Graham, S , & Paarsalu, M. E (1980) Perception in sport Basketball Journal of Sport Psychology, 2, 14-21

Allard, F., & Starkes, J L. (1980). Perception in sport Volleyball Journal of Sport Psychology, 2, 22-33

Allard, F , & Starkes, J L (1991) Motor skill experts in sports, dance and other domains In Ericsson & Smith (Eds), Toward a general theory of expertise Prospects and limits (pp 126-152) Cambridge, New York Cambridge University Press

Allen, I. (1966) Detecting respondents who fake and confuse information about question areas on surveys Journal of Applied Psychology, 50(6), 523-528

Alnwick, M , Leighton, S., & Staniforth, D (1983) Volleyball Secondary cycle I Unpublished manuscript, Instructional Services Division, Lakeshore School Board, Montreal

Anderson, G. (1990) Fundamentals of educational research London The Falmer Press

Anderson, J R. (1982) Acquisition of cognitive skill Psychological Review, 89(4), 369-406

Anderson, L. W , & Burns, R. B. (1989) Research in classrooms: The study of teachers, teaching and instruction Oxford: Pergamon Press

Armstrong, C W , & Hoffman, S J (1979) Effects of teaching experience, knowledge of performer competence, and knowledge of performance outcome on performance error identification Research Quarterly for Exercise and Sport, 50(3), 318-327.

Bandura, A (1977) Self-efficacy Toward a unifying theory of behavioral change. Psychological Review, 84, 191-215

Bandura, A (1986) The explanatory and predictive scope of self-efficacy theory Journal of Social and Clinical Psychology, 4, 359-373.

Baranowski, T (1988) Validity and reliability of self report measures of physical activity An information-processing perspective Research Quarterly for Exercise and Sport, 59(4), 314-327

Bard, C , & Fleury, M (1981) Considering eye movement as a predictor of attainment In I M Cockerill & W W MacGillivary (Eds), Vision and sport (pp 28-41) Cheltenham, England Stanley Thomas

Bard, C , Fleury, M , & Carriere, L (1975) La strategie perceptive et la performance motrice Actes du 7ieme Symposium Canadien en apprentissage psychomoteur et psychologies du sport, Mouvement, 10, 163-183

Barrow, H. M., & McGee, R (1971) A practical approach to measurement in physical education Toronto Macmillan

Berdie, D R , Anderson, J F , & Niebuhr, M A (1986) Questionnaires Design and use (2nd ed) New Jersey Scarecrow Press

Best, J W (1981) Research in education (4th ed). New Jersey Prentice-Hall

Biscan, D V , & Hoffman S J (1976). Movement analysis as a generic ability of physical education teachers and students Research Quarterly, 47(2), 161-163

Borg, W R , & Gall, M D (1989) Educational Research. An introduction (5th ed). New York Longman

Borgeaud, P , & Abernethy, B (1987) Skilled perception in volleyball defense Journal of Sport Psychology, 9, 400-406

Bouffard, M (1986) Knowledge, anticipation, and the solution of movement problems by mentally retarded adolescents. Unpublished doctoral dissertation, University of Alberta, Department of Physical Education and Sport Studies, Edmonton

Bratton, R., & Lefroy, C (1980) Basic volleyball skills and concepts Ottawa Canadian Volleyball Association Publications

Bressan, E S., & Weiss, M R. (1982) A theory of instruction for developing competence, self confidence and persistance in physical education Journal of Teaching in Physical Education, 1, 38-47

Brown, A L (1977) Development, schooling, and the acquisition of knowledge In R C Anderson, R J Spiro & W E Montagne (Eds), Schooling and the acquisition of knowledge (pp 241-253) Hillsdale, New Jersey Erlbaum

Bruner, J S (1983) Child's talk. New York Norton

Butler, R P (1973) Effects of signed and unsigned questionnaires for both sensitive and nonsensitive items Journal of Applied Psychology, 57, 348-349

Campione, J C , Brown, A L , & Ferrara, R A (1982) Mental retardation and intelligence In R J Sternberg (Ed), Handbook of human intelligence (pp 392-490) Cambridge Cambridge University Press

Carey, S (1985) Are children fundamentally different kinds of thinkers and learners than adults? In S F Chipman, J W Segal & R Glaser (Eds), Thinking and learning skills (Vol 2, pp 485-517) Hillsdale, N J Erlbaum

Chase, W G , & Simon, A S (1973) Perception in chess Cognitive Psychology, 4, 55-81

Chi, M T H (1978) Knowledge structures and memory development In R S Siegler (Ed), Children's thinking What develops? (pp 73-105) Hillsdale, N J Erlbaum

Chi, M T H , Feltovich, P J , & Glaser, R (1981) Categorization and representation of physics problems by experts and novices Cognitive Science, 5, 121-152

Chi, M T H , & Glaser, R (1980) The measurement of expertise Analysis of the development of knowledge and skill as a basis for assessing achievement In E L Baker & E S Quellmely (Eds), Educational testing and evaluation (pp 37-47) Beverly Hills Sage

Chi, M. T H , & Rees, E T (1983) A learning framework for development In M T H Chi (Ed), Trends in memory development research (pp 71-107). New York Karger

Corbin, C B , & Nix, C (1979) Sex-typing of physical activities and success predictions of children before and after cross-sex competition Journal of Sport Psychology, 1, 43-52

Corbin, C B , Stewart, M J , & Blair, W O (1981) Self confidence and motor performance of pre-adolescent boys and girls studied in different feedback situations Journal of Sport Psychology, 3, 30-34.

Cox, R (1980) Teaching volleyball Philadelphia Burgess Publishing

Duda, J L (1987) Toward a developmental theory of children's motivation in sport Journal of Sport Psychology, 9, 130-145

Edwards, A I , & Kenney, K C (1946) A comparison of the Thurstone and Likert techniques of attitude scale construct Journal of Applied Psychology, 30, 72-83

Ennis, C D , Mueller, L K , & Zhu, W (1991) Descriptior of knowledge structures within a concept-based curriculum framework Research Quarterly for Exercise and Sport, 62(3), 309-318.

Feather, N T , & Simon, J G (1973) Fear of success and causal attributions for outcome Journal of Personality, 41, 525-542

Feltz, D L (1984) Self efficacy as a cognitive mediator of athletic performance In W F Straub & J M Williams (Eds), Cognitive Sport Psychology (pp 191-198) Lansing, New York Sport Science Associates

Feltz, D L (1988) Self-confidence and sports performance Exercise and Sport Sciences Reviews, 16, 423-457

Feltz, D L , & Doyle, L A (1981) Improving self confidence in athletic performance Motor Skills Theory into Practice, 5, 89-95

Fisher, A C (1984) Sport Intelligence In W F Straub & J M. Williams (Eds), Cognitive Sport Psychology (pp 42-50) Lansing, New York Sport Science Associates

Fitts, P M (1964) Perceptual-motor skill learning In A W Melton (Ed.), Categories of human learning New York Academic Press.

Fleury, M , Goulet, C , & Bard, C (1986) Eye fixation as visual indices of programming of service return in tennis Paper presented at the annual meeting of the North American Society for the Psychology of Sport and Physical Activity, Scottsdale, Arizona

Francis, L (1981) Anonymity and attitude scores among 10 and 11 year-old children Journal of Experimental Education, 49, 74-76

French, K E , & Thomas, J R (1987) The relation of knowledge development in children's basketball performance Journal of Sport Psychology, 9, 15-32

Frieze, I H , Parsons, J E , Johnson, P B , Ruble, P N , & Zellerman, G L (1978) Women and sex roles A social psychological perspective New York Norton

Gallagher, J D (1984) Influence of developmental information processing abilities In W F Straub & J M Williams (Eds), Cognitive Sport Psychology (pp 153-162) Lansing, New York Sport Science Associates

Gallagher, J D , & Thomas, J R (1986) Developmental effects of grouping and recoding on learning a movement series Research Quarterly for Exercise and Sport, 57(2), 117-127

Glass, G V , & Hopkins, K D (1984) Statistical methods in education and psychology (2nd ed) Englewood Cliffs, N J Prentice-Hall

Glaser, R (1989) Expertise and learning How do we think about instructional processes now that we have discovered knowledge structures? In D Klahr & K Kotovsky (Eds), Complex information processing The impact of Herbert Simon (pp 269-282) Hillsdale, N J Lawrence Erlbaum Associates

Gozansky, S (1983) Championship volleyball technique and drills West Nyack, New York Parker Publishing

Griffin, N S , & Keogh, J F (1982) A model for movement confidence In J A S Kelso & J E Clark (Eds), The development of movement control and coordination (pp 213-236) New York Wiley

Griffin, N S , Keogh, J F , & Maybee, R (1984) Performer perceptions of movement confidence Journal of Sport Psychology, 6, 395-407

Gronlund, N E (1971) Measurement and evaluation in teaching (2nd ed) New York MacMillan Co

Gusthart, J L , & Kelly, I W (1991) Teachers' motor skills in volleyball and students' learning Perceptual and Motor Skills, 72, 795-801

Hanrahan, S J , Grove, J R , & Hattie, J A (1989) Development of a questionnaire measure of sport-related attributional style International Journal of Sport Psychology, 20, 114-134

Hansford, B C , & Hattie, J A (1982) The relationship between self and achievement/performance measures Review of Educational Research, 52(1), 123-142

Harter, S (1981) The development of competitive motivation in the mastery of cognitive and physical skills Is there still a place for joy? In G C Roberts & D M Landers (Eds), Psychology of Motor Behavior and Sport (pp 3-29) Champaign, Ill Human Kinetics Press

Harter, S (1982) The perceived competence scale for children Child Development, 53, 87-97

Henerson, M E , Morris, L L ,& Fitz-Gibbon, C T (1978) How to measure attitudes London Sage Publications

Ho, L , & Shea, J B (1978) Levels of processing and the coding of position cues in motor short-term memory Journal of Motor Behaviour, 10, 133-138

Holdaway, E A (1971) Different response categories and questionnaire response patterns Journal of Experimental Psychology, 40(2), 57-60

Holden, R R , & Jackson, D N (1981) Subtlety, information and faking effects in personality assessment Journal of Clinical Psychology, 37, 379-386

Hopkins, K D (1982) The unit of analysis Group means versus individual observations American Educational Research Journal, 19, 5-18

Horn, T S , & Hasbrook, C A (1987) Psychological characteristics and the criteria children use for self-evaluation Journal of Sport Psychology, 9, 208-221

Imwold, C H , & Hoffman, S J (1983). Visual recognition of a gymnastic skill by experienced and inexperienced instructors Research Quarterly for Exercise and Sport, 54(2), 149-155

Irwin, D M , & Bushnell, M M (1980) Observational strategies for child study New York Holt, Rinehart & Winston

Jonassen, D H (1987) Assessing cognitive structure Verifying a method using pattern notes Journal of Research and Development in Education, 20, 1-13

Jones, C M , & Miles, T R (1978) Use of advance cues in predicting the flight of a lawn tennis ball Journal of Human Movement Studies, 4, 231-235

Keogh, J F , & Griffin, N S (1984) Movement confidence inventory Journal of Sport Psychology, 6, 395-407

Kich, L (1978) The scope of volleyball In C V A (Eds), Coaches' manual Level 1 (pp 1-8) Ottawa Canadian Volleyball Association Publications

Kich, L (1981) Volleyball skills- for coaches, teachers and students An innovative approach for developing players Ottawa Canadian Volleyball Association Publications

Klesges, R C , Eck, L H , Mellon, M W , Fullton, W , Somes, G W , & Hanson, C L (1990) The accuracy of self-reports of physical activity Medicine and Science in Sports and Exercise, 22(5), 690-697

Lenney, E (1977) Women's self confidence in achievement situations Psychological Bulletin, 84, 1-13

Lindberg, M (1980) Is knowledge base development a necessary and sufficient condition for memory development? Journal of Experimental Child Psychology, 30, 401-410

Locke, L F (1972) Implications for Physical Education Research Quarterly, 43, 374-386

Maccoby, E E , & Jacklin, C N (1974) The psychology of sex differences Stanford Stanford University Press

Magill, R A (1984) Influences in remembering movement information In W F Straub & J M Williams (Eds), Cognitive Sport Psychology (pp 175-188) Lansing, New York· Sport Science Associates

Magill, R A (1985) Motor learning Concepts and applications (2nd ed) Dubuque Wm C Brown Publishers

Marjoribanks, K (1976) School attitudes, cognitive ability and academic achievement Journal of Educational Psychology, 68, 653-660

McAuley, E , & Duncan, T E (1990) Cognitive appraisal and affective reactions following physical achievement outcomes Journal of Sport and Exercise Psychology, 12, 415-426

McAuley, E , & Gill, D (1983) Reliability and validity of the physical self-efficacy scale in a competitive sport setting Journal of Sport Psychology, 5, 410-418

Murphy, G L , & Wright, J C (1984) Changes in conceptual structure with expertise Differences between real-world experts and novices Journal of Experimental Psychology, 10(1), 144-155

Newell, L M , & Barclay, C R (1982) Developing knowledge about action In J A S Kelso and J E Clark (Eds), The development of movement control and coordination (pp 175-212) New York. Wiley

Nicholls, J G (1978) The development of the concepts of effort and ability, perception of academic attainment, and the understanding that different tasks require more ability Child Development, 49, 800-814

Nicholls, J G (1979) The development of perception of own attainment and causal attributions for success and failure in reading Journal of Educational Psychology, 71, 94-99

Nicholls, J G (1984) Achievement motivation Conceptions of ability, subjective experience, task choice and performance Psychological Review, 91, 328-346

Nicholls, J G , & Miller, A T (1983) The differentiation of the concepts of difficulty and ability Child Development, 54, 951-959

Norman D A , & Shallice, T (1980) Attention to action Willed and automatic control of behaviour (Tech Rep) San Diego University of California, Center for Human Information Procesing

O'Dell, J W (1971) Method for detecting random answers on personality questionnaires Journal of Applied Psychology, 55, 380-383

Ornstein, P A , & Naus, M J (1985) Effects of the knowledge base on children's memory strategies In H. W Reese (Ed), Advances in child development and behaviour (pp 113-148) New York Academic Press

Osborne, M. M , & Gordon, M E (1972) An investigation of the accuracy of ratings of a gross motor skill Research Quarterly, 43(1), 55-61

Parsons, J E , & Ruble, D N (1977) The development of achievement-related expectancies Child Development, 48, 1075-1079

Proudfoot, J A (1990) The development, implementation and evaluation of a skill assessment instrument to evaluate expertise in defensive football Unpublished master's thesis, McGill University, Department of Physical Education, Montreal

Rink, J E , Werner, P H , Hohn, R C , Ward, D S , & Timmermans, H M (1986) Differential effects of three teachers over a unit of instruction Research Quarterly for Exercise and Sport, 57(2), 132-138

Roberts, G (1984) Toward a new theory of motivation in sport The role of perceived ability In J M Silva & R S Weinberg (Eds), Psychological Foundations of Sport (pp 214-228) Champaign, Ill Human Kinetics

Robinson, D W , & Howe, B L (1989) Appraisal variable/affect relationships in youth sport A test of Weiner's attributional model Journal of Sport Psychology, 11, 431-443

Rovegno, I (1991) A participant-observation study of knowledge restructuring in a filed-based elementary physical education methods course Research Quarterly for Exercise and Sport, 62(2), 205-212

Ruble, D N (1983) The development of social comparisons processes and their role in achievement-related self-socialization In E T Higgins, D N Ruble, & W L Hartup (Eds), Social cognition and social development (pp 134-157) Cambridge Cambridge University Press

Ruble, D N , Parsons, J E , & Ross, J (1976) Self evaluative responses of children in an achievement setting Child Development, 47, 990-997

Ruble, D. N , Boggiano, A K , Feldman, N S , & Loebl, J H (1980) Developmental analysis of the role of social comparison in self-evaluation Developmental Psychology, 16(2), 105-115

Salmela, J H (1974) An information processing approach to volleyball National Volleyball Coaches Association Technical Journal, 1(1), 49-62

Salmela, J H , & Fiorito, P (1979) Visual cues in ice hockey goaltending Canadian Journal of Applied Sport Sciences, 4, 56-59

Sanguinetti, C, Lee, A M , & Nelson, J (1985) Reliability estimates and age and gender comparisons of expectations of success in sex-typed activities Journal of Sport Psychology, 7, 379-388

Sawula, L , & Valeriote, T (1981) Volleyball development model Ottawa Canadian Volleyball Association Publications

Scates, A E (1976) Winning volleyball (2nd ed) Boston Allen & Bacon

Shaklee, H , & Tucker, D (1979) Cognitive bases of development in inferences of ability Child Development, 50, 904-907

Shavelson, R J , Hubner, J J , & Stanton, G C (1976) Self concept Validation of constant interpretations Review of Educational Research, 46(3), 407-441

Singer, R N (1972) Coaching, athletics and psychology New York McGraw-Hill

Smith, M (1978) Attribution, achievement motivation, and task difficulty in physical education Paper presented at the B C conference on the teaching of physical education, Victoria, B C

Smith, M (1988, April) Individual differences A critical issue in teaching physical education Paper presented at the 1988 physical education workshop of the Greater Montreal Sport Scolaire, Montreal

Speltz, M L (1976) Note on effects of anonymity response consequence information and sex on self assessment of fear Behavior Research and Therapy, 14, 375-377

Starkes, J L (1987) Skill in field hockey Nature of cognitive advantage Journal of Sport Psychology, 9, 146-160

Starkes, J. L , & Deakin, J (1984) Perception in sport A cognitive approach to skilled performance In W F Straub & J M Williams (Eds), Cognitive Sport Psychology (pp 115-128) Lansing, New York Sport Science Associates

Stein, A H , Pohly, S R , & Mueller, E (1971) The influence of masculine, feminine, neutral tasks on children's achievement behavior, expectancies of success and attainment values Child Development, 42, 195-207

Stelmach, G E , & Hughes B (1984) Memory, cognition and motor behaviour In W F Straub & J M Williams (Eds), Cognitive Sport Psychology (pp 163-174) Lansing, New York Sport Science Associates

Stipek, D J (1981) Children's perceptions of their own and their classmates' ability Journal of Educational Psychology, 73(3), 404-410

Stipek, D J., & Hoffman, J (1980) Development of children's performance-related judgments Child Development, 51, 912-914

Stipek, D J , & Tannatt, L M (1984) Children's judgments of their own and their peers' academic competence Journal of Educational Psychology, 76 (1), 75-84

Tennant, M (1976) Volleyball team play Ottawa Canadian Volleyball Association Publications

Thomas, J R , French, K E , & Humphries, C A (1986) Knowledge development and sport skill performance Directions for motor behaviour research Journal of Sport Psychology, 8, 259-272

Thomas, J R , French, K E , Thomas, K T , & Gallagher, J D (1988) Children's knowledge development and sport performance In F L Smoll, R A Magill & M J Ash (Eds), Children in sport (3rd ed , pp 179-202) Champaign, Illinois Human Kinetics Books

Tittle, C R , & Hill, R J (1967) Attitude measurement and prediction of behaviour An evaluation of conditions and measurement techniques Sociometry, 30, 199-213.

Tuckman, B W (1978) Conducting educational research (2nd ed) New York: Harcourt Brace Jovanovich

Vealey, R S (1986) Conceptualization of sport confidence and competitive orientation Preliminary investigation and instrument development Journal of Sport Psychology, 8, 221-246.

Vosniadou, S , & Brewer, W F (1987) Theories of knowledge restructuring in development Review of Educational Research, 57(1), 51-67

Wall, A E (1982) Physically awkward children A motor development perspective In J P Das, R F Mulcahy & A E Wall (Eds.), Theory and Research in Learning Disabilities (pp 253-268) New York: Plenum Press

Wall, A E (1986) A knowledge-based approach to motor skill acquisition In M G Wade & H T A Whiting (Eds), Motor development in children Aspects of co-ordination and control (pp 33-47) Dordrecht Martinus Nyhoff Publishers

Wall, A E (1990) Skill acquisition research with persons with developmental disabilities Research design considerations In G Reid (Ed), Problems in movement control (pp 31-63) North-Holland Elsevier Science Publishers B V

Wall, A E , McClements, J , Bouffard, M , Findlay, H , & Taylor, M J (1985) A knowledge-based approach to motor development Implications for the physically awkward Adapted Physical Activity Quarterly, 2, 21-42

Wall, A E , Reid, G , & Paton, J (1990) The syndrome of physical awkwardness In G Reid (Ed), Problems in movement control (pp 283-316) North-Holland Elsevier Science Publishers B V.

Weiss, M R (1983) Modeling and motor performance A developmental perspective Research Quarterly for Exercise and Sport, 54, 190-197.

Weiss, M R , & Bredemeir, B J (1983) A theoretical perspective for studying children in sport Journal of Sport Psychology, 5, 216-230

Weiss, M R , Wiese, D M , & Klint, K A (1989) Head over heels with success The relationship between self-efficacy and performance in competitive youth gymnastics Journal of Sport & Exercise Psychology, 11, 444-451

Wellman, H M (1984) The development of concepts of the mental world Behavioral and Brain Sciences, 7(4), 651-652

Whiting, H T A. (1982) Skill in sport. In J H Salmela, J T Partington & T. Orlick (Eds), New paths of sport learning and excellence (pp 7-13) Ottawa Sport Perspective & Coaching Association of Canada

Winther, K T , & Thomas, J R (1981) Developmental differences in children's labelling of movement Journal of Motor Behaviour, 13, 77-90

Wylie, R (1979) The self concept Theory and research on selected topics (Vol 2) Lincoln, NB University of Nebraska Press

APPENDICES

SELF EVALUATION IN VOLLEYBALL

These questions are designed to help you evaluate your strengths and needs in volleyball. If they are to be of use to you, you have to try and answer them as accurately as possible.

Remember that learning a sport like volleyball takes time and practice, so you cannot expect to be skillful in all areas. When evaluating yourself be honest so that over the course of a few weeks you can measure your progress.

EVALUATION IN A PRACTICE SITUATION

You are in your P. E. class working with a partner or in a group, PRACTICING a skill. When you answer the following questions, assume that the situation is a good one, that is, the volleyball comes relatively close to you so you do not have to move too much to play it.

Circle the question mark (?) if you do not know what to answer

IN A PRACTICE SITUATION, OUT OF 10 POSSIBLE TRIES:

NUMBER OF SUCCESSFUL TRIES

1. Circle the number of accurate bump passes that you think you could make to a teammate.________ 1 2 3 4 5 6 7 8 9 10 ?
2. Circle the number of accurate volley passses that you think you could make to a teammate.________ 1 2 3 4 5 6 7 8 9 10 ?
3. Circle the number of successful serves (successful means over but not touching the net and in the court) you think you could make.________ 1 2 3 4 5 6 7 8 9 10 ?
4. Circle the number of times you think you can get to the ball so you are ready and balanced to perform a volley or bump pass well.________ 1 2 3 4 5 6 7 8 9 10 ?
5. Circle the number of accurate sets that you think you could make to a teammate.________ 1 2 3 4 5 6 7 8 9 10 ?
6. When receiving a serve, how often do you think that you could accurately pass the ball to a teammate?________ 1 2 3 4 5 6 7 8 9 10 ?
7. Using the scale from 1 to 10, where 1 means EXTREMELY DIFFICULT and 10 means NOT VERY DIFFICULT, rate how difficult it was for you to think about the answers to all the questions in this section?________ 1 2 3 4 5 6 7 8 9 10 ?
8. Using the scale from 1 to 10, where 1 means DID NOT UNDERSTAND and 10 MEANS UNDERSTOOD VERY WELL, rate how well you understood all the questions in this section?________ 1 2 3 4 5 6 7 8 9 10 ?

EVALUATION IN A GAME SITUATION

Assume that you are in your regular P. E. class. When evaluating yourself in a game situation, imagine that it is a competitive game situation where you have to move to the volleyball because your opponents want to win the point or serve.

Circle the question mark (?) if you do not know what to answer

REMEMBERING THAT YOU ARE IN A COMPETITIVE GAME SITUATION, CIRCLE THE NUMBER OF TRIES OUT OF 10 ATTEMPTS THAT YOU THINK YOU COULD SUCCESSFULLY DO FOR EACH SKILL — NUMBER OF SUCCESSFUL TRIES

1. Circle the number of accurate bump passes that you think you could make to a teammate.________ 1 2 3 4 5 6 7 8 9 10 ?

2. Circle the number of accurate volley passes that you think you could make to a teammate.________ 1 2 3 4 5 6 7 8 9 10 ?

3. Circle the number of successful serves you think you could make.________ 1 2 3 4 5 6 7 8 9 10 ?

4. Circle the number of times you think you can get to the ball so you are ready and balanced to perform a volley or bump pass well.________ 1 2 3 4 5 6 7 8 9 10 ?

5. Circle the number of accurate sets that you think you could make to a teammate.________ 1 2 3 4 5 6 7 8 9 10 ?

6. When receiving a serve, how often do you think that you could accurately pass the ball to a teammate?________ 1 2 3 4 5 6 7 8 9 10 ?

7. Using the scale from 1 to 10, where 1 means EXTREMELY DIFFICULT and 10 means NOT VERY DIFFICULT, rate how difficult it was for you to think about the answers to all the questions in this section?________ 1 2 3 4 5 6 7 8 9 10 ?

8. Using the scale from 1 to 10, where 1 means DID NOT UNDERSTAND and 10 means UNDERSTOOD VERY WELL, rate how well you understood all the questions in this section?________ 1 2 3 4 5 6 7 8 9 10 ?

IN ANSWERING THE NEXT SET OF QUESTIONS
USE THE FOLLOWING SCALES FROM 1 TO 10

Circle the question mark (?) if you do not know what to answer

1 ________ 5 ________ 10
NOT VERY WELL — SO-SO — EXTREMELY WELL

1. How well can you analyze what you are doing wrong when you have difficulty performing a skill? ______ 1 2 3 4 5 6 7 8 9 10 ?

2. How well do you know how to correct a skill if you are not doing it properly? ______ 1 2 3 4 5 6 7 8 9 10 ?

3. How well can you use your teacher's instructions when learning the volleyball skills? ______ 1 2 3 4 5 6 7 8 9 10 ?

4. How well can you use the teacher's feedback that you were given to improve your volleyball skills? ______ 1 2 3 4 5 6 7 8 9 10 ?

---

1 ________ 5 ________ 10
NOT VERY GOOD — SO-SO — EXTREMELY GOOD

5. How good are you at recognizing the proper cues to react quickly and accurately to a ball coming over the net? ______ 1 2 3 4 5 6 7 8 9 10 ?

---

1 ________ 5 ________ 10
NOT VERY CONFIDENT — SO-SO — EXTREMELY CONFIDENT

6. How confident are you that you are correct when evaluating how well you can perform the skills you use in volleyball? ______ 1 2 3 4 5 6 7 8 9 10 ?

7. How confident are you that you are focusing on the right things when performing volleyball skills? ______ 1 2 3 4 5 6 7 8 9 10 ?

---

8. Using the scale from 1 to 10, where 1 means EXTREMELY DIFFICULT and 10 means NOT VERY DIFFICULT, rate how difficult it was for you to think about the answers to all the questions in this section? ______ 1 2 3 4 5 6 7 8 9 10 ?

9. Using the scale from 1 to 10, where 1 means DID NOT UNDERSTAND and 10 means UNDERSTOOD VERY WELL, rate how well you understood all the questions in this section? ______ 1 2 3 4 5 6 7 8 9 10 ?

EVALUATION IN A GAME SITUATION

Assume that you are in your regular P. E. class. When evaluating yourself in a game situation, imagine that it is a competitive game situation where you have to move to the volleyball because your opponents want to win the point or serve.

IN ANSWERING THE NEXT SET OF QUESTIONS USE THE FOLLOWING SCALE FROM 1 TO 10

Circle the question mark (?) if you do not know what to answer

IN A GAME SITUATION,	1------5--------10 NOT VERY WELL SO-SO EXTREMELY WELL
1. How well do you know where to be on the court to receive a serve from the opposite team?______	1 2 3 4 5 6 7 8 9 10 ?
2. How well do you know where to be on the court to receive a set from a teammate?______	1 2 3 4 5 6 7 8 9 10 ?
3. How well do you understand the importance of using three hits in a volleyball game?______	1 2 3 4 5 6 7 8 9 10 ?
4. How well do you understand how to play a high, slow ball coming towards you?______	. 2 3 4 5 6 7 8 9 10 ?
5. How well do you understand how to play a lower, faster ball coming towards you?______	1 2 3 4 5 6 7 8 9 10 ?
6. How well do you understand how to communicate with other teammates during play?______	1 2 3 4 5 6 7 8 9 10 ?
7. How well do you understand the basic rules of volleyball?______	1 2 3 4 5 6 7 8 9 10 ?
8. How well do you understand the service rotation pattern in volleyball?______	1 2 3 4 5 6 7 8 9 10 ?
9. How well do you understand the different roles you might play in a volleyball game? (e.g. setter, spiker, server, etc.)______	1 2 3 4 5 6 7 8 9 10 ?
10. How well do you think you understand what is happening in a game of volleyball when watching other teams play?______	1 2 3 4 5 6 7 8 9 10 ?
11. How would you rate yourself as a volleyball player, using the scale from 1 to 10, 1 means NOT GREAT and 10 means EXCELLENT______	1 2 3 4 5 6 7 8 9 10 ?
12. Using the scale from 1 to 10, where 1 means EXTREMELY DIFFICULT and 10 means NOT VERY DIFFICULT, rate how difficult it was for you to think about the answers to all the questions in this section?______	1 2 3 4 5 6 7 8 9 10 ?
13. Using the scale from 1 to 10, where 1 means DID NOT UNDERSTAND and 10 means UNDERSTOOD VERY WELL, rate how well you understood all the questions in this section?______	1 2 3 4 5 6 7 8 9 10 ?

EVALUATION IN A GAME SITUATION

Assume that you are in your regular P. E. class. When evaluating yourself in a game situation, imagine that it is a competitive game situation where you have to move to the volleyball because your opponents want to win the point or serve.

Circle the question mark (?) if you do not know what to answer

IN A GAME SITUATION, RATE HOW YOU FEEL ON THE FOLLOWING SCALE

1--------5--------10
EXTREMELY AFRAID — SO-SO — NOT AFRAID

1. Rate to what degree you are afraid of receiving a hard, fast ball ________ 1 2 3 4 5 6 7 8 9 10 ?

2. Rate to what degree you are afraid of receiving a soft, slow ball ________ 1 2 3 4 5 6 7 8 9 10 ?

3. Rate to what degree you are afraid of receiving a serve ________ 1 2 3 4 5 6 7 8 9 10 ?

4. Rate to what degree you are afraid of bumping the ball ________ 1 2 3 4 5 6 7 8 9 10 ?

5. Rate to what degree you are afraid of volleying the ball ________ 1 2 3 4 5 6 7 8 9 10 ?

6. Rate to what degree you are afraid of hurting your fingers when volleying ________ 1 2 3 4 5 6 7 8 9 10 ?

7. Rate to what degree you are afraid of hurting your arms when bumping ________ 1 2 3 4 5 6 7 8 9 10 ?

8. Rate to what degree you are afraid of making a mistake because you are afraid of what your classmates might think about you ________ 1 2 3 4 5 6 7 8 9 10 ?

9. Rate to what degree you do not want to play the ball because you might make a mistake ____ 1 2 3 4 5 6 7 8 9 10 ?

IN A GAME SITUATION, RATE HOW YOU FEEL ON THE FOLLOWING SCALE FROM 1 TO 10

1--------5--------10
DO NOT ENJOY — SO-SO — ENJOY A LOT

10. Rate to what degree you enjoy playing the game of volleyball ________ 1 2 3 4 5 6 7 8 9 10 ?

---

11. Using the scale from 1 to 10, where 1 means EXTREMELY DIFFICULT and 10 means NOT VERY DIFFICULT, rate how difficult it was for you to think about the answers to all the questions in this section? ________ 1 2 3 4 5 6 7 8 9 10 ?

12. Using the scale from 1 to 10, where 1 means DID NOT UNDERSTAND and 10 means UNDERSTOOD VERY WELL, rate how well you understood all the questions in this section? ________ 1 2 3 4 5 6 7 8 9 10 ?

In answering the following questions, assume that you are in your regular physical education class.

Circle the question mark (?) if you do not know what to answer

IN A LEARNING SITUATION, RATE HOW YOU FEEL ON THE FOLLOWING SCALE FROM 1 TO 10

1---------5---------10
DO NOT LIKE — SO-SO — LIKE A LOT

1. Rate to what degree you like coming to volleyball class ________ 1 2 3 4 5 6 7 8 9 10 ?

2. Rate to what degree you like working with other players to practise your skills ________ 1 2 3 4 5 6 7 8 9 10 ?

3. Rate to what degree you like practising to improve your volleyball skills ________ 1 2 3 4 5 6 7 8 9 10 ?

IN A LEARNING SITUATION, RATE HOW YOU FEEL ON THE FOLLOWING SCALE FROM 1 TO 10

1---------5---------10
NO EFFORT — SO-SO — ALL OUT EFFORT

4. Rate to what degree you feel you make the necessary effort to improve your volleyball skills ________ 1 2 3 4 5 6 7 8 9 10 ?

IN A LEARNING SITUATION, RATE HOW YOU FEEL ON THE FOLLOWING SCALE FROM 1 TO 10

1---------5---------10
EXTREMELY FRUSTRATED — SO-SO — NOT FRUSTRATED

5. Rate to what degree you become frustrated when you cannot perform the volleyball skills to your satisfaction ________ 1 2 3 4 5 6 7 8 9 10 ?

IN A LEARNING SITUATION, RATE HOW YOU FEEL ON THE FOLLOWING SCALE FROM 1 TO 10

1---------5---------10
EXTREMELY AFRAID — SO-SO — NOT AFRAID

6. Rate to what degree you are afraid of making mistakes ________ 1 2 3 4 5 6 7 8 9 10 ?

---

7. Using the scale from 1 to 10, where 1 means EXTREMELY DIFFICULT and 10 means NOT VERY DIFFICULT, rate how difficult it was for you to think about the answers to all the questions in this section? ________ 1 2 3 4 5 6 7 8 9 10 ?

8. Using the scale from 1 to 10, where 1 means DID NOT UNDERSTAND and 10 means UNDERSTOOD VERY WELL, rate how well you understood all the questions in this section? ________ 1 2 3 4 5 6 7 8 9 10 ?

OTHER INFORMATION

SEX: MALE FEMALE

AGE: ________________ DATE OF BIRTH: ________________

VOLLEYBALL EXPERIENCE:

Place a checkmark (✓) at the correct experience level		Number of years you played volleyball at this level
____________	P.E. class only	____________
____________	Intramurals	____________
____________	School team	____________
____________	Community team	____________

Other information about your volleyball experience you think I should know

APPENDIX A-2

March 5, 1992

Mother Johnson;

I have been a physical education teacher at Lindsay Place High School for seventeen years. Presently I am enjoying a leave of absence to complete my master's degree in educational psychology at McGill University.

As per your request, following is a brief introduction as to why I am conducting this study.

In the past, a great deal of emphasis in the evaluation of skill learning has been based on norm-referenced skill performance tests. Rather than being only teacher centered this study is concerned with the development of self evaluation techniques that students can readily use to complement the teachers' overall evaluation of their performance and learning.

It has been argued that we need to collect more information from a broader perspective to begin to see the patterns and relationships that might be operating in skill learning situations (Wall, 1986; Wall, McClements, Bouffard, Findlay & Taylor, 1990). One way of examining skill learning (and sport expertise) is through a knowledge based approach.

Acquired knowledge developed over a period of time, is a major determining factor in skill performance, especially in cognitively demanding sports such as volleyball. Such acquired knowledge is developed in five domains: procedural, declarative, affective, metacognitive knowledge and metacognitive skill. An important aspect of acquired knowledge is metacognitive knowledge; that is an awareness of one's entire knowledge base in a specific domain.

Given the fact that expertise is categorized by more sophisticated organization and use of knowledge; it has been assumed that developing a self evaluation instrument that would help students systematically evaluate their knowledge base might facilitate the development of sport specific expertise in volleyball. As a result a volleyball self evaluation questionnaire based on the five domains in the knowledge based approach to skill acquisition has been developed.

This study is a descriptive study that follows the knowledge base framework in the development of a sport specific questionnaire which attempts to recognize differences in volleyball skill and tries to be of help in the school milieu by focusing on the types of knowledge acquired in a sport like volleyball. The study may broaden the students' perspective of what other areas of knowledge are involved when learning and refining a skill in physical education class. This may prompt the students to look at what has to be learned in these different domains, how the domains interact and give the students an idea of what to improve upon.

Evaluating students from a knowledge based perspective may help teachers understand more about how their students learn and where teaching may have to be focussed. The teachers may also be able to use the questionnaire as a tool t. help adapt their teaching methodology to meet the different needs of all students. The self evaluation volleyball instrument could potentially be a very valuable teaching and learning tool for teachers and students.

As a teacher myself, I understand the importance of minimizing the loss of class instruction time due to interruptions. This study will only require the grade 8 physical education students to answer the self evaluation volleyball questionnaire before the unit of volleyball is taught and then to answer a second self evaluation volleyball questionnaire after the unit of volleyball has been completed.

The questionnaire takes approximately twenty minutes to complete. I have included a copy of the questionnaire for your viewing. All information and results will be held in strict confidence with students and staff remaining anonymous.

I have spoken to Dawn Cumming and informed her of the research procedures. I assure you that a minimum amount of time will be required on Dawn's part, if you approve the study. In turn the information may provide the teachers and students of Sacred Heart with increased knowledge of skill learning in volleyball, which may be applied to other sporting activities.

It would be greatly appreciated if you would allow me to collect information for my research. If you would like to discuss any aspect of the study, do not hesitate to call me at 697-9451.

Sincerely,

Margot Alnwick

APPENDIX A-3

CLASS INSTRUCTIONS AND PROCEDURES

Teacher's information

1. In the second volleyball class, the questionnaire will be given out along with pencils.

   a. numbered questionnaires will be distributed to the students
   b. students will be told that their answers will be confidential

2. Purpose of the questionnaire will be discussed by myself

   a. interested in knowing your feelings and how you learn skills
   b. the questionnaire will help us know how to teach you better so you will learn more easily
   c. please be as honest as possible when answering the questions so that this information will be useful to both you and us

3. Instructions

   a. Circle the appropriate answer for you. THERE ARE NO RIGHT OR WRONG ANSWERS
   b. There may be some questions you do not know the answer to, please circle the question mark, as this answer is also important for me to know
   c. Please read the instructions very carefully
   d. Explain to students the difference between game and competitive situations before they start

4. The examiner will walk around the gym and mark down the student's name with the matching questionnaire number

5. At the same time the teacher will fill out the skill ranking form for the appropriate class size

6. Two days later, the teacher will be asked to fill out another skill ranking form

7. When the unit of volleyball has been completed, the questionnaire will again be given to the students following all the same procedures as before

8. At the same time the teacher will be asked to fill out another skill ranking form

9. Two days later another skill ranking form will be completed by the teacher

APPENDIX A-4

VOLLEYBALL SKILL RANKING FORM FOR A CLASS OF 27 STUDENTS

Based on the student's observable volleyball skill in class (consider factors such as accuracy, consistency, technique, appropriate use of skill and the student's basic knowledge of the game) place your students into one of the 5 appropriate skill groups. Place only the number of students specified for each group.

Name of student HIGH SKILL

1
2
3
4
5
6

Name of student ABOVE AVERAGE

1
2
3
4
5

Name of student AVERAGE SKILL

1
2
3
4
5
6

Name of student BELOW AVERAGE

1
2
3
4

Name of student LOW SKILL

1
2
3
4
5
6

APPENDIX B-1

Manova of Pre-Instructional Results for the

Students'Understanding of the Questions in Each Section of the

SEV Questionnaire, Testing for the Factor Class (N=54)

Univariate F tests

Dependent variable	SS	DF	MS	F	P
Procedural practice knowledge	23.815	2	11.907	3 662	0.034
Error	146.333	45	3.252		
Procedural game knowledge	18.111	2	9 056	3 247	0 048
Error	125 500	45	2.789		
Metacognitive skill	4.111	2	2.056	0 459	0 635
Error	201 500	45	4 478		
Declarative knowledge	4.593	2	2.296	0 401	0 672
Error	258 000	45	5 733		
Affective practice knowledge	8 037	2	4.019	1 123	0 334
Error	161.000	45	3 578		
Affective game knowledge	20.481	2	10.241	2.487	0.095
Error	185.333	45	4.119		

Multivariate test statistics

Wilks' Lambda=	0 761		
F-ratio=	0 977	DF=12,80	p=0 478
Hotelling-Lawley trace=	0.301		
F-ratio=	0.977	DF=12,78	p=0.478

APPENDIX B-2

Manova of Pre-Instructional Results for the Students' Understanding of the Questions in Each Section of the SEV Questionnaire, Testing for the Interaction Between Class and Skill Level (N=54)

Univariate F tests

Dependent variable	SS	DF	MS	F	P
Procedural practice knowledge	5 074	4	1.269	0.390	0.815
Error	146.333	45	3.252		
Procedural game knowledge	5.111	4	1.278	0.458	0.766
Error	125 500	45	2.789		
Metacognitive skill	41 111	4	10 278	2.295	0 074
Error	201.500	45	4 478		
Declarative knowledge	54.407	4	13.602	2.372	0 066
Error	258 000	45	5.733		
Affective practice knowledge	22.630	4	5 657	1.581	0.196
Error	161.000	45	3.578		
Affective game knowledge	30.519	4	7.630	1.853	0.135
Error	185 333	45	4.119		

Multivariate test statistics

Wilks' Lambda=	0.395		
F-ratio=	1.787	DF=24,140	P=0.200
Hotelling-Lawley trace=	1.154		
F-ratio=	1.852	DF=24,154	P=0.140

APPENDIX B-3

Manova of Post-Instructional Results for the Students' Understanding of the Questions in Each Section of the SEV Questionnaire, Testing for the Factor Class (N=54)

Univariate F tests

Dependent variable	SS	DF	MS	F	P
Procedural practice knowledge	0 444	2	0 222	0 163	0 850
Error	61 167	45	1 359		
Procedural game knowledge	4 148	2	2 074	1 569	0 220
Error	59 500	45	1 322		
Metacognitive skill	1 593	2	0.796	0 350	0 707
Error	102.500	45	2 278		
Declarative knowledge	0 778	2	0.389	0.133	0 876
Error	131.667	45	2.926		
Affective practice knowledge	4 778	2	2 389	1 177	0.318
Error	91.333	45	2 030		
Affective game knowledge	1 815	2	0.907	0.400	0 672
Error	102 000	45	2 267		

Multivariate test statistics

Wilks' Lambda=	0.864		
F-ratio=	0.505	DF=12,80	p=0 906
Hotelling-Lawley trace= F-ratio=	0.155 0.505	DF=12,78	p=0 906

APPENDIX B-4

Manova of Post-Instructional Results for the Students' Understanding

of the Questions in Each Section of the SEV Questionnaire,

Testing for the Interaction Between Class and Skill Level (N=54)

Univariate F tests

Dependent variable	SS	DF	MS	F	P
Procedural practice knowledge	1 111	4	0.278	0 204	0 935
Error	61 167	45	1 359		
Procedural game knowledge	9 185	4	2.296	1 737	0.159
Error	59 500	45	1.322		
Metacognitive skill	7 296	4	1.824	0.801	0 531
Error	102 500	45	2.278		
Declarative knowledge	3 778	4	0.944	0 323	0 861
Error	131 667	45	2.926		
Affective practice knowledge	15 778	4	3 944	1 943	0.120
Error	91 333	45	2.030		
Affective game knowledge	2 407	4	0.602	0 266	0.899
Error	102 000	45	2 267		

Multivariate test statistics

Wilks' Lambda=	0 576		
F-ratio=	1.006	DF=24,140	p=0.463
Hotelling-Lawley trace=	0 646		
F-ratio=	1 037	DF=24,154	p=0.424

APPENDIX B-5

Manova of Pre-Instructional Results for the Students'

Perceived Difficulty in Answering the Questions in Each Section

of the SEV Questionnaire, Testing for the Factor Class (N=54)

Univariate F tests

Dependent variable	SS	DF	MS	F	P
Procedural practice knowledge	51 444	2	25 722	4 478	0 017
Error	258 500	45	5 744		
Procedural game knowledge	38 111	2	19.056	4 259	0 020
Error	201 333	45	4 474		
Metacognitive skill	11 444	2	5 722	1 327	0 275
Error	194 000	45	4 311		
Declarative knowledge	16 926	2	8.463	1 310	0 280
Error	290.667	45	6 459		
Affective practice knowledge	0 037	2	0 019	0 003	0 997
Error	245 000	45	5 444		
Affective game knowledge	9 481	2	4 741	0 792	0 459
Error	269 500	45	5 989		

Multivariate test statistics

Wilks' Lambda=	0.71		
F-ratio=	1 247	DF=12,80	p=0 267
Hotelling-Lawley trace=	0.381		
F-ratio=	1.237	DF=12,78	p=0 274

APPENDIX B-6

Manova of Pre-Instructional Results for the Students' Perceived Difficulty in Answering the Questions in Each Section of the SEV Questionnaire, Testing for the Interaction Between Class and Skill Level (N=54)

Univariate F tests

Dependent variable	SS	DF	MS	F	P
Procedural practice knowledge	12.444	4	3.111	0.542	0 706
Error	258 500	45	5.744		
Procedural game knowledge	16 444	4	4 111	0.919	0.461
Error	201 333	45	4.474		
Metacognitive skill	26.444	4	6.611	1 534	0 209
Error	194 000	45	4 311		
Declarative knowledge	35.852	4	8.963	1 388	0 253
Error	290 667	45	6.459		
Affective practice knowledge	10 185	4	2.546	0 468	0.759
Error	245 000	45	5 444		
Affective game knowledge	32 407	4	8.102	1.353	0.265
Error	269.500	45	5.989		

Multivariate test statistics

Wilks' Lambda=	0.514		
F-ratio=	1.233	DF=24,140	p=0.224
Hotelling-Lawley trace=	0.776		
F-ratio=	1.246	DF=24,154	p=0.212

APPENDIX B-7

Manova of Post-Instructional Results for the Students'

Perceived Difficulty in Answering the Questions in Each Section

of the SEV Questionnaire, Testing for the Factor Class (N=54)

Univariate F tests

Dependent variable	SS	DF	MS	F	P
Procedural practice knowledge	6 333	2	3 167	0 708	0 498
Error	201.333	45	4 474		
Procedural game knowledge	3.593	2	1 796	0 908	0 410
Error	89.000	45	1.978		
Metacognitive skill	6 333	2	3 167	1 257	0 294
Error	113.333	45	2 519		
Declarative knowledge	3 704	2	1 852	0.666	0 519
Error	125.167	45	2 781		
Affective practice knowledge	3 593	2	1.796	0 792	0.459
Error	102 000	45	2.267		
Affective game knowledge	4 926	2	2.463	0.773	0.468
Error	143.333	45	3.185		

Multivariate test statistics

Wilks' Lambda=	0.807		
F-ratio=	0.753	DF=12,80	p=0.696
Hotelling-Lawley trace= F-ratio=	0.229 0.743	DF=12,78	p=0.705

APPENDIX B-8

Manova of Post-Instructional Results for the Students' Perceived Difficulty in Answering the Questions in Each Section of the SEV Questionnaire, Testing for the Interaction Between Class and Skill Level (N=54)

Univariate F tests

Dependent variable	SS	DF	MS	F	P
Procedural practice knowledge	6 222	4	1.556	0.348	0 844
Error	201 333	45	4.474		
Procedural game knowledge	4 185	4	1.046	0.529	0.715
Error	89.000	45	1.978		
Metacognitive skill	4 667	4	1.167	0.463	0.762
Error	113 333	45	2.519		
Declarative knowledge	1.407	4	0.352	0 126	0.972
Error	125 167	45	2 781		
Affective practice knowledge	8.741	4	2.185	0.964	0.437
Error	102.000	45	2.267		
Affective game knowledge	8.963	4	2.241	0.703	0.594
Error	143.333	45	3.185		

Multivariate test statistics

Wilks' Lambda=	0.693		
F-ratio=	0.651	DF=24,140	p=0.890
Hotelling-Lawley trace=	0 399		
F-ratio=	0 639	DF=24,154	p=0.900

APPENDIX B-9

Manova Testing for the Effect of Class in the Various Sections of the SEV Questionnaire for the Pre-Instructional Results (N=54)

Univariate F tests

Dependent variable	SS	DF	MS	F	P
Procedural practice knowledge	2.254	2	1 127	0 437	0.649
Error	116.042	45	2 579		
Procedural game knowledge	0 966	2	0.483	0 167	0.846
Error	129.866	45	2 886		
Metacognitive skill	6.492	2	3.246	1 484	0 238
Error	98.435	45	2.187		
Declarative knowledge	6.439	2	3 220	1 022	0.368
Error	141.804	45	3.151		
Affective practice knowledge	0.655	2	0 328	0 167	0.847
Error	88 356	45	1 963		
Affective game knowledge	5.711	2	2 856	1 016	0 370
Error	126.502	45	2.811		

Multivariate test statistics

Wilks' Lambda=	0.801		
F-ratio=	0.781	DF=12,80	p=0.669
Hotelling-Lawley trace=	0.236		
F-ratio=	0.767	DF=12,78	p=0 682

APPENDIX B-10

Manova Testing for the Interaction Between Class and Skill Level in the Various Sections of the SEV Questionnaire for the Pre-Instructional Results (N=54)

Univariate F tests

Dependent variable	SS	DF	MS	F	P
Procedural practice knowledge	11 767	4	2.942	1 141	0.350
Error	116.042	45	2 579		
Procedural game knowledge	16 340	4	4.085	1 415	0.244
Error	129 866	45	2.886		
Metacognitive skill	8 145	4	2 036	0.931	0 455
Error	98.435	45	2 187		
Declarative knowledge	16.627	4	4 157	1.319	0 277
Error	141 804	45	3.151		
Affective practice knowledge	20 860	4	5 215	2 656	0.045
Error	88.356	45	1.963		
Affective game knowledge	4.676	4	1.169	0.416	0.796
Error	126.502	45	2 811		

Multivariate test statistics

Wilks' Lambda=	0.501		
F-ratio=	1.257	DF=24,140	p=0 184
Hotelling-Lawley trace=	0.81		
F-ratio=	1.299	DF=24,154	p=0.173

APPENDIX B-11

Manova Testing for the Effect of Class in the Various Sections of the SEV Questionnaire for the Post-Instructional Results (N=54)

Univariate F tests

Dependent variable	SS	DF	MS	F	P
Procedural practice knowledge	4.966	2	2 483	1 273	0.290
Error	87.741	45	1.950		
Procedural game knowledge	8.199	2	4.099	1 987	0 149
Error	92 815	45	2 063		
Metacognitive skill	3 656	2	1 828	1.043	0 361
Error	78.833	45	1 752		
Declarative knowledge	4.001	2	2 001	0 975	0.385
Error	92.351	45	2.052		
Affective practice knowledge	2.322	2	1.161	0 979	0.383
Error	53.352	45	1.186		
Affective game knowledge	11.585	2	5.792	3 369	0 043
Error	77 372	45	1.719		

Multivariate test statistics

Wilks' Lambda=	0.775		
F-ratio=	0.906	DF=12,80	p=0 544
Hotelling-Lawley trace=	0.277		
F-ratio=	0.9	DF=12,78	p=0 551

APPENDIX B-12

Manova Testing for the Interaction Between Class and Skill Level in the Various Sections of the SEV Questionnaire for the Post-Instructional Results (N=54)

Univariate F tests

Dependent variable	SS	DF	MS	F	P
Procedural practice knowledge	14 698	4	3.674	1 884	0 130
Error	87.741	45	1 950		
Procedural game knowledge	16 237	4	4.059	1.968	0.116
Error	92 815	45	2 063		
Metacognitive skill	9 394	4	2.348	1 342	0.270
Error	78 833	45	1 752		
Declarative knowledge	11 859	4	2 965	1 445	0.235
Error	92.351	45	2.052		
Affective practice knowledge	4 064	4	1.016	0.857	0.497
Error	53.352	45	1.186		
Affective game knowledge	18 802	4	4.700	2.734	0.040
Error	77.372	45	1.719		

Multivariate test statistics

Wilks' Lambda=	0.459		
F-ratio=	1 469	DF=24,140	p=0.088
Hotelling-Lawley trace=	0.901		
F-ratio=	1.445	DF=24,154	p=0 095

APPENDIX C-1

Univariate ANOVAS Testing for the Effect of Skill Level, Class and the Interaction Between Skill Level and Class in the Students' Understanding of the Questions in Each Section of the SEV Questionnaire for the Pre Instructional Results (N=54)

Dependent variable	Source	SS	DF	MS	F	P
Procedural practice knowledge	Skill	17 815	2	8 907	2 739	0 075
	Class	23 815	2	11 907	3 662	0 034*
	Skill *Class	5 074	4	1 269	0 390	0 815
	Error	146 333	45	3 252		
Procedural game knowledge	Skill	36 111	2	18 056	6 474	0 003*
	Class	18 111	2	9 056	3 247	0 048*
	Skill *Class	5 111	4	1 278	0 458	0 766
	Error	125 500	45	2 789		
Metacognitive skill	Skill	46 778	2	23 389	5 223	0 009*
	Class	4 111	2	2 056	0 459	0 635
	Skill *Class	41 111	4	10 278	2 295	0 074
	Error	201 500	45	4 478		
Declarative knowledge	Skill	54 704	2	27 352	4 771	0 013*
	Class	4 593	2	2 296	0 401	0 672
	Skill *Class	54 407	4	13 602	2 372	0 066
	Error	258 000	45	5 733		
Affective practice knowledge	Skill	17 370	2	8 685	2 428	0 100
	Class	8 037	2	4 019	1 123	0 334
	Skill *Class	22 630	4	5 657	1 581	0 196
	Error	161 000	45	3 578		
Affective game knowledge	Skill	15 815	2	7 907	1 920	0 158
	Class	20 481	2	10 241	2 487	0 095
	Skill *Class	30 519	4	7 630	1 853	0 135
	Error	185 333	45	4 119		

* - a significant difference (p<0 05)

APPENDIX C-2

Univariate ANOVAS Testing for the Effect of Skill Level, Class and the Interaction Between Skill Level and Class in the Students' Understanding of the Questions in Each Section of the SEV Questionnaire for the Post Instructional Results (N=54)

Dependent variable	Source	SS	DF	MS	F	P
Procedural practice knowledge	Skill	10 111	2	5 056	3 719	0 032*
	Class	0 444	2	0 222	0 163	0 850
	Skill *Class	1 111	4	0 278	0 204	0 935
	Error	61 167	45	1 359		
Procedural game knowledge	Skill	23 259	2	11 630	8 796	0 001*
	Class	4 148	2	2 074	1 569	0 220
	Skill *Class	9 185	4	2 296	1 737	0 159
	Error	59 500	45	1 322		
Metacognitive skill	Skill	20 704	2	10 352	4 545	0 016*
	Class	1 593	2	0 796	0 350	0 707
	Skill *Class	7 296	4	1 824	0 801	0 531
	Error	102 500	45	2 278		
Declarative knowledge	Skill	29 778	2	15 889	5 089	0 010*
	Class	0 778	2	0 389	0 133	0 876
	Skill *Class	3 778	4	0 944	0 323	0 861
	Error	131 667	45	2 926		
Affective practice knowledge	Skill	21 444	2	10 722	5 283	0 009*
	Class	4 778	2	2 389	1 177	0 318
	Skill *Class	15 778	4	3 944	1 943	0 120
	Error	91 333	45	2 030		
Affective game knowledge	Skill	19 704	2	9 852	4 346	0 019*
	Class	1 815	2	0 907	0 400	0 672
	Skill *Class	2 407	4	0 602	0 266	0 899
	Error	102 000	45	2 267		

* - a significant difference (p<0 05)

APPENDIX C-3

Tukey Post Hoc Results for Contrasts Among Three Skill Levels for the Students' Understanding of Each Section of the SEV Questionnaire for the Pre Instructional Results

CONTRASTS

Dependent variable	Bottom-Top	Bottom-Middle	Middle-Top
Procedural practice knowledge	n s	n s	n s
Procedural game knowledge	*sign*	*sign*	n s
Metacognitive skill	*sign*	n s	n s
Declarative knowledge	*sign*	n s	n s
Affective practice knowledge	n s	n s	n s
Affective game knowledge	n s	n s	n s

sign means a significant difference was found between the means ($p<0.05$)
n s means no significant difference was found between the means ($p>0.05$)

APPENDIX C-4

Tukey Post Hoc Results for Contrasts Among Three Skill Levels for the Students' Understanding of Each Section of the SEV Questionnaire for the Post Instructional Results

CONTRASTS

Dependent variable	Bottom-Top	Bottom-Middle	Middle-Top
Procedural practice knowledge	*sign*	n s	n s
Procedural game knowledge	*sign*	*sign*	n s
Metacognitive skill	*sign*	*sign*	n s
Declarative knowledge	*sign*	n s	n s
Affective practice knowledge	*sign*	*sign*	n s
Affective game knowledge	*sign*	*sign*	n s

sign means a significant difference was found between the means ($p<0.05$)
n s means no significant difference was found between the means ($p>0.05$)

APPENDIX D-1

Repeated Measures ANOVA of Students' Understanding of the Questions in the Section on Procedural Knowledge in a Practice Situation (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	26 741	2	13 370	3 892	0 028*
Class	13 352	2	6 676	1 943	0 155
Skill*Class	3 037	4	0 759	0 221	0 925
Error	154 583	45	3 435		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Understanding of Procedural practice knowledge	49 343	1	49 343	41 961	0 0001*
Understanding of Procedural practice knowledge *Skill	1 185	2	0 593	0 504	0 608
Understanding of Procedural practice knowledge *Class	10 907	2	5 454	4 638	0 015*
Understanding of Procedural practice knowledge *Skill *Class	3 148	4	0 787	0 669	0 617
Error	52 917	45	1 176		

* - significant difference, p<0 05

APPENDIX D-2

Repeated Measures ANOVA of Students' Understanding of the Questions

in the Section on Procedural Knowledge in a Game Situation (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	58 019	2	29 009	10 584	0 0001*
Class	12 241	2	6 120	2 233	0 119
Skill *Class	12 148	4	3 037	1 108	0 364
Error	123 333	45	2 741		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Understanding of Procedural game knowledge	42 815	1	42 815	31 243	0 0001*
Understanding of Procedural game knowledge *Skill	1 352	2	0 676	0 493	0 614
Understanding of Procedural game knowledge *Class	10 019	2	5 009	3 655	0 034*
Understanding of Procedural game knowledge *Skill *Class	2 148	4	0 537	0 392	0 813
Error	61 667	45	1 370		

* - significant difference, p<0 05

APPENDIX D-3

Repeated Measures ANOVA of Students' Understanding of the Questions in the Section on Metacognitive Skill (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	61 685	2	30 843	6 578	0 003*
Class	5 352	2	2 676	0 571	0 569
Skill *Class	34 593	4	8 648	1 844	0 137
Error	211 000	45	4 689		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Understanding of Metacognitive skill	29 037	1	29 037	14 050	0 001*
Understanding of Metacognitive skill *Skill	5 796	2	2 898	1 402	0 257
Understanding of Metacognitive skill *Class	0 352	2	0 176	0 085	0 919
Understanding of Metacognitive skill *Skill *Class	13 815	4	3 454	0 671	0 173
Error	93 000	45	2 067		

* - significant difference, p<0 05

APPENDIX D-4

Repeated Measures ANOVA of Students' Understanding of the Questions

in the Section on Declarative Knowledge (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	80 241	2	40 120	6 151	0 004*
Class	3 685	2	1 843	0 283	0 755
Skill *Class	40 759	4	10 190	1 562	0 201
Error	293 500	45	6 522		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Understanding of Declarative knowledge	68 481	1	68 481	32 045	0 0001*
Understanding of Declarative knowledge *Skill	4 241	2	2 120	0 992	0 379
Understanding of Declarative knowledge *Class	1 685	2	0 843	0 394	0 676
Understanding of Declarative knowledge *Skill *Class	17 426	4	4 356	2 039	0 105
Error	96 167	45	2 137		

* - significant difference, p<0 05

APPENDIX D-5

Repeated Measures ANOVA of Students' Understanding of the Questions

in the Section on Affective Knowledge in a Practice Situation (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	36 963	2	18 481	4 104	0 023*
Class	6 130	2	3 065	0 681	0 511
Skill *Class	34 981	4	8 745	1 942	0 120
Error	202 667	45	4 504		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Understanding of Affective practice knowledge	2 370	1	2 370	2 148	0 150
Understanding of Affective practice knowledge *Skill	1 852	2	0 926	0 839	0 439
Understanding of Affective practice knowledge *Class	6 685	2	3 343	3 029	0 058
Understanding of Affective practice knowledge *Skill *Class	3 426	4	0 856	0 776	0 547
Error	49 667	45	1 104		

* - significant difference, p<0 05

APPENDIX D-6

Repeated Measures ANOVA of Students' Understanding of the Questions

in the Section on Affective Knowledge in a Game Situation (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	31 056	2	15 528	3 376	0 043*
Class	14 000	2	7 000	1 522	0 229
Skill*Class	23 611	4	5 903	1 283	0 291
Error	207 000	45	4 600		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Understanding of Affective game knowledge	0 593	1	0 593	0 332	0 567
Understanding of Affective game knowledge *Skill	4 463	2	2 231	1 250	0 296
Understanding of Affective game knowledge *Class	8 296	2	4 148	2 324	0 110
Understanding of Affective game knowledge *Skill *Class	9 315	4	2 329	1 304	0 283
Error	80 333	45	1 785		

* - significant difference, p<0 05

APPENDIX E-1

Univariate ANOVAS Testing for the Effect of Skill Level, Class and the Interaction Between Skill Level and Class in the Students' Perceived Difficulty in Answering Each Section of the SEV Questionnaire for the Pre Instructional Results (N=54)

Dependent variable	Source	SS	DF	MS	F	P
Procedural practice knowledge	Skill	40 444	2	20 222	3 520	0 038*
	Class	51 444	2	25 722	4 478	0 017*
	Skill *Class	12 444	4	3 111	0 542	0 706
	Error	258 500	45	5 744		
Procedural game knowledge	Skill	38 111	2	19 056	4 259	0 020*
	Class	38 111	2	19 056	4 259	0 020*
	Skill *Class	16 444	4	4 111	0 919	0 461
	Error	201 333	45	4 474		
Metacognitive skill	Skill	60 111	2	30 056	6 972	0 002*
	Class	11 444	2	5 722	1 327	0 275
	Skill *Class	26 444	4	6 611	1 534	0 209
	Error	194 000	45	4 311		
Declarative knowledge	Skill	43 815	2	21 907	3 392	0 042*
	Class	16 926	2	8 463	1 310	0 280
	Skill *Class	35 852	4	8 963	1 388	0 253
	Error	290 667	45	6 459		
Affective practice knowledge	Skill	36 926	2	18 463	3 391	0 042*
	Class	0 037	2	0 019	0 003	0 997
	Skill *Class	10 185	4	2 546	0 468	0 759
	Error	245 000	45	5 444		
Affective game knowledge	Skill	56 481	2	28 241	4 716	0 014*
	Class	9 481	2	4 741	0 792	0 459
	Skill *Class	32 407	4	8 102	1 353	0 265
	Error	269 500	45	5 989		

* - a significant difference ($p<0\ 05$)

APPENDIX E-2

Univariate ANOVAS Testing for the Effect of Skill Level, Class and the Interaction Between Skill Level and Class in the Students' Perceived Difficulty in Answering Each Section of the SEV Questionnaire for the Post-Instructional Results (N=54)

Dependent variable	Source	SS	DF	MS	F	P
Procedural practice knowledge	Skill	40 111	2	20 056	4 483	0 017*
	Class	6 333	2	3 167	0 708	0 498
	Skill *Class	6 222	4	1 556	0 348	0 844
	Error	201 333	45	4 474		
Procedural game knowledge	Skill	25 593	2	12 796	6 470	0 003*
	Class	3 593	2	1 796	0 908	0 410
	Skill *Class	4 185	4	1 046	0 529	0 715
	Error	89 000	45	1 978		
Metacognitive skill	Skill	21 000	2	10 500	4 169	0 022*
	Class	6 333	2	3 167	1 257	0 294
	Skill *Class	4 667	4	1 167	0 463	0 762
	Error	113 333	45	2 519		
Declarative knowledge	Skill	16 037	2	8 019	2 883	0 066
	Class	3 704	2	1 852	0 666	0 519
	Skill *Class	1 407	4	0 352	0 126	0 972
	Error	125 167	45	2 781		
Affective practice knowledge	Skill	14 037	2	7 019	3 096	0 055
	Class	3 593	2	1 796	0 792	0 459
	Skill *Class	8 741	4	2 185	0 964	0 437
	Error	102 000	45	2 267		
Affective game knowledge	Skill	28 259	2	14 130	4 436	0 017*
	Class	4 926	2	2 463	0 773	0 468
	Skill *Class	8 963	4	2 241	0 703	0 594
	Error	143 333	45	3 185		

* - a significant difference (p<0 05)

APPENDIX E-3

Tukey Post Hoc Results for Contrasts Among Three Skill Levels for the Students' Perceived Difficulty in Answering Each Section of the SEV Questionnaire Pre Instructional Results

	CONTRASTS		
Dependent variable	Bottom-Top	Bottom-Middle	Middle-Top
Procedural practice knowledge	*sign*	n s	n s
Procedural game knowledge	*sign*	n s	n s
Metacognitive skill	*sign*	n s	n s
Declarative knowledge	*sign*	n s	n s
Affective practice knowledge	*sign*	n s	n s
Affective game knowledge	*sign*	n s	n s

sign means a significant difference was found between the means (p<0 05)
n s means no significant difference was found between the means(p>0 05)

APPENDIX E-4

Tukey Post Hoc Results for Contrasts Among Three Skill Levels for the Students' Perceived Difficulty in Answering Each Section of the SEV Questionnaire Post Instructional Results

CONTRASTS

Dependent variable	Bottom-Top	Bottom-Middle	Middle-Top
Procedural practice knowledge	*sign*	n s	n s
Procedural game knowledge	*sign*	n s	n s
Metacognitive skill	*sign*	n s	n s
Declarative knowledge	n s	n s	n s
Affective practice knowledge	n s	n s	n s
Affective game knowledge	*sign*	n s	n s

sign means a significant difference was found between the means (p<0 05)
n s means no significant difference was found between the means (p>C 05)

APPENDIX F-1

Repeated Measures ANOVA of Students' Perceived Difficulty

in Answering the Questions in the Section on Procedural Knowledge

in a Practice Situation (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	80 167	2	40 083	8 941	0 001*
Class	35 389	2	17 694	3 947	0 026*
Skill *Class	5 111	4	1 278	0 285	0 886
Error	201 750	45	4 483		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Difficulty in procedural practice knowledge	102 083	1	102 083	17 799	0 0001*
Difficulty in procedural practice knowledge *Skill	0 389	2	0 194	0 034	0 967
Difficulty in procedural practice knowledge *Class	22 389	2	11 194	1 952	0 154
Difficulty in procedural practice knowledge *Skill *Class	13 556	4	3 389	0 591	0 671
Error	258 083	45	5 735		

* - significant difference, p<0 05

APPENDIX F-2

Repeated Measures ANOVA of Students' Perceived Difficulty

in Answering the Questions in the Section on Procedural Knowledge

in a Game Situation (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	62 463	2	31 231	8 729	0 001*
Class	20 074	2	10 037	2 805	0 071
Skill*Class	7 981	4	1 995	0 558	0 694
Error	161 000	45	3 578		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Difficulty in procedural game knowledge	116 148	1	116 148	40 412	0 0001*
Difficulty in procedural game knowledge *Skill	1 241	2	0 620	0 216	0 807
Difficulty in procedural game knowledge *Class	21 630	2	10 815	3 763	0 031*
Difficulty in procedural game knowledge *Skill *Class	12 648	4	3 162	1 100	0 368
Error	129 333	45	2 874		

* - significant difference, p<0 05

APPENDIX F-3

Repeated Measures ANOVA of Students' Perceived Difficulty in

Answering the Questions in the Section on Metacognitive Skill (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	74 056	2	37 028	8 633	0 001*
Class	6 889	2	3 444	0 803	0 454
Skill*Class	23 722	4	5 931	1 383	0 255
Error	193 000	45	4.289		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Difficulty in metacognitive skill	120 333	1	120 333	47 362	0 0001*
Difficulty in metacognitive skill *Skill	7 056	2	3 528	1 388	0 260
Difficulty in metacognitive skill *Class	10 889	2	5 444	2 143	0 129
Difficulty in metacognitive skill *Skill *Class	7 389	4	1 847	0 727	0 578
Error	114 333	45	2 541		

* - significant difference, $p<0\ 05$

APPENDIX F-4

Repeated Measures ANOVA of Students' Perceived Difficulty in

Answering the Questions in the Section on Declarative Knowledge (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	54 889	2	27 444	4 615	0 015*
Class	12 167	2	6 083	1 023	0 368
Skill *Class	19 778	4	4 944	0 832	0 512
Error	267 583	45	5 946		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Difficulty in declarative knowledge	73 343	1	73 343	22 263	0 0001*
Difficulty in declarative knowledge *Skill	4 963	2	2 481	0 753	0 477
Difficulty in declarative knowledge *Class	8 463	2	4 231	1 284	0 287
Difficulty in declarative knowledge *Skill *Class	17 481	4	4 370	1 327	0 275
Error	148 250	45	3 294		

* - significant difference, $p<0\ 05$

APPENDIX F-5

Repeated Measures ANOVA of Students' Perceived Difficulty in Answering the Questions in the Section on Affective Knowledge in a Practice Situation (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	48 222	2	24 111	4 197	0 021*
Class	1 556	2	0 778	0 135	0 874
Skill*Class	18 389	4	4 597	0 800	0 531
Error	258 500	45	5 744		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Difficulty in affective practice knowledge	23 148	1	23 148	11 770	0 001*
Difficulty in affective practice knowledge *Skill	2 741	2	1 370	0 697	0 503
Difficulty in affective practice knowledge *Class	2 074	2	1 037	0 527	0 594
Difficulty in affective practice knowledge *Skill *Class	0 537	4	0 134	0 068	0 991
Error	88 500	45	1 967		

* - significant difference, p<0 05

APPENDIX F-6

Repeated Measures ANOVA of Students' Perceived Difficulty in Answering the Questions in the Section on Affective Knowledge in a Game Situation (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	77 556	2	38 778	7 460	0 002*
Class	5 722	2	2 861	0 550	0 581
Skill *Class	30 222	4	7 556	1 454	0 232
Error	233 917	45	5 198		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Difficulty in affective game knowledge	15 565	1	15 565	3 915	0 054
Difficulty in affective game knowledge *Skill	7 185	2	3 593	0 904	0 412
Difficulty in affective game knowledge *Class	8 685	2	4 343	1 092	0 344
Difficulty in affective game knowledge *Skill *Class	11 148	4	2 787	0 701	0 595
Error	178 917	45	3 976		

* - significant difference, p<0 05

APPENDIX G-1

Manova of Pre-Instructional Results for the Students'

Understanding of the Questions in Each Section of the SEV

Questionnaire, Testing for the Factor of Skill Level (N=54)

Univariate F tests

Dependent variable	SS	DF	MS	F	P
Procedural practice knowledge	17 815	2	8 907	2 739	0 075
Error	146 333	45	3 252		
Procedural game knowledge	36 111	2	18.056	6 474	0 003*
Error	125 500	45	2 789		
Metacognitive skill	46 778	2	23 389	5 223	0 009*
Error	201.500	45	4 478		
Declarative knowledge	54 704	2	27 352	4.771	0 013*
Error	258 000	45	5 733		
Affective practice knowledge	17.370	2	8 685	2 428	0 100
Error	161 000	45	3 578		
Affective game knowledge	15 815	2	7 907	1 920	0 158
Error	185.333	45	4 119		

* - a significant finding (p<0.05)

Multivariate test statistics

Wilks' Lambda=	0 645		
F-ratio=	1 634	DF=12,80	p=0 099
Hotelling-Lawley trace= F-ratio=	0 527 1 711	DF=12,78	p=0 080

APPENDIX G-2

Manova of Post-Instructional Results for the Students'

Understanding of the Questions in Each Section of the SEV

Questionnaire, Testing for the Factor of Skill Level (N=54)

Univariate F tests

Dependent variable	SS	DF	MS	F	P
Procedural practice knowledge	10 111	2	5 056	3.719	0.032*
Error	61 167	45	1 359		
Procedural game knowledge	23 259	2	11 630	8 796	0 001*
Error	59 500	45	1.322		
Metacognitive skill	20 704	2	10.352	4 545	0 016*
Error	102 500	45	2.278		
Declarative knowledge	29.778	2	14.889	5 089	0.010*
Error	131 667	45	2.926		
Affective practice knowledge	21 444	2	10.722	5 283	0 009*
Error	91.333	45	2 030		
Affective game knowledge	19.704	2	9 852	4 346	0.019*
Error	102 000	45	2.267		

* - a significant finding ($p<0.05$)

Multivariate test statistics

Wilks' Lambda=	0.635		
F-ratio=	1 699	DF=12,80	p=0 082
Hotelling-Lawley trace=	0 552		
F-ratio=	1.794	DF=12,78	p=0 064

APPENDIX G-3

Manova of Pre-Instructional Results for the Students' Perceived Difficulty in Answering the Questions in Each Section of the SEV Questionnaire, Testing for the Factor of Skill Level (N=54)

Univariate F tests

Dependent variable	SS	DF	MS	F	P
Procedural practice knowledge	40.444	2	20.222	3.520	0.038*
Error	258.500	45	5.744		
Procedural game knowledge	38 111	2	19.056	4 259	0 020*
Error	201.333	45	4.474		
Metacognitive skill	60.111	2	30.056	6 972	0.002*
Error	194 000	45	4.311		
Declarative knowledge	43.815	2	21 907	3 392	0 042*
Error	290 667	45	6 459		
Affective practice knowledge	36 926	2	18 463	3 391	0.042*
Error	245 000	45	5.444		
Affective game knowledge	56.481	2	28.241	4 716	0 014*
Error	269.500	45	5.989		

* - a significant finding (p<0 05)

Multivariate test statistics

Wilks' Lambda=	0 649		
F-ratio=	1 611	DF=12,80	p=0 105
Hotelling-Lawley trace=	0.521		
F-ratio=	1 694	DF=12,78	p=0 084

APPENDIX G-4

Manova of Post-Instructional Results for the Students'

Perceived Difficulty in Answering the Questions in Each Section

of the SEV Questionnaire, Testing for the Factor of Skill Level (N=54)

Univariate F tests

Dependent variable	SS	DF	MS	F	P
Procedural practice knowledge	40 111	2	20 056	4 483	0.017*
Error	201 333	45	4.474		
Procedural game knowledge	25 593	2	12.796	6.470	0.003*
Error	89.000	45	1.978		
Metacognitive skill	21 000	2	10.500	4.169	0.022*
Error	113.333	45	2 519		
Declarative knowledge	16.037	2	8.019	2.883	0.066
Error	125.167	45	2.781		
Affective practice knowledge	14 037	2	7.019	3.096	0 055
Error	102.00	45	2.267		
Affective game knowledge	28.259	2	14.130	4.436	0.017*
Error	143 333	45	3.185		

* - a significant finding (p<0.05)

Multivariate test statistics

Wilks' Lambda=	0.698		
F-ratio=	1.315	DF=12,80	p=0.226
Hotelling-Lawley trace=	0.413		
F-ratio=	1.343	DF=12,78	p=0.212

APPENDIX G-5

Manova Testing for the Effect of Skill Level in the Various Sections of the SEV Questionnaire for the Pre-Instructional Results (N=54)

Univariate F tests

Dependent variable	SS	DF	MS	F	P
Procedural practice knowledge	17.242	2	8 621	3.343	0 044*
Error	116.042	45	2.579		
Procedural game knowledge	21.815	2	10.907	3.780	0.030*
Error	129 866	45	2.886		
Metacognitive skill	22.138	2	11.069	5.060	0.010*
Error	98 435	45	2.187		
Declarative knowledge	58.345	2	29 172	9 258	0.0001*
Error	141.804	45	3.151		
Affective practice knowledge	44.569	2	22 284	11 349	0 0001*
Error	88.356	45	1.963		
Affective game knowledge	70.171	2	35 086	12 481	0 0001*
Error	126.502	45	2 811		

* - a significant finding ($p<0.05$)

Multivariate test statistics

Wilks' Lambda=	0.489		
F-ratio=	2.869	DF=12,80	p=0.002*
Hotelling-Lawley trace= F-ratio=	0.927 3 014	DF=12,78	p=0.002*

APPENDIX G-6

Manova Testing for the Effect of Skill Level in the Various Sections of the SEV Questionnaire for the Post-Instructional Results (N=54)

Univariate F tests

Dependent variable	SS	DF	MS	F	P
Procedural practice knowledge	82.410	2	41.205	21.133	0.0001*
Error	87.741	45	1.950		
Procedural game knowledge	93 859	2	46 930	22.753	0.0001*
Error	92.815	45	2 063		
Metacognitive skill	60.228	2	30.114	17.190	0 0001*
Error	78.833	45	1 752		
Declarative knowledge	81.102	2	40.551	19.759	0.0001*
Error	92.351	45	2.052		
Affective practice knowledge	63 563	2	31.781	26.806	0 0001*
Error	53.352	45	1.186		
Affective game knowledge	49.311	2	24.656	14.340	0.0001*
Error	126.502	45	2.811		

* - a significant finding (p<0.05)

Multivariate test statistics

Wilks' Lambda=	0.221		
F-ratio=	7.52	DF=12,80	p=0.0001*
Hotelling-Lawley trace= F-ratio=	3.069 9 975	DF=12,78	p=0.0001*

APPENDIX H-1

Univariate ANOVAS Testing for the Effect of Skill Level, Class and the Interaction Between Skill Level and Class in the Various Sections of the SEV Questionnaire for the Pre Instructional Results (N=54)

Dependent variable	Source	SS	DF	MS	F	P
Procedural practice knowledge	Skill	17 242	2	8 621	3 343	0 044*
	Class	2 254	2	1 127	0 437	0 649
	Skill *Class	11 767	4	2 942	1 141	0 350
	Error	116 042	45	2 579		
Procedural game knowledge	Skill	21 815	2	10 907	3 780	0 030*
	Class	0 966	2	0 483	0 167	0 846
	Skill *Class	16 340	4	4 085	1 415	0 244
	Error	129 866	45	2 886		
Metacognitive skill	Skill	22 138	2	11 069	5 060	0 010*
	Class	6 492	2	3 246	1 484	0 238
	Skill *Class	8 145	4	2 036	0 931	0 455
	Error	98 435	45	2 187		
Declarative knowledge	Skill	58 345	2	29 172	9 258	0 0001*
	Class	6 439	2	3 220	1 022	0 368
	Skill *Class	16 627	4	4 157	1 319	0 277
	Error	141 804	45	3 151		
Affective practice knowledge	Skill	44 569	2	22 284	11 349	0 0001*
	Class	0 655	2	0 328	0 167	0 847
	Skill *Class	20 860	4	5 215	2 656	0 045*
	Error	88 356	45	1 963		
Affective game knowledge	Skill	70 171	2	35 086	12 481	0 0001*
	Class	5 711	2	2 856	1 016	0 370
	Skill *Class	4 676	4	1 169	0 416	0 796
	Error	126 502	45	2 811		
Overall volleyball knowledge base	Skill	40 297	2	20 149	13 873	0 0001*
	Class	1 571	2	0 786	0 541	0 586
	Skill *Class	1 402	4	0 351	0 241	0 913
	Error	65 358	45	1 452		
Overall volleyball knowledge base affective component removed	Skill	13 559	2	6 779	10 335	0 0001*
	Class	0 512	2	0 256	0 390	0 679
	Skill *Class	0 223	4	0 056	0 085	0 987
	Error	29 519	45	0 656		

* - a significant difference (p<0 05)

APPENDIX H-2

Univariate ANOVAS Testing for the Effect of Skill Level, Class and the Interaction Between Skill Level and Class in the Various Sections of the SEV Questionnaire for the Post Instructional Results (N=54)

Dependent variable	Source	SS	DF	MS	F	P
Procedural practice knowledge	Skill	82 410	2	41 205	21 133	0 0001*
	Class	4 966	2	2 483	1 273	0 290
	Skill *Class	14 698	4	3 674	1 884	0 130
	Error	87 741	45	1 950		
Procedural game knowledge	Skill	93 859	2	46 930	22 753	0 0001*
	Class	8 199	2	4 099	1 987	0 149
	Skill *Class	16 237	4	4 059	1 968	0 116
	Error	92 815	45	2 063		
Metacognitive skill	Skill	60 228	2	30 114	17 190	0 0001*
	Class	3 656	2	1 828	1 043	0 361
	Skill *Class	9 394	4	2 348	1 341	0 270
	Error	78 833	45	1 752		
Declarative knowledge	Skill	81 102	2	40 551	19 759	0 0001*
	Class	4 001	2	2 001	0 975	0 385
	Skill *Class	11 859	4	2 965	1 445	0 235
	Error	92 351	45	2 052		
Affective practice knowledge	Skill	63 563	2	31 781	26 806	0 0001*
	Class	2 322	2	1 161	0 970	0 383
	Skill *Class	4 064	4	1 016	0 857	0 497
	Error	53 352	45	1 186		
Affective game knowledge	Skill	49 311	2	24 656	14 340	0 0001*
	Class	11 585	2	5 792	3 369	0 043*
	Skill *Class	18 802	4	4 700	2 734	0 040*
	Error	77 372	45	1 719		
Overall volleyball knowledge base	Skill	68 803	2	34 401	41 593	0 0001*
	Class	4 578	2	2 289	2 767	0 074
	Skill *Class	5 736	4	1 434	1 734	0 159
	Error	37 220	45	0 827		
Overall volleyball knowledge base affective cmponent removed	Skill	32 929	2	16 464	34 935	0 0001*
	Class	1 495	2	0 747	1 586	0 216
	Skill *Class	2 260	4	0 565	1 199	0 324
	Error	21 208	45	0 471		

* - a significant difference (p<0 05)

APPENDIX H-3

Tukey Post Hoc Results for Contrasts Among Three Skill Levels for Each Section of the SEV Questionnaire Pre Instructional Results

CONTRASTS

Dependent variable	Bottom-Top	Bottom-Middle	Middle-Top
Procedural practice knowledge	*sign*	n s	n s
Procedural game knowledge	*sign*	n s	n s
Metacognitive skill	*sign*	n s	n s
Declarative knowledge	*sign*	n s	n s
Affective practice knowledge	*sign*	n s	*sign*
Affective game knowledge	*sign*	n s	*sign*
Overall volleyball knowledge base	*sign*	n s	*sign*
Overall volleyball knowledge base affective component removed	*sign*	n s	n s

sign means a significant difference was found between the means(p<0 05)
n s means no significant difference was found between the means(p>0 05)

APPENDIX H-4

Tukey Post Hoc Results for Contrasts Among Three Skill Levels for Each Section of the SEV Questionnaire Post Instructional Results

	CONTRASTS		
Dependent variable	Bottom-Top	Bottom-Middle	Middle-Top
Procedural practice knowledge	*sign*	*sign*	n s
Procedural game knowledge	*sign*	*sign*	*sign*
Metacognitive skill	*sign*	*sign*	*sign*
Declarative knowledge	*sign*	*sign*	n s
Affective practice knowledge	*sign*	*sign*	*sign*
Affective game knowledge	*sign*	*sign*	n s
Overall volleyball knowledge base	*sign*	*sign*	*sign*
Overall volleyball knowledge base affective component removed	*sign*	*sign*	*sign*

sign means a significant difference was found between the means($p<0.05$)
n s means no significant difference was found between the means($p>0.05$)

APPENDIX I-1

Repeated Measures ANOVA of Metacognitive Awareness of

Procedural Knowledge in a Practice Situation (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	87 496	2	43 748	12 129	0 0001*
Class	2 680	2	1 340	0 371	0 692
Skill *Class	22 773	4	5 693	1 578	0 196
Error	162 313	45	3 607		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Procedural practice knowledge	57 543	1	57 543	62 442	0 0001*
Procedural practice knowledge *Skill	12 156	2	6 078	6 596	0 003*
Procedural practice knowledge *Class	4 541	2	2 270	2 464	0 097
Procedural practice knowledge *Skill *Class	3 692	4	0 923	1 002	0 417
Error	41 470	45	0 922		

* - significant difference, p<0 05

APPENDIX I-2

Repeated Measures ANOVA of Metacognitive Awareness of

Procedural Knowledge in a Game Situation (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	102 454	2	51 227	13 289	0 0001*
Class	3 954	2	1 977	0 513	0 602
Skill *Class	28 053	4	7 013	1 819	0 142
Error	173 475	45	3 855		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Procedural game knowledge	54 661	1	54 661	49 988	0 0001*
Procedural game knowledge *Skill	13 220	2	6 610	6 045	0 005*
Procedural game knowledge *Class	5 210	2	2 605	2 383	0 104
Procedural game knowledge *Skill *Class	4 523	4	1 131	1 034	0 400
Error	49 206	45	1 093		

* - significant difference, p<0 05

APPENDIX I-3

Repeated Measures ANOVA of Metacognitive Awareness of

Declarative Knowledge (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	135 979	2	67 990	16 001	0 0001*
Class	9 401	2	4 700	1 106	0 340
Skill* Class	21 931	4	5 483	1 290	0 288
Error	191 205	45	4 249		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Declarative knowledge	133 131	1	133 131	139 482	0 0001*
Declarative knowledge *Skill	3 468	2	1 734	1 816	0 174
Declarative knowledge *Class	1 040	2	0 520	0 545	0 584
Declarative knowledge *Skill *Class	6 555	4	1 639	1 717	0 163
Error	42 951	45	0 954		

* - significant difference, p<0 05

APPENDIX I-4

Repeated Measures ANOVA of Metacognitive Awareness of Metacognitive Skill (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	77 259	2	38 629	12 579	0 0001*
Class	8 288	2	4 144	1 349	0 270
Skill* Class	13 749	4	3 437	1 119	0 359
Error	138 192	45	3 071		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Metacognitive skill	12 095	1	12 095	13 929	0 001*
Metacognitive skill *Skill	5 107	2	2 553	2 941	0 063
Metacognitive skill *Class	1 860	2	0 930	1 071	0 351
Metacognitive skill *Skill *Class	3 790	4	0 947	1 091	0 372
Error	39 077	45	0 868		

* - significant difference, p<0 05

APPENDIX I-5

Repeated Measures ANOVA of Metacognitive Awareness of

Affective Knowledge in a Practice Situation (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	107 186	2	53 593	23 106	0 0001*
Class	2 630	2	1 315	0 567	0 571
Skill* Class	13 291	4	3 323	1 433	0 239
Error	104 373	45	2 319		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Affective practice knowledge	9 780	1	9 780	11 788	0 001*
Affective practice knowledge *Skill	0 946	2	0 473	0 570	0 570
Affective practice knowledge *Class	0 347	2	0 174	0 209	0 812
Affective practice knowledge *Skill *Class	11 633	4	2 908	3 505	0 014*
Error	37 336	45	0 830		

* - significant difference, p<0 05

APPENDIX I-6

Repeated Measures ANOVA of Metacognitive Awareness of

Affective Knowledge in a Game Situation (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	112 777	2	56 389	15 159	0 0001*
Class	16 154	2	8 077	2 171	0 126
Skill*Class	17 257	4	4 314	1 160	0 341
Error	167 388	45	3 720		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Affective game knowledge	31 796	1	31 796	39 217	0 0001*
Affective game knowledge *Skill	6 706	2	3 353	4 135	0 022*
Affective game knowledge *Class	1 142	2	0 571	0 705	0 500
Affective game knowledge *Skill *Class	6 221	4	1 555	1 918	0 124
Error	36 485	45	0 811		

* - significant difference, p<0 05

APPENDIX I-7

Repeated Measures ANOVA of Metacognitive Awareness of

the Students' Overall Knowledge Base in Volleyball (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	105 178	2	52 589	27 155	0 0001*
Class	5 412	2	2 706	1 397	0 258
Skill*Class	3 414	4	0 853	0 441	0 779
Error	87 149	45	1 937		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Overall volleyball knowledge base	50 228	1	50 228	146 498	0 0001*
Overall volleyball knowledge base *Skill	3 922	2	1 961	5 720	0 006*
Overall volleyball knowledge base *Class	0 737	2	0 368	1 075	0 350
Overall volleyball knowledge base *Skill *Class	3 725	4	0 931	2 716	0 041*
Error	15 429	45	0 343		

* - significant difference, p<0 05

APPENDIX I-8

Repeated Measures ANOVA of Metacognitive Awareness of

the Students' Overall Volleyball Knowledge Base

with the Affective Knowledge Component Removed (N=54)

BETWEEN SUBJECTS

Source	SS	DF	MS	F	P
Skill	44 206	2	22 103	23 449	0 0001*
Class	1 160	2	0 580	0 615	0 545
Skill*Class	1 444	4	0 361	0 383	0 820
Error	42 417	45	0 943		

WITHIN SUBJECTS

Source	SS	DF	MS	F	P
Overall volleyball knowledge base (minus affective component)	27 480	1	27 480	148 798	0 0001*
Overall volleyball knowledge base (minus affective component) *Skill	2 282	2	1 141	6 178	0 004*
Overall volleyball knowledge base (minus affective component) *Class	0 847	2	0 423	2 293	0 113
Overall volleyball knowledge base (minus affective component) *Skill *Class	1 040	4	0 260	1 408	0 247
Error	8 311	45	0 185		

* - significant difference, p<0 05