Guidelines for Psychomotor Skill Instruction for Athletic Performance: A Design and Development Study

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ABSTRACT

The field of Instructional Design and Technology has produced several instructional frameworks grounded in educational psychology to provide guidance for effective learning. The realm of athletics is an area that can benefit from these instructional frameworks by providing systematic methods to facilitate an efficient learning process. This study employed Gagne's Nine Events of Instruction to develop instructional guidelines for psychomotor skill learning of athletic movements to enhance athletic performance. This design and development study conducted model research through model development and model validation. Components of the guidelines reflected the Nine Events and were supported by research in motor skill learning in sports. These guidelines were then validated by subject matter experts and revised based on their recommendations.

General Abstract

This study was conducted to establish instructional guideline that can be used to teach motor skills in sports. The guidelines were created and supported by current research in the literature and validated by experts in the field of teaching and athletic performance.

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Dedication

I dedicate this document to my family, friends, and colleagues in the fields of Education, Instructional Design and Technology, Strength and Conditioning, and Track and Field.

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CHAPTER ONE: INTRODUCTION

Background

Sport and physical activity are popular worldwide and are socially accepted as forms of entertainment and recreation by participants and spectators. (Bailey, 2005; Banias, 2011; Hughes & Coakley, 1984; Wann, Grieve, Zapalac, & Pease, 2008). In order to partake in these activities, one must learn the rules and be able to perform the necessary skills with adequate proficiency. According to the U.S. National Library of Medicine (2008), athletic performance, also known as sports performance, refers to the act of "carrying out of specific physical routines or procedures by one who is trained or skilled in physical activity. Performance is influenced by a combination of physiological, psychological, and socio-cultural factors" (para 1). The primary elements of athletic performance include demonstration of endurance, strength, and power (Guth & Roth, 2013). In order for these athletic skills to be conducted, individuals must acquire the necessary skills through proper psychomotor skill instruction of athletic movements. Psychomotor skills, also referred to as motor skills or perceptual-motor skills, are coordinated, movement-oriented reactions that are responses to situational stimuli (Singer, 1980). In addition to athletics, psychomotor skills comprise fine and gross motor skills including dancing, playing the piano, operating heavy machinery and writing with a pencil.

Within the last decade, research has explored various components of psychomotor skill learning (PSL) for physical activity and sport (Carter & Patterson, 2012; Kalkhoran, & Shariati, 2012; Lewthwaite & Wulf, 2010; Makaruk & Porter, 2014; Munzert, Maurer, & Reiser, 2014; Ruitenberg, De Kleine, Van der Lubbe, Verwey, & Abrahamse, 2012; Zipp & Gentile, 2010), as well as instructional framework implementation in other realms of education (Khalil & Elkhider, 2016; Lee & Kim, 2014; Maggio, Cate, Irby, & O'Brien, 2015; Mehddeb, 2015; Soto, 2013).

However, studies fail to focus on instructional frameworks that are applied to PSL to enhance athletic performance in sports. Successful instruction of athletic movement yields effectual learning, longer retention, and decreased risk of injury when participating in sports and other physical activities.

The field of instructional design and technology (IDT) has the ability to play a major role in PSL of athletic movement for athletic performance due to the emphasis on effective methodology and pedagogy as it relates to the learner and learning process (Reiser, 2001a). Researchers have emphasized the value of exploring learning expertise, performance, and instruction as it relates to physical activity and sport now and in the future (Housner & French, 1994). Utilizing IDT principles and frameworks for psychomotor skill instruction will not only promote improvements in athletic movement for athletic performance, but enhance the knowledge base of educators and instructors around the world. In order to be clear and consistent in this paper, PSL will be defined as the acquisition of motor skills from the learner, while psychomotor skill instruction refers to the series of events or protocol used to teach motor skills. In addition, instructional guidelines refers to any set of framework or steps that are adhered to during the instructional process. According to the U.S. National Library of Medicine (2008) athletic performance is defined as the act of "carrying out of specific physical routines or procedures by one who is trained or skilled in physical activity" while athletic movement describes the routines, procedures, and skills needed for the performance (para. 1).

Need for the Study

Teaching psychomotor skills for athletic performance should be informed by IDT principles. There are many instructional frameworks and models that are used in areas of school education, military training and corporate training (Reiser, 2001a; Reiser, 2001b). These models

have been proven to be productive and yield successful outcomes with systematic implementation of its instructional components but as of yet, no validation of guidelines has occurred for this purpose. These frameworks could also be used in PSL in order to enhance athletic performance. Gagne's Nine Events of Instruction (Gagne, 1985) is an example of an instructional framework that could be used to facilitate PSL of athletic movement. This framework contains essential events that promote an efficient learning process to acquire new skills. When skill acquisition occurs in an operative fashion, physical tasks can be performed and learning outcomes are achieved. Thus, Gagne's Nine Events of Instruction (Gagne, 1985) has promise for use in the athletic performance context, and further exploration on implementation would be highly beneficial.

Purpose of Study

The study seeks to operationalize Gagne's Nine Events of Instruction (Gagne, 1985) for PSL of athletic movement to enhance athletic performance. This instructional framework has been utilized in various settings by establishing and implementing specific events that are vital in the instruction process (Al-Shalabi, Andraws, Alrabea, & Kumar, 2012; Belfield, 2010; Buscombe, 2013; Condell & Elliott, 1989; Gokdemir, Akdemir, & Vural, 2013; Ilie, 2014; Khadjooi, Rostami, & Ishaq, 2011; Krull, Oras, & Pikksaar, 2010; Ng, 2014; Woo, 2016). It has yet to be explored in psychomotor skills generally and athletic movement specifically. This investigation proposed to inform the instructional design (ID) knowledge base through validation of this framework for use in psychomotor skill instruction in an athletic performance context for novice learners. This was accomplished by the selection of instructional guidelines specific to PSL that align with the events in this framework.

Benefits of the Study

This study contributed to the field of IDT by bridging theory to practice. The validation of an existing instructional framework grounded in educational psychology and ID practices determines its applicability in various contexts, specifically, PSL of athletic movement for athletic performance. This research also contributed to the data on implementation and validation of design and development research methods (Richey & Klein, 2014). This relatively new style of research is bounded by theoretical underpinnings and built upon replicable empirical findings. This promoted credibility and validity to the research design and research topic.

IDT professionals urge researchers to further the empirical findings of ID models and frameworks to validate usages in various educational contexts. "While instructional design models have been applied to many situations over the decades, a rigorous evaluation during the implementation of those instructional design models rarely included collecting empirical evidence about the model's effectiveness" (Branch & Kopcha, 2014, p.85). In order to validate these models, the research would require a detailed account of the components of the model, systematic data collection concerning their procedures, report of impact on performance, and detection of possible discrepant or negative data. Recognition of negative data would then allow researchers to set specific conditions under which a particular model can or cannot be implemented (Branch & Kopcha, 2014). With this in mind, this study utilized a well-known instructional framework to establish detailed instructional guidelines for PSL. This paper addresses the validation of the framework in the realm of psychomotor skill instruction for athletic performance.

Assumptions and Limitations

This study assumed that the subject matter experts (SMEs) were familiar with subject-specific knowledge and terminology as it relates to psychomotor skills, athletic movement, and athletic performance. This study was limited by the design and development and procedures set forth by this research method.

Organization of the Study

Chapter One consists of an overview of the problem, the need for the study, the purpose of the study, benefit of the study and the assumptions and limitations of the study. Chapter Two contains an extensive literature review, including the intricacies of psychomotor skill learning, motor skill theories, motor skill taxonomies, the relationship between PSL and athletic performance, the role of IDT in PSL, the use of instructional frameworks in PSL for athletic performance, and existing practices of Gagne's Nine Events of Instruction (Gagne, 1985).

Chapter Three describes the design and development methodology and model that was used to conduct the study. This chapter also includes a detailed description of the phases followed to conduct the study, as well as a description of the participants and settings, data analysis, and ethical considerations.

Chapter Four discusses the results gathered from the evaluation phase of the design and development study procedure. This section also states the credentials of the SMEs who participated in the study and the feedback provided based on their expertise in athletic performance or IDT. A summative overview was provided in order to assess the overall opinions of the experts for synthesis and potential revisions to the proposed guidelines.

Chapter Five restates the purpose of the study and provides a summary. The theoretical and practical implications were addressed, in addition to contributions of the study in IDT and

athletic performance. This chapter also discusses lessons learned and reflections regarding the study. Finally, the last section discusses future research ideas as it relates to psychomotor skill instruction of for athletic performance.

CHAPTER TWO: REVIEW OF THE LITERATURE

Introduction

This chapter discusses the research related to PSL, athletic performance, the field of IDT, and an instructional framework widely used in other realms of education, Gagne's Nine Events of Instruction (1985). This chapter consists of six sections. The first section discusses psychomotor skills learning in depth. The second section presents known motor skill learning theories that have been developed by theorist in the field motor learning. The third section continues with identifying components of athletic performance and how psychomotor motor skill learning facilitates these performance outcomes. The fourth section defines the field of IDT and its significance in psychomotor skill instruction. The final section of the literature review discusses Gagne's theory of instruction (1985) and the utilization of the Gagne's Nine Events of Instruction in realms of practice outside of PSL for athletic performance.

Psychomotor Skill Learning

Instruction occurs in various fields of education including school systems, military training, and corporate industries (Reiser, 2001a; Reiser, 2001b). The goal of instruction is to convey knowledge in order to achieve a particular outcome, specifically, learning outcomes (Gagne, 1985). In order to achieve the learning outcome, effective instruction must be implemented. Psychomotor skills are one of the five learning domains or learner capabilities that are performed and observed as said learning outcomes (Gagne, Briggs & Wagner, 1992). Gagne et al (1992) stated that, "the performances that may be observed as learning outcomes are considered to be made possible by internally stored states of human learner, called capabilities" (p. 43). The other learning capabilities or domains include intellectual skills, verbal information, cognitive strategies, and attitudes. Intellectual skills reveal a learner's ability to demonstrate

procedural knowledge and verbal information is exhibited by someone's ability to demonstrate declarative knowledge. Cognitive strategy capabilities regulate a person's own learning and self-management behavior, and the affective domain modifies the learner's choice of action (Gagne et al, 1992).

According to Gagne and Driscoll, psychomotor skill describes "precise, smooth and accurately timed execution of performances involving the use of muscles" (1988, p. 59). Another definition emphasizes coordinated movement that occurs as a response to a particular stimulus (Singer, 1980). These skills vary from playing the piano to performing a barbell back squat and can range drastically in complexity. Many psychomotor skills involve the combination of simple skills, also known as part skills or subskills, into a complex skill, or total skill. Some part skills may already exist in the learner's prior knowledge; therefore, learning to incorporate those skill into a new skill is referred to as executive subroutine (Fitts & Posner, 1967).

In order for the learner to execute the steps successively, procedural knowledge must be used to ensure the events of the performance are occurring correctly (Gagne et al, 1992). In addition, skill acquisition is achieved through repeated practice and internal and external feedback, also known as internal and external conditions of learning, respectively (Wulf, McConnel, Gartner, & Schwarz, 2002). Internal or intrinsic feedback describes the stimulus from muscles and joints that acts as reference in which the learner can assess success or error during practice trials. External or augmented feedback provides knowledge of results (KR) or knowledge of performance (KP) as an extrinsic indication quality of performance (Gagne et al. 1992).

Many motor learning theorists believe the stages of skill acquisition occur in a specific fashion. According to Fitts and Posner (1967), stage one is the early cognitive phase in which

learners attempt to understand the executive subroutine, stage two is the intermediate phase where learners practice of subskills in addition to the total skill, and stage three is the autonomous phase where the skill is essentially instinctive. A few years later, Gentile (1972) suggests a two stage process that synthesizes some of Fitts and Posner's (1967) stages to explain motor skill acquisition. The first stage consists of the learner getting the idea of the movement, by learning the general motor pattern that is needed to accomplish the task using cognitive and exploratory means. The second stage is called fixation/diversification, where "the learner progresses into a stage in which he attempts to increase the consistency of goal-attainment" (Gentile, 1972, p. 11). However, Gallahue and Ozmun (1995) place emphasis on lifetime motor development through phases of transition, application, and utilization. Transition describes gaining an overall idea of how to perform the skill, application describes the development of higher skill level through practice, and utilization describes the refinement of the skill over long term usage.

While these three theories strive to explain the stages of motor skill acquisition, other theories seek to provide a comprehensive justification for both motor control and motor learning. The motor control theories discussed in the next section include the reflex theory (Sherrington, 1947), the hierarchical theory (Gesell, 1954; Foerster, 1938; Magnus, 1925; McGraw, 1945; Weisz, 1938), motor programming theories (Bernstein, 1967; Wilson, 1961), the systems theory (Bernstein, 1967), and the ecological theory (Gibson, 1966; Lee & Young, 1986). The motor learning theories discussed in the next section include Adam's closed-loop theory (1971), Schmidt's schema theory (1975) and Newell's ecological theory (1991).

Motor Control and Motor Learning

Motor Control

Motor control is a field of study that speaks to mechanisms that control movement in humans and describes how the "central nervous system is organized so that the many individual muscles and joints become coordinated" (Schmidt & Lee, 2005, p. 4). Interactions between individuals systems and task classifications effect one's ability to control movement. These individual systems include the motor/action system (Bernstein, 1967), the sensory/perceptual system (Rosenbaum, 1991), and the cognitive system. Motor/action systems describes the neuromuscular and biomechanical systems that control functional movement. Functional movement involves the selection and regulation of all the muscles and joints responsible during movement (Bernstein, 1967). Sensory/perceptual systems provide information on the body in space and features within the environment that are vital to the management of movement (Rosenbaum, 1991). Cognitive systems include areas surrounding attention, planning, motivation, and emotions that are associated with one's intent or success in functional movement (Shumway-Cook & Woollacott, 2017). Although each set of systems can be studied discretely, gathering a comprehensive viewpoint allows researchers to see the full scope of the systems' effects on movement control.

There are two task classification schemes that categorize movement behaviors. One is the discrete/continuous/serial dimension (Schmidt & Lee, 2005). Discrete movements have a recognizable beginning and end, where the end is defined by the skill being performed (Schmidt & Lee). These include throwing ball or a bicep curl. Continuous movements have no recognizable beginning and end, where the action is continued until the movement is arbitrary stopped (Schmidt & Lee). These include running or swimming. Serial movements are neither

discrete nor continuous; however, they are "made up of a series of individual movements tied together in time to make some 'whole'" (Schmidt & Lee, 2005, p. 21). These tasks may appear to have a beginning and end, and can be seen as several discrete tasks placed in a specific order. The other classification of tasks is open/closed dimension (Schmidt & Lee, 2005). This classification considers the environment in which the task is being performed. "Open skills are those for which the environment is constantly (perhaps unpredictably) changing, so that the performer cannot effectively plan the entire movement in advance" (Schmidt & Lee, 2005, p. 22). Examples would be a fast break play in basketball or a punt return play in football where adaption to the environment is essential for success. Closed skills are those that occur in a predictable and stable environment where prior planning and preparation are vital for success in the task (Schmidt & Lee, 2005). This includes bowling, or throwing an indoor shot put into the sector. There are semi-predictable environments that fall between open and closed in the spectrum and have varying characteristic of each extreme (Schmidt & Lee, 2005). Understanding the various systems and skill classifications involved in movement allows researchers to develop theories for how motor control is established within humans.

Over the years, several theories have developed to provide an explanation for how motor control is attained. These theories include the reflex theory (Sherrington, 1947), the hierarchical theory (Gesell, 1954; Foerster, 1938; Magnus, 1925; McGraw, 1945; Weisz, 1938), the motor programming theories (Bernstein, 1967; Wilson, 1961), systems theory (Bernstein, 1967), and the ecological theory (Gibson, 1966; Lee & Young, 1986). The reflex theory suggests that reflexes are the building blocks of complex behavior that achieve a specific outcome. Sherrington (1947) believed these reflexes would be a combination of several individual reflexes that chained together to form a response to a particular stimulus. The hierarchical theory states

that the central nervous system is organized in hierarchical levels in a way that the higher association areas are followed by the motor cortex, followed by the spinal levels for motor function in a top down format (Gesell, 1954; Foerster, 1938; Magnus, 1925; McGraw, 1945; Weisz, 1938). Later, researchers recognize that each level in hierarchy can act on other level, above or below, depending on the task. This theory now negates the premise that reflexes are the single factor responsible for motor control, but one of many mechanisms critical in movement (Shumway-Cook & Wallacott, 2017). Motor programming theories begin to focus more on the physiology of action rather than the physiology of reactions. This theory suggest that movement can occur with or without a sensory stimulus and still produce a patterned motor response (Bernstein, 1967; Wilson, 1961). Scientists believe that if the motor response is removed from the stimulus, the central motor pattern, or motor program, still remains. This theory strives to explain how a motor pattern can be exhibited in the presence of sensory stimuli or by central processes and repudiates the notion that reflexes are the sole determinate in movement (Bernstein, 1967; Wilson, 1961). Systems theory begins to look at both the neutral and mechanical mechanisms responsible for movement. Mechanical systems include the internal and external forces that act on the body, like inertia and gravity respectively (Bernstein, 1967). This theory speaks to the idea that in order to understand the neural control of movement, one must fully understand the characteristics of the system in motion and the forces acting on the body. Bernstein (1967) proposes that the same central command from the nervous system could yield very different movements due to the variances in the external forces and initial conditions; inversely, the same movement can be exhibited when different commands from the nervous system. The systems theory allows researchers to predict movement more accurately due to the combination of neural and mechanical elements that may influence motion (Bernstein, 1967).

Lastly, the ecological theory explores the way humans use the environment to guide movement (Gibson, 1966). From this perspective, it is important to understand how the individual detects the relevant information in environment, how the individual establishes meaning from the information, and how this information is used to modify and control movement (Lee &Young, 1986). The information from the environment allows for more effective interaction when developing goal-oriented behaviors.

While some researchers seeks to understand how motor control is attained, others strive to understand how motor learning occurs in various contexts and levels of complexity.

Motor Learning

According to the Oxford Dictionary of Sports Science and Medicine (2016), motor learning is defined as "the acquisition of skills or skilled movements as a result of practice. Motor learning involves a set of internal processes associated with practice of experience leading to relatively permanent changes in motor skill" (para. 1). These permanent changes represent the skills that have been stored in a learner's long term memory and are retrievable in order to perform the motor skill. The three main motor learning theories that seek to explain how motor learning occurs include Adam's closed-loop theory (1971), Schmidt's schema theory (1975) and Newell's ecological theory (1991). Adam's closed-loop theory (1971) proposed that normal movement is regulated by continuous comparison between current sensory information arriving during the movement and a stored set of sensory information from prior experiences of successful movements. The stored sensory information, also known as perceptual trace, develops in the early stages of learning (verbal-cognitive) through the use of extrinsic KR and later becomes KR independent during the advanced stages of motor learning. As further research was conducted in motor learning, Schmidt's schema theory (1975) emerged with the intent to

incorporate open-loop and generalized motor program mechanisms to explain the learning process. This learning theory states that task-specific experiences result in the abstraction of rules that are formed by data on the movement parameters and accuracy, environmental conditions, sensory consequences and the relationships between them. These rules then provide guidelines for particular movements and are stored in the motor control program for future use in similar tasks. As the learner practices the skill, information is gathered and used to update the rules developed by the schemas created upon initial exposure to the motor task (Schmidt, 1975; Schmidt & Lee, 2005). The most recent motor learning theory, ecological theory (Newell, 1991), incorporates concepts of the systems and ecological motor control theories. Instead of placing emphasis on practice and cumulative behavior changes to enhance motor control programs, Newell's ecological theory (1991) suggests that motor learning is a process that increases the coordination between perception and action in a way that is consistent with the task and the environmental constraints. Essentially, during practice, learners seek to find optimal strategies to solve a task by selecting appropriate motor responses in addition to perceptual cues for task solutions. Some perceptual cues include demonstrations, KP and KR (Newell, 1991). This theory of motor learning highlights optimal task-relevant mapping of perception and action as opposed to a rule-based depiction of action.

The theories on motor control and motor learning provide educators with a theoretical framework when developing psychomotor skill instruction for students. These instructional methods are used to facilitate learning of specific observable outcomes. The area of interest discussed in this paper is the psychomotor skill learning in the realm of athletic performance and sport.

Athletic Performance and PSL

Athletic Performance

Virtually all sports require participants to perform tasks in order to achieve a goal. These goals include a touchdown in football, a far discus throw in track and field, or a three-point shot in basketball. In order to reach these goals, participants must exhibit elements of athleticism through the sports-specific skill. Examples of these elements include endurance, strength, and power (Guth & Roth, 2013). The ability to use these attributes in an organized fashion allows individuals to participate in sports and other physical activities. One's ability to execute precise physical routines or procedures after being taught or skilled in physical activity is referred to as athletic performance (U.S. National Library of Medicine, 2008). In this study, the physical routines or procedures that are being taught are referred to as the athletic movements. Various factors can influence the quality of athletic performance, including sleep habits (Bird, 2013; Marshall & Turner, 2016; Reilly, 2009), dietary supplements (Belliner, 2014; Cannell, Hollis, Sorenson, Taft, & Anderson, 2009; Lukaski, 2004), genetic make-up (Hong & Jin, 2013; MacArthur & North, 2005; Ostrander, Huson, & Ostrander, 2009), movement deficiencies (Lloyd, Oliver, Radnor, Rhodes, Faigenbaum, & Myer, 2014; Parchmann & McBride, 2011), training conditions (Daniels, 1979; Nimmo, 2005; Pryor, Casa, Adams, Belval, DeMartini, Huggins, Steams, & Vandermark, 2013), and training regiments (Cormie, McGuigan, Newton, 2010; Hedrick, 2002; Santana, 2001). However, without being taught or trained to perform a particular athletic movement, the chance of successful athletic performance declines considerably. This point supports the crucial importance of effective PSL of athletic movement for enhanced athletic performance.

Psychomotor Skill Instruction

Research has highlighted several key components of psychomotor skill instruction in athletic performance that should be considered during the learning process. Understanding and addressing these key components allows for a proficient educational encounter for the instructor and the learner. These eight components include (1) learner entry status (Carter & Patterson, 2012; Garcia & Garcia, 2006; Koedijker, Poolton, Maxwell, Oudejans, Beek, & Masters, 2010; Zipp, & Gentile, 2010), (2) demonstration (Landers, 1975), (3) practice/rehearsal (Kalkhoran & Shariati, 2012; Zipp, & Gentile, 2010), (4) feedback (Gagne et al. 1992; Sullivan, Kantak, & Burtner, 2008; Weinstein & Schmidt, 1990), (5) learning context (Immink, Wright, & Barnes, 2012; Ruitenberg, De Kleine, Van der Lubbe, Verwey, & Abrahamse, 2012; Wright & Shea, 1991), (6) performance (Kantak & Winstein, 2012; Polsgrove, Parry, & Brown, 2016) , (7) assessment methods (Kelly, Taliaferro, & Krause, 2012; Kennedy, Brown & Stagnitti, 2013; O'Connor, McCaffrey, Whyte & Moran, 2016; Rabin, Levi, Abramowitz & Kozol, 2016), and (8) transfer of skills (Boutin, Badets, Salesse, Fries, Panzer & Blandin, 2012; Ferrari, 1999; Rosalie & Muller, 2012; Stevens, Anderson, O'Dwyer & Williams, 2012; Weigelt, Williams, Wingrove & Scott, 2000). When teaching a psychomotor skill, instructors first consider the entry status of the learner and alter the instruction accordingly. Factors include age, grade, education level, and skill expertise level for the assigned task. These qualities reflect the learner's readiness and capability to acquire the new skill (Carter & Patterson, 2012; Garcia & Garcia, 2006; Koedijker, Poolton, Maxwell, Oudejans, Beek, & Masters, 2010; Zipp, & Gentile, 2010). Demonstration features to consider include the quality, method and frequency of the demonstration. Examples of quality of demonstration refers to expert versus novice, and methods of demonstration refers to in-person versus technological demos or static versus

animated presentation (Landers, 1975). Two prominent components of psychomotor skill instruction are the methods and frequency of practice and feedback during the learning process. Practice methods include blocked practice, serial practice, random practice, and mental practice (Kalkhoran & Shariati, 2012; Zipp, & Gentile, 2010). Feedback is categorized by intrinsic and extrinsic/augmented feedback, where intrinsic feedback relies on information from the learner's body movements, and extrinsic feedback provides information on KR or KP (Gagne et al. 1992; Sullivan, Kantak, & Burtner, 2008; Weinstein & Schmidt, 1990). The learning context or learning environment should be conducive for learning by fostering a context-dependent space and appropriate environmental and social conditions. These elements strive to mitigate distractions that may have adverse effects on the learning process (Immink, Wright, & Barnes, 2012; Ruitenberg, De Kleine, Van der Lubbe, Verwey, & Abrahamse, 2012; Wright & Shea, 1991). Performance describes the action displayed by the learner after the instruction has occurred. Performance-focused studies seek to explore if a particular instructional method was effective (Canal-Bruland, Kishna & Schenau, 2014; Jennings, Reaburn & Rynne, 2013; Oudejans, Binsch & Bakker, 2013; Pena, Murray & Janelle, 2008). Others focus on the quality of performance and if the display is a true indication that learning has occurred (Kantak & Winstein, 2012). Similar to performance, assessments are used to determine the learners' ability, as well as the attributes of the instruction. Other assessment-based research investigates the quality and validity of the assessment method being used in the study (Kelly et al, 2016; Kennedy et al., 2013; O'Connor et al., 2016). Lastly, transfer of skills refers to the ability to use prior knowledge and change them to meet the needs of a new situation (Collard et. al, 2007). Studies explore the various mechanisms responsible for the one's ability to transfer skills

including body adaptations, skill associations, and motivational elements (Rosalie & Muller, 2012; Stevens et al., 2012).

Learner Entry Status. When assessing learner entry status, instructors must consider the age, grade level, and expertise level of the participant. Studies have shown that these characteristics effect the feedback and practice methods, retention rates, and performance outcomes of the learning process. According to Carter & Patterson (2012), "learning benefits of a self-controlled KR are modulated by the age of the learner" (p. 1471). This study showed that feedback approaches were assessed and the findings suggested that self-controlled KR did not benefit adults as they did for younger adults and children. Zipp & Gentile (2010) found that blocked practice enhanced the learning process for children and adults as opposed to random practice; however, the retention rate was greater in children taught with blocked practice methods. Another stance discussed by Garcia & Garcia (2006) and Koedijker et al (2010) suggested that expertise level should guide the instructional lesson as rather than grade level. Koedijker et al goes on to state that "novice in the early (declarative) stages of skill acquisition need to consciously monitor and control their movements, whereas experts have progressed, by extensive practice, to a procedural stage in which conscious attention to movement preparation and control is no longer necessary" (pp. 245-246). In addition, novice execution of motor skills is lessened when attention is taken away from the task; however, the opposite occurs in expert performers.

Demonstration. Prior to learning a new skill, learners must gain information about the skill and observe what is being asked of them. Demonstration or task presentations allow the learner to know all the information needed for the task including description of the task as well as the skill outcome (Gurvitch & Metzler, 2013). Research showed that instructors examined the

quality, method and frequency of demonstrations in order to explore beneficial outcomes. One element explored was the effects of expert versus novice demonstration on the learner's ability to acquire a particular skill. According to Darden (1997), novice demonstrations were able to reveal the actual learning process that was occurring. This method allowed the learner to observe various aspects of the learning process including instruction, practice, feedback, and corrections that were made by the student in the demonstration. The downside of this approach was that the learner was unable to see the skill in its entirety. This could prohibit the learner from grasping the full concept of the new skill to be learned. The most common demonstration used in motor skill instruction was expert demonstration. This method shows the learner a complete representation of the skill in the correct way and can assist in self-correction of one's own errors. On the other hand, this method can be disadvantageous for learning if the learner places more focus on imitation rather than application of rules and protocol that guided the performance to the desired outcome (Darden, 1997). Demonstration can also be presented in-person or through technological means. Videotapes, movement analysis software, animation, and static images are all forms of technological demonstration mediums (Darden, 1997; Wong, Marcus, Ayres, Smith, Cooper, Pass, & Sweller, 2009). The frequency of demonstration refers to the how often the presentation of the skill is displayed to the learner. In Landers's (1975) experiment, demonstrations would occur at various points during the instruction for three different groups and mean scores were examined. "Results indicated partial support for the hypothesis that observers viewing temporally spaced model demonstrations prior to and midway in the learning trial should perform better than all other groups witnessing other temporal distributions of model portrayal" (Landers, 1975, p. 285). Learners were informed of the motor

skill task prior to instruction and later reminded as the learning process continued. As a result, greater mean scores on performance were attained.

Practice and Rehearsal. One of the most important components of PSL is practice and rehearsal (Sanchez, 1994). Practice can be modified by method and frequency in order to meet the needs of the learner. Examples of methods include blocked, serial, random, and mental practice. The Oxford Dictionary of Sports Science & Medicine (2016) states that block practice is "practice within a single period in which each component of a multi-task skill is practiced completely before moving on to the next component" (para. 1). Serial practice describes skills being rehearsed in a repeated sequence or series, and random practice is "practice in which all components of a multi-task skill are practiced in random order within each practice period" (para. 1). Mental practice is a more intrinsic form of rehearsal and is defined below:

> A form of practice in which subjects produce a vivid mental image of actually performing a technique; that is, they do not imagine that they are watching themselves perform, but they actually carry out the activity in their imagination without overt physical movement. Some research evidence suggests that, for a skilled person, mental practice can be as effective as actual practice. (Kent, 2016)

Many studies have examined these methods of practice used wholly and partially to assess efficacy during the learning process. According to Shea & Morgan (1979) and Kalkoran & Shariati (2012), blocked practice was the most effective during the acquisition phase of instruction, while serial and random practice proved more beneficial during the retention and transfer phases of instruction. Other studies validate that positive outcomes occur when combining mental practice and physical practice in sports like table tennis and golf (Sanchez, 1994; Ploszay, Gentner, Skinner, & Wrisberg, 2006).

Feedback. Another critical aspect of PSL in sports is feedback methods and frequency. This component allows the learner to gain knowledge on performance during practice trials in order to create a foundation for error correction. Feedback can be intrinsic or extrinsic in nature, meaning that information can come from an internal or external source, respectively. Intrinsic feedback results in internal focus of attention on muscle sensation and body movements, while extrinsic feedback causes external focus of attention on KR or KP during practice sessions (Wulf, McConnel, Gartner, & Schwarz, 2002). KR focuses on the outcome of movement in terms of the environmental goal, while KP focuses on kinematic aspects of the particular movement pattern (Schmidt, 1982). Frequency of feedback is another variable that can affect the learning process of a new motor skill. For example, two primary descriptors related to the frequency of KR are the absolute and relative frequency. Absolute frequency describes the total number of KR exhibitions during a practice session, and relative frequency is a ratio that expresses the number of KR presentations to the number of practice trials (Winstein & Schmidt, 1990). Several studies investigate feedback schedule and its benefits for motor skill acquisition. For example, studies have shown that participants have better performances when feedback is lessened as opposed to others who receive 100% feedback during practice sessions (Badets & Bladin, 2010; Sullivan et al, 2008, Weeks & Kordus, 1998). Also, "to optimize motor learning, children may require longer periods of practice, with feedback reduced gradually, compared with young adults" (Sullivan et al, 2008, p. 720). In addition, Winstein & Schmidt (1990) mentioned that intermittent KR encourages the learner to develop response accuracy and consistency of the new skill. Other studies support the necessity of high frequency of feedback is beneficial for motor skill learning especially for novice learners and when the feedback is not visually linked to the performance during practice trials (Buchanan & Wang, 2012; Wulf, 1998). In order to

maximize the potential of the learning process, feedback methods and schedules can be modified to cater to the learners needs.

Learning Context. Another component of PSL is ensuring a learning context that is conducive for learning. Tessmer and Richey (1997) define context as "a multilevel body of factors in which learning and performance are embedded" (p. 87). The instructor must consider the context dependencies of the task and the environmental factors present during instruction. Contextual dependencies describe the elements present during the original learning context that are used as retrieval cues for accessing necessary task-specific information (Wright & Shea, 1991). According to Magill (1998), the setting of the learning, practice, and performance context should all be the consistent to increase the learner's likelihood of performing at a higher level due to the retrieval efficiency from the surroundings. Studies have shown that changing, altering, and/or removing contextual cues have negative effects on motor skill performance (Wright & Shea, 1991; Ruitenberg et al, 2011). Environmental conditions also play a crucial role in creating a conductive learning context. Examples include the temperature and social-interactions that may arise during the learning process. Instructors must make attempts to mitigate extreme heat or cold that make have adverse effects to the physiological functions of the learner. Conversely, studies have suggested that in order to avoid negative effects of hypo- and hyperthermic conditions on motor skill performance, students should be exposed to the appropriate temperature conditions to develop temperature appropriate behavior (Enander 1989; Oksa, Rintamaki, & Makinen, 2006). In addition, changes in temperature between training and test conditions could result in poor performances, and the selection of thermal conditions for practice should account for the internal and external sources of sensory information needed to perform the motor skill (Immink et al, 2012).

Learning context also includes the social environment in which the learning takes place (Lungu & Debas, 2013). Social interactions refer to the relations that occur between the instructor, and one or more learners during the learning process. Research shows conflicting data related to the benefits and pitfalls that learning can occur when multiple learners are in a group setting. For example, Lungu & Debas's (2013) "found that social interactions improved motor performance only when participants had prior individual experience with the task" (p. 1984). On the other hand, Heidrich and Chiviacowsky's (2015) study on the effects of stereotypical conditions revealed that women who were stereotyped against during skill training reported lower self-efficacy after practice and lower retention of soccer skills. This social phenomenon, as well as many others, has the potential to produce positive or negative effects on the learning process.

Performance. When conducting studies in motor skill learning, nearly all the research elicited some form of performance in order to determine if the skill had been acquired. These performances attempt to explain the instructional practices that were employed (Polsgrove et al, 2016). Examples of this include studies that examine the effects of peer-tutoring courses (Pulling & Allen, 2014), negative self-instruction (Oudejans, Binsch & Bakker, 2013; Pena, Murray & Janelle, 2008), target versus movement-directed instruction (Canal-Bruland, Kishna & Schenau, 2014), and self-modeling video interventions (Jennings, Reaburn & Rynne, 2013) to name a few. However, other research focuses on the quality of performance and if the display of the skill accurately determines if learning had occurred. For example, Kantak & Winstein (2012) wanted to determine the "distinction between immediate performance that accompanies practice and long-term performance that reflects the relative permanence in the capability for the practiced skill [i.e. learning]" (p. 219). The presence of performance provides an observable

behavior that researchers can assess and evaluate to provide findings on the study and further the discussion on instructional implications.

Assessment. The most commonly used assessment tools in motor skill instruction is criterion-referenced assessments which are assessments that are "linked to the instructional goals and an explicit set of performance objective derived from the goals" (Dick, Carey & Carey, 2015, p.137). This method is used to assess the learner's ability as well as the attributes of instruction that are being examined. However, other studies seek to investigate the quality of the assessment tool and determine its validity (Kelly, Taliaferro & Krause, 2012; Kennedy, Brown & Stagnitti, 2013; O'Connor, McCaffrey, Whyte & Moran, 2016; Rabin, Levi, Abramowitz & Kozol, 2016). Examples of this includes exploring computer-based motor skill assessment (Kelly et al., 2016), top-down versus bottom up instruments (Kennedy et al., 2013), the truck stability test (O'Connor, et al., 2016), and a real-time faculty movement pattern assessments (Rabin et al., 2016). Researchers consider these findings on assessment outcomes and assessment validity to determine the best way to evaluate motor learning and skill acquisition. The ultimate goal is that these skills are mastered and can be applied to other areas for further learning and psychomotor enhancement.

Transfer of Skills. Another component of PSL noted in the literature was the concept of motor skill transfer or transfer of learning. Thorndike and Woodworth (1901) refer to the transfer of learning phenomenon as the dependency of current or future behavior on prior experience. In the realm of perceptual-motor skills, transfer describes the ability to use experience from past motor skill learning and performance in a certain context and then change these experiences to suit similar or dissimilar settings (Collard, Oboeuf & Ahmaidi, 2007). Some studies examine the mechanisms that cause the transfer of motor skill learning in sports

and everyday tasks such as body adaptation and skill association (Rosalie & Muller, 2012; Weigelt et al., 2000). Other studies seek to establish if motivational constructs, like self-efficacy, are related to skill transfer after practicing said skill under varying levels of difficulty (Stevens et al., 2012). Ferrari (1999) was interested in the learner's level of expertise and how this component effected one's ability to transfer skills in a psychomotor task. Research in skill transfer can assist in the development of strategies for learning. When applied, these tactics can allow students to transfer basic skills to more advanced skills they may encounter future learning experiences.

As an instructor, it is important to consider these key elements of PSL when developing instruction for athletic performance. Prior research and established guidance in the field of IDT may help address the needs of PSL with systematic processes to enhance learning (Reiser, 2001a).

IDT and Psychomotor Skill Instruction

The field of IDT has its beginnings in the early 1900s and has developed into a comprehensive area of research and practice. This area has made great strides in meeting educational needs of instructors in the realm of public and private school system, military personnel training, and corporate training over several decades in the United States (Reiser, 2001a; Reiser, 2001b).

Definition of IDT

The current definition of instructional design and technology is as follows:

> The field of instructional design and technology encompasses the analysis of learning and performance problems, and the design, development, implementation, evaluation and management of instructional and noninstructional processes and resources intended to

> improve learning and performance in a variety of settings, particularly educational institutions and the workplace. Professionals in the field of instructional design and technology often use systematic instructional design procedures and employ a variety of instructional media to accomplish their goals. Moreover, in recent years, they have paid increasing attention to noninstructional solutions to some performance problems. Research and theory related to each of the aforementioned areas is also an important part of the field. (Reiser, 2001a, p. 53)

IDT utilizes ID to aid in the learning process. According to Branch and Kopcha (2014), "instructional design is intended to be an iterative process of planning outcomes, selecting effective strategies for teaching and learning, choosing relevant technologies, identifying educational media, and measuring performance" (p. 77). The multifaceted nature of the field of IDT provides professionals with the necessary tools to deliver efficient instruction to all areas of education including PSL.

IDT and Psychomotor Skill Instruction

The specific components of PSL are essential to the effectiveness of the learning process. Learner entry status (Carter & Patterson, 2012), demonstration (Landers, 1975), practice and rehearsal (Kalkhoran & Shariati, 2012), feedback (Gagne et al. 1992), learning context (Immink et al., 2012), performance (Kantak & Winstein, 2012) and assessment (Kelly et al., 2012), and transfer of skills (Boutin et al., 2012) are areas that should be addressed to fit the needs of the learner. IDT professions are trained to provide empirically sound pedagogy to satisfy these components for various types of motor skill learning. In order to facilitate an effective ID process, IDT professionals have developed instructional frameworks in order to meet the needs

of various educational contexts. IDT has the ability to utilize these instructional frameworks, strategies, and resources to achieve optimal outcomes in skill acquisition. Studies have shown ID being widely used in various areas of education, corporate and military training (Campbell, Schwier, & Kenny, 2009; Konings, Brand-Gruwel, & Merrienboer, 2010; Levinson, 2010; Park, 2015; Robinson & Dearmon, 2013; Schultz & Higbee, 2011; Uriarte, Cummings, & Lloyd, 2014; Vogel-Walcutt, Fiorella, & Malone, 2013; White & Branch, 2001). However, there are limited studies specifically related to ID and physical activity, sport, or athletics (Fadde, 2009; Statt, Plummer, & Marinelli, 2001).

Research has shown the immediate and long-term effects of ID influences on learning. IDT researchers have a wide variety of instructional theories and frameworks to implement and assess for learning. The instructional theory to be addressed and validated in this paper is referred to as Gagne's Theory of Instruction generally, and the Nine Events of Instruction (Gagne, 1985) specifically.

Gagne's Theory of Instruction

Theoretical Background

Gagne's (1985) theory of instruction has strong underpinnings in educational psychology, specifically, the learning theory of cognitivism and the information-processing model (Atkinson & Shiffrin, 1968; Gagne, 1985). This theory explores the mental processes that are believed to occur to encourage learning. The presence of these processes serve as a justification for how learners receive, process, store, and output information (Atkinson & Shiffrin, 1968). Several information-processing theories have conducted research in an attempt to explain the model of learning and memory that "postulates a number of internal structures in the human brain and

some corresponding processes that they carry" (Gagne, 1985, pp. 70-71). These internal structures are also referred to as internal processes and will be discussed in the following section.

In order to explain the series of events that take place in the human mind, researchers developed the cognitive information-processing (CIP) model in the early 1950's (Atkinson & Shiffrin, 1968). This model consists of three main components including sensory memory, working memory, and long-term memory. "Sensory and working memory enable people to manage limited amounts of incoming information during initial processing, whereas long-term memory serves as a permanent repository for knowledge" (Anderman & Anderman, 2009, p. 493). Figure 1 presents Gagne & Driscoll's (1988) basic model of learning and memory underlying modern information-processing theories. See Appendix A for publisher permission to use Figure 1 and Figure 2 in this document.

Figure 1.

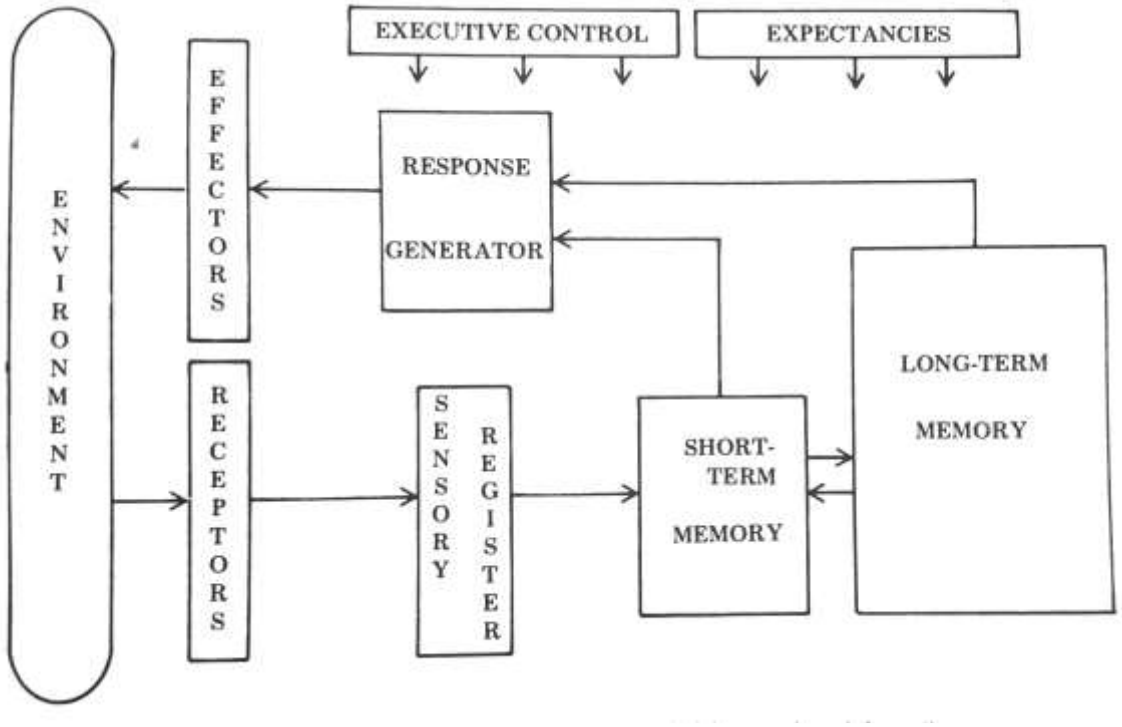

Figure 1. The basic model of learning and memory underlying modern information-processing theories. GAGNE, ROBERT M.; DRISCOLL, MARCY P., ESSENTIALS OF LEARNING FOR INSTRUCTION, 2nd, © 1988. Reprinted by permission of Pearson Education, Inc., New York, New York.

The function of the sensory memory is to sort through incoming stimuli and absorb the relevant information. The sensory memory processes incoming information via the human senses like sight, sound and feel (Atkinson & Shiffrin, 1968). Only five to seven elements, including letters or numbers, can be retained with this brief period that lasts for a maximum of three seconds (Anderman & Anderman, 2009). After stimuli has entered the sensory memory, it is either forgotten or sent into the working memory (Atkinson & Shiffrin, 1968). "Working memory is a term that is used to refer to a multi-component temporary memory system in which information is assigned meaning" (Anderman & Anderman, 2009, p. 493). During this time, the brain is responsible for managing the information and linking small components into larger units.

With this new information, learners are able to perform visual-spatial mental operations and establish sound relationships and associations between new and formerly learned material. During this phase, a person can remember up to nine units of information for up to fifteen seconds. Once the information is structured, it can move into long-term memory (Atkinson & Shiffrin, 1968). This portion provides a permanent storage location for all knowledge acquired. The working and long term memory are connected by encoding and retrieval processes that support organization and data search, respectively. Information must be associated and stored with efficient organizational systems to promote ease of retrieval (Anderman & Anderman, 2009). The CIP model helps researchers understand the processes and limitations to the human memory. This theory also serves as the theoretical underpinnings Gagne's theory of instruction (Gagne, 1985) that is made up of three components: a taxonomy of learning outcomes, the learning conditions required to attain each outcome, and the Nine Events of Instruction (Gagne, 1985).

Gagne's Conditions of Learning

As discussed earlier in the paper, types of learning outcomes include verbal information, intellectual skills, cognitive strategies, attitudes, and motor skills (Gagne et al, 1992). In order for these outcomes to be displayed through learning objectives, the instructor must enforce external conditions that influence the learners' ability to display said learning outcomes. Gagne and Driscoll (1988) summarize these external conditions for each learning outcome and provide instructors with action items to aid in acquiring the desired skill. Figure 2 includes a summary of the external conditions that can critically influence learning of the five major learning outcomes.

Figure 2.

TYPES OF LEARNING OUTCOME	CRITICAL LEARNING CONDITIONS
Verbal Information	1. Draw attention to distinctive features by variations in print or speech. 2. Present information so that it can be made into chunks. 3. Provide a meaningful context for effective encoding of information. 4. Provide cues for effective recall and generalization of information.
Intellectual Skills	1. Call attention to distinctive features. 2. Stay within the capacity limits of working memory. 3. Stimulate the recall of previously learned component skills. 4. Present verbal cues to the ordering or combination of component skills. 5. Schedule occasions for practice and spaced review. 6. Use a variety of contexts to promote transfer.
Cognitive Strategies	1. Describe or demonstrate the strategy. 2. Provide a variety of occasions for practice using the strategy. 3. Provide informative feedback as to the creativity or originality of the strategy or outcome.
Attitudes	1. Establish an expectancy of success associated with the desired attitude 2. Assure student identification with an admired human model. 3. Arrange for communication or demonstration of choice of personal action. 4. Give feedback for successful performance; or allow observation of feedback in the human model.
Motor Skills	1. Present verbal or other guidance to cue the executive subroutine. 2. Arrange repeated practice. 3. Furnish immediate feedback as to the accuracy of performance. 4. Encourage the use of mental practice.

Figure 2. A summary of external conditions which can critically influence the learning of the five major varieties of learning outcomes. GAGNE, ROBERT M.; DRISCOLL, MARCY P., ESSENTIALS OF LEARNING FOR INSTRUCTION, 2nd, © 1988. Reprinted by permission of Pearson Education, Inc., New York, New York.

Once the instructor is able to identify the learning outcome and establish the conditions of learning for the desired learning objective, the final step is to facilitate the activation of internal processes and structures through the Nine Events of Instruction (Gagne, 1985).

Explanation of Gagne's Nine Events of Instruction

Gagne's Nine Events of Instruction (Gagne, 1985) has been applied to various educational environments to provide guidelines and specifications for efficient instruction. These events describe the process of external events that occur to the learner in order to support internal processes of learning. These events are designed to facilitate achievement of the identified target objective and often occur naturally as the learner interacts with the instructional material. The exact method for carrying out each event should intend to have the greatest desired effect in supporting the learning process (Gagne, Briggs & Wager, 1992). Gagne's events are listed below:

1. Gaining attention.
2. Informing learner of the objective.
3. Stimulating recall of prerequisite learning.
4. Presenting the stimulus material.
5. Providing learning guidance.
6. Eliciting the performance.
7. Providing feedback about performance correctness.
8. Assessing the performance.
9. Enhancing retention and transfer. (Gagne et al, 1992, p.190)

Although likely, the events do not unvaryingly occur in exact order; however, it must be deliberately arranged by an instructional designer or teacher. The events of instruction describe the "external events that are designed to help learning occur" and typically occur in a chronological order. (Gagne, 1985, p.244). Each event is associated with an internal process that occurs during the learning process. There are also action examples that suggest how instructors might be implement these steps. The events are explained in the following sections.

Gaining Attention. This first step involves grabbing the attention of the learner by introducing rapid stimulus change. This occurrence allows the student to exhibit the internal process of reception which alerts them and prepares them for the incoming stimulus that follows. This event could be a gesture or sudden volume change in the instructor's voice. Visual or auditory stimuli could also gain the attention of the learner if related to the content of the lesson (Gagne, 1985). For example, if the lesson is related to the physics behind rocket science, instructors may show a video on a real-life rocket launch at the beginning of the class.

Informing Learners of the Objective. The next step involves telling the learner what they will be able to do or what they will know after instruction. This event allows learners to acquire the internal process of expectancy that prepares them for the information that is ahead. Simply stating the learning objectives satisfies this event (Gagne, 1985). This can be done verbally, in a presentation, or listed on course documents distributed to the learner.

Stimulating Recall of Prerequisite Learning. Prior to presenting new material, instructors must ask the learner to remember previous knowledge or skills from their past. The internal process of retrieval to working memory is employed by the learner allowing them to recount information related to the topic of the new content (Gagne, 1985). For example, before a lesson on

trigonometry, math teachers may ask students to recall the rules and processes used in basic algebra and geometry.

Presenting the Stimulus Material. At this point, instructors can present the new content to the learners. This is to be done in an organized fashion that is clear to the learner. The internal process of selective perception allows students to take in the new material during the instruction and differentiate between relevant and irrelevant information as it pertains to the lesson topic (Gagne, 1985). Presentation of the new information can be done through various ways, including a lecture, textbook, or instructional video.

Providing Learning Guidance. This event prompts instructors to make the new content as meaningful and significant as possible to the learner. This can be achieved by "using concrete examples of abstract terms or concepts, and elaborating each idea by relating it to others already in memory" (Gagne, 1985, p. 252). This event supports the internal process of semantic encoding which allows learners to enter and store information into long-term memory. Instructors could utilize scaffolding or clustering strategies that enhance mental schema organization during the learning process.

Eliciting the Performance. This event allows the learner to demonstrate the newly learned capability or skill that has now been encoded in their long-term memory. The learner performs the task based on the previous events. The internal process of responding allows students to react to the stimuli and change behavior by either saying, doing or choosing something based on the knowledge that was acquired in the steps before (Gagne, 1985). This could include having a novice volleyball player perform a serve after being presented with the content on proper serving technique.

Providing Feedback about Performance Correctness. Providing feedback allows the learner to know the how well they were able to perform the task. Over time, this feedback develops the internal process of reinforcement which allows learners to make internal checks on performance to make the information permanent. According to Gagne (1985), "feedback is useful because it confirms the learner's expectancy" and informs the learner that the goal has been reached (p. 79). To provide feedback, instructors can give verbal feedback as the performance is done, or provide written comments on papers on assignments in the classroom.

Assessing the Performance. Once the skill is acquired, the learner must perform the new knowledge in several instances and receive an assessment of performance by the instructor. The goal of the assessment is to establish that the newly learned skill is stable, and provide additional practice to ensure cohesiveness and fluidity in what was learned (Gagne, 1985). The internal processes of retrieval and reinforcement are active in this event. The learners need to recall information that was learned to perform the skill, and receive a response from the instructor on the correctness of the performance. Examples include taking an exam and getting a letter grade, and receiving a score on a diving attempt and at a swim meet.

Enhancing Retention and Transfer. The final event refers to learners retaining the new skill for an extended period of time and using it to learn other skills. Retrieval and generalizations are the internal processes active in this event. For retrieval, learners must recover information stored in long-term memory and perform the skill over time (Gagne, 1985). Generalizations refer to the learner's ability to take what they have learned and use them in other context. An example of enhancing retention would be a teacher scheduling subject review sessions throughout the semester. An example of enhancing transfer would be using a particular coaching cue during the basic and advanced skill being learned. Cueing an athlete to swing their arms violently and be

explosive could be used in both the standing long jump, the basic movement, and the high jump, the transfer skill.

Gagne's Nine Events of Instruction in Practice

The utilization of instructional frameworks, specifically Gagne's Nine Events of Instruction (Gagne, 1985), can promote an efficient learning process by providing effective instructional episodes that have a definite beginning, middle and end through organized external events (Branch & Dousay, 2015). Branch & Kopcha (2014) makes the following statement as it relates to current and future ID model research:

> Rarely are instructional design models tested in the sense of rigorous assessment of their application and the resulting instruction against either predetermined criteria or competitive means of developing instruction using some other defined process. Rather, instructional design models with wide distribution and acceptance gained their credibility by being found useful by practitioners, who frequently adapt and modify them to match specific conditions. (Branch & Kopcha, 2014, p. 85)

The Nine Events (Gagne, 1985) have been implemented in various contexts for various skills. Studies have been conducted in the realm of traditional classroom education, medical education, and online learning (Al-Shalabi, Andraws, Alrabea, & Kumar, 2012; Belfield, 2010; Buscombe, 2013; Condell & Elliott, 1989; Gokdemir, Akdemir, & Vural, 2013; Ilie, 2014; Khadjooi, Rostami, & Ishaq, 2011; Krull, Oras, & Pikksaar, 2010; Ng, 2014; Woo, 2016). Classroom settings implement the Nine Events (Gagne, 1985) to teach various topics around the world. For example, Ilie (2014) combined Gagne's Nine Events of Instruction (Gagne, 1985) with effective learning context in the Romanian university education system. "The result

indicated a significant correlation between the adapted model and students' perceptions of the effectiveness of the teaching activity" (Ilie, 2014, p. 767). This suggests that the modified model provides functioning guidance for the development of instructional process. Another study was done with student teachers of Tartu University in Estonia. This experiment addressed the importance of teachers' perceptions of the instructional events and their understanding of the events with the idea that the quality of lesson analysis depends on these elements (Krull, Oras, & Pikksaar, 2010). The results showed that the experimental group progressed more than the control group where Gagne's Nine Events of Instruction (Gagne, 1985) was used as the theoretical framework for defining the lesson and each event of instruction (Krull, Oras, & Pikksaar, 2010). The Nine Events (Gagne, 1985) have also been implemented in the realm of medical education for general educational processes (Condell & Elliott, 1989) and to teach procedural skills necessary to practice medicine (Buscombe, 2013). Some research has been done regarding the instruction of the slit-lamp examination (Ng, 2014), phlebotomy education (Woo, 2016), the insertion of a peritoneal drain (Khadjooi, Rostami, & Ishaq, 2011), and a chest x-ray interpretation (Belfield, 2010). Online and distance learning have also utilized the Nine Events of Instruction (Gagne, 1985) for learning management system development (Gokdemir, Akdemir, & Vural, 2013), and instruction in computer engineering courses (Al-Shalabi, Andraws, Alrabea, & Kumar, 2012).

Although the Nine Events of Instruction (Gagne, 1985) have been utilized in various settings, there are minimal studies that are specific to PSL for athletic performance. When assessing athletic performance, sport-related psychomotor skills need to be acquired and performed at a high level of proficiency. Not only can performance be evaluated and documented, but the activities during sport will be safer and more enjoyable for participants and

spectators. In order to achieve this enhanced skill sets, proper instruction of a particular movement or activity is essential. The instructional frameworks set by Gagne meet these needs and can be applied to motor learning.

Summary

Psychomotor skills describe a learners' ability to physically perform movement in a controlled fashion. These skills range from simple to complex and various theories and taxonomies strive to explain to mechanism that occur in order for these skill to manifest. These skill are recurrently exhibited in athletics and addressing specific themes during the instruction process prove to be beneficial in skill acquisition. Considering the learner entry status, demonstration, practice, feedback, learning context, performance, assessment and transfer of skills during the learning process promotes efficiency of PSL for athletic performance. IDT has the potential to play a major role in establishing specific guidelines to address this specific area of education. Utilizing theoretical underpinnings in cognitivism, Gagne's theory of instruction (Gagne, 1985) provides external conditions and events that instructors can implement to facilitate learning. Gagne's Nine Events (Gagne, 1985) have be used in various fields of education and is now be applied to PSL for athletic performance.

CHAPTER THREE: METHODOLOGY

Introduction

This chapter describes the methodology of this study. It begins by restating the purpose of the study. This is followed by the specifics of the methodology, beginning with a discussion of design and developmental research, followed by a description of the research design utilized in this study. Chapter 3 continues with the study procedures and a detailed description of the phases used to develop instructional strategies for psychomotor skill instruction for athletic performance. Sampling and sampling strategies, data sources and analysis methods, and a timetable for the study will be discussed and conclude this chapter.

Purpose of Study

The purpose of this study was to examine Gagne's Nine Events of Instruction (Gagne, 1985) by designing and developing instructional strategies that align with this instructional framework. This framework was used in the realm of psychomotor skill learning and is specific to the context of athletics. For this study, the context of athletics includes areas that involve physical activities that are related to athletic movements performed during sporting activities. These instructional guidelines cater to the specific needs of motor learning for novice learners and assist in the learning process of athletic movements used in athletic performance.

Study Design

This study used a design and development research (DDR) approach. "Design and development research is a type of inquiry unique to the Instructional Design and Technology field that is dedicated to the creation of new knowledge and the validation of existing practice" (Richey & Klein, 2014, p.142). According to Richey and Klein (2007), design and development research "is the systematic study of design, development, and evaluation processes with the aim

of establishing an empirical basis for the creation of instructional and non-instructional products and tools and new or enhanced models that govern their development" (p. 1). This study was classified as a Type 2 DDR, also known as model research, and will seek to address the effectiveness of the existing instructional process through model development and validation (Richey & Klein, 2014).

Study Procedure

Model research addresses model development and model validation (Richey & Klein, 2014). This study utilized the Nine Events of Instruction (Gagne, 1985) through Type 2 DDR, model research, to provide guidance in the design of psychomotor skill instruction for athletic performance. In this study, model development consisted of creating instructional guidelines that align with the Nine Events of Instruction (Gagne, 1985) and cater to the specific needs of PSL of athletic movement. Model validation involved SMEs in athletic performance and IDT to examine the instructional guidelines to determine its authenticity and potential effectiveness in practice. The outcomes of this study was the validation of the Nine Events of Instruction (Gagne, 1985) as an effective framework in PSL for athletic performance, and a set of instructional guidelines that can provide assistance when implemented in PSL for athletic performance in various learning situations. This study occurred in four phases that include (1) analysis, (2) design and development, (3) evaluation and (4) revisions.

Phase One: Analysis Phase

The analysis phase began the model development step and consist of an extensive literature review that investigated the theoretical and practical application of IDT and PSL for athletic performance. The data was collected and organized to align with the actions set by Gagne's Nine Events of Instruction (Gagne, 1985). The information was summarized in a table

that displays the data related to the instructional event, the application of IDT and consideration to PSL for athletic performance.

Phase Two: Design and Development Phase

The design and development phase consisted of synthesis of the data collected in the analysis phase and creation of the prototype containing suggested instructional guidelines for PSL of athletic movement used in athletic performance. These guidelines aligned with the Nine Events of Instruction (Gagne, 1985) in order to facilitate learning and provide suggestions for instruction when teaching learners a psychomotor skill to be utilized in athletic performance. See Appendix B for the proposed guidelines for PSL for athletic performance.

Phase Three: Evaluation Phase

The evaluation phase launched the model validation step and consisted of a formative evaluation process involving SME's in the area of athletic performance and IDT. These experts critiqued these strategies and assisted in providing internal validation of the guidelines. The SMEs were given the proposed guidelines and a survey to determine if the guidelines met specific needs of instruction based on their individual expertise. See Appendix C and Appendix D for survey items for SME in IDT and athletic performance.

Phase Four: Revision Phase

The revision phase concluded the study and provided a summative evaluation and revision of the instructional guidelines. The feedback collected from the evaluation phase was used to make modifications and amendments to the original instructional prototype. See Appendix E, Appendix F, and Appendix G for SME responses and feedback.

Participants

Participants in this study were experts in the field of IDT and athletic performance. These experts were selected using purposeful sampling in order to ensure the individuals have particular characteristics that represent the population of interest (Patton, 2001). See Appendix H for the participant invitation letter. Institutional Review Board (IRB) protocol was followed in utilizing expert feedback to inform this study. See Appendix I for the IRB letter of approval.

Data Source and Analysis

Data Sources

The analysis phase collected information from the existing literature in the field of IDT, PSL and athletic performance. The evaluation phase yielded data from survey responses from SME's in the areas of IDT and athletic performance.

Data Analysis

The data collected from the literature review was analyzed and utilized as the theoretical and practical foundation for the instructional guidelines to be developed. Feedback from the expert reviewers were be collected, analyzed, and applied to the instructional guidelines for enhancement. These changes improved the validity and reliability of the instructional framework, the Nine Events of Instruction (Gagne, 1985), using the constant comparative analytic method the support the Nine Events of Instruction as a useful instructional framework according the Gagne's theory of instruction (Gagne, 1985; Glaser, 1965).

Table 1 provides a summary of the study procedure presented in this paper.

Table 1. Study Procedure Summary

Phase	**Step in Model Research**	**Process/Course of Action**
Analysis	Model Development	• Literature Review • Compilation and Synthesis of data
Design and Development	Model Development	• Prototype created of suggested instructional guidelines
Evaluation	Model Validation	• Formative Evaluation • SME Review
Revisions		• Summative Evaluation • Revision of instructional guidelines based on SME evaluation

CHAPTER FOUR: RESULTS

Introduction

This chapter discusses the results gathered during the evaluation phase of this DDR study procedure. This data includes the credentials of the SMEs who participated in the study, in addition to the feedback collected from said experts within the realms of IDT and athletic performance based on their respective fields. There is also be a section dedicated to the suggestions used in the amendments if the instructional guidelines. Finally, a summative overview reflecting the general opinions of the experts is presented and synthesized for further analysis for guideline revisions.

Subject Matter Experts

IDT Subject Matter Experts

Dr. Katherine Sears Cennamo. Dr. Katherine Sears Cennamo currently serves as the Professor of Instructional Design and Technology at Virginia Polytechnic Institute and State University in Blacksburg, Virginia. She received her Ph.D. in Instructional Technology Supporting from the University of Texas at Austin and has been working in the field of ID in various academic and private sector settings. Some of these positions include Assistant Professor in the Division of Educational Computing and Instructional Development at Purdue University, Director of Instructional Media Services at the University of Rio Grande, and an Instructional Designer for River City Productions and IBM Corporation. Dr. Cennamo's work extends well beyond her work experience. She has earned several awards and honors, conducted numerous professional presentations, and published many book chapters, textbooks, and papers in refereed journals, edited journals, and refereed conference proceedings. She has assisted in sponsored research and grant applications at various institutions that further the knowledge base of IDT in

several areas of education. Dr. Cennamo has been working in IDT since the early 1980's to present day, making her more than qualified to serve as a SME in IDT.

Dr. Wendy Ann Gentry. Dr. Wendy Gentry currently serves as an instructor of Instructional Design and Performance Technology at Baker University in Baldwin City, Kansas. She received her Ph.D. in Instructional Design and Technology from Virginia Polytechnic Institute and State University. While completing her doctoral degree, Dr. Gentry worked as a graduate assistant in the Department of Learning Sciences and Technologies where she served as a co-instructor for graduate level courses. She also completed IDT work outside of her graduate studies and served as an ID consultant for Learning in Non-governmental Organizations. Dr. Gentry has several publications in invited and refereed conference journals, in addition to conducting independent and collaborative presentations at educational conferences nationwide. Dr. Gentry's work and educational experience qualifies her as an expert and allows her perspective to be valuable as it related to IDT.

Athletic Performance Subject Matter Experts

Scott Caulfield. Scott Caulfield currently serves as the Coaching Education Manager and Head Strength Coach at the National Strength and Conditioning Association (NSCA) Performance Center in Colorado Springs, CO. In his role, he works to support the organization and its coaches though education of its members and various collaborations with other organizations in the athletics. These organizations include the Professional Baseball Coaches Strength and Conditioning Coaches Society (PBSCCS), the National Basketball Strength and Conditioning Association (NBSCA), the U.S. Anti-Doping Association, United States Olympic Committee, the U.S. Ski and Snowboard Association, and U.S.A. Hockey. Prior to his current role, he served as the Head Strength and Conditioning Coach for Colorado College Hockey and

was an Assistant Strength and Conditioning Coach at Dartmouth College. Caulfield is a Certified Strength and Conditioning Specialist with Distinction (CSCS*D) and Registered Strength and Conditioning Coach (RSCC*D) through the NSCA. He also earned his bachelor's degree in Physical Education from Castleton University and his master's degree in Sport Coaching from the University of Denver. Caulfield's role as the Head Strength Coach of the Performance Center at the NSCA National Headquarters allows him promotes the goals and missions of this internationally recognized organization. His role and coaching experience qualifies him as a SME for athletic performance.

Dr. G. Gregory Haff. Dr. G. Gregory Haff currently serves as the President of the NSCA and is an Associate Professor and Course Coordinator for the Post Graduate Degree in Strength and Conditioning at Edith Cowan University in Joondalup, Australia. He has been recognized as the Strength and Conditioning Coach of the Year for Education and Research by the United Kingdom Strength and Conditioning Association (UKSCA) and won the William J. Kraemer Sport Scientist of the Year award from the NSCA. Dr. Haff is also the Senior Associate Editor for the *Journal of Strength and Conditioning Research*, and serves as a consultant for various sport programs in Australia and the United States. Dr. Haff is also a co-editor of *Essentials of Strength Training and Conditioning; 4th Edition* which is the textbook authored by the NSCA. This book is a major resource for professionals in strength and conditioning, sports science, performance research and education surrounding strength training in various settings. Dr. Haff's publications extend to several other books, book chapters, refereed journals, published abstracts and research presentations. He is a level-2 strength and conditioning coach by the Australian Strength and Conditioning Association (ASCA), an accredited strength coach with the UKSCA and possess the CSCS*D from the NSCA. These

contributions to the knowledge base of sport performance and athletics qualify Dr. Haff to be a credible SME in athletic performance.

Joseph Kenn. Joseph Kenn currently serves as the Strength and Conditioning Coach for the Carolina Panthers, a professional football team in the National Football League in Charlotte, NC. He is also the owner of the Big House Power Competitive Athletic Training, where athletes from various disciplines come to enhance their athletic performance on the high school, college and professional level. Kenn has been awarded the Collegiate and Professional Strength and Conditioning Coach of the Year from the NSCA and the NFL Strength and Conditioning Coach of the Year by the Professional Football Strength and Conditioning Coaches Association. Kenn is the author of several books that focus on strength training in sport, and has been published in top journals in the field including *Strength and Conditioning, the Journal of Strength and Conditioning Research,* and *Human Movement.* In addition to over 30 years of experience in physical preparation for sport, Kenn has a bachelor's degree in Health and Sport Science and a master's degree in Education with an emphasis in Curriculum and Instruction. Kenn is a Certified Strength and Conditioning Specialist (CSCS) through the NSCA and was recognized as a Master Strength and Conditioning Coach (MCCC) through the Collegiate Strength and Conditioning Coaches Association (CSCCa). As one of the leaders and most sought out speakers in the field of athletic preparation and performance, Joseph Kenn qualifies as a SME for athletic performance.

Dr. J. Bryan Mann. Dr. J. Bryan Mann currently serves as an Assistant Teaching Professor in the Department of Physical Therapy, Associate Clinical Professor and Research Director in Human Performance Institute and the Director of Performance Research with the Department of Athletics at the University of Missouri in Columbia, MO. His research interest

include the enhancement of sports performance through resistance training, the reduction of injuries through resistance training, the effects of stress on injuries in sport and the effect of power training on the aging population. Mann is known internationally for his work in Velocity Based Training and the Autoregulatory Progressive Resistance Exercise (APRE) method. In addition to his extensive research in the field, Dr. Mann has years of collegiate and professional strength and conditioning coaching. He has worked with various sport teams at the University of Missouri and Southwest Missouri State University. Dr. Mann received his PhD in Health Education and Promotion from the University of Missouri and has published numerous peer-reviewed journal articles, books and conducted presentations at scientific professional conferences. He is CSCS*D and RCCC through the NSCA, a Strength and Conditioning Coach Certified (SCCC) through the CSCCa, and a member of the Central Area Consortium of Clinical Educators (CACCE). His work in both research and practice which the realm of strength and conditioning qualifies him to be a SME in athletic performance.

Patrick McHenry. Patrick McHenry currently serves as an Educational/Institutional Strength and Conditioning Professional Member and the Director of Strength and Conditioning at Castle View High School in Castle Rock, CO. He designs all aspects of the strength and conditioning program for all the strength training classes as well as the 23 varsity sports at the high school. During his coaching career, McHenry was recognized as the regional Strength Coach of the Year by *American Football Monthly,* the NSCA High School Strength Coach of the Year, the Strength of America Award from the President's Council on Fitness and the Editorial Excellence Award from the *Strength and Conditioning Journal.* In addition to several national and international conference presentations, he has been published in books, research journals, manuals, and videos. McHenry's experience with high school student-athletes displays his

expertise in athletic development in the adolescent population. McHenry is a CSCS*D and a RSCC through the NSCA. He is also a Certified Club Coach through USA Weightlifting. His knowledge and involvement in sports development qualifies him to be a SME in athletic performance.

Ron McKeefery. Ron McKeefery currently serves as the Vice President of Performance and Education for PLAE Performance located in Woodstock, GA. He is recognized worldwide as a leader in sports development on the collegiate and professional level. McKeefery has held several positions that include sports programs at Eastern Michigan University, the University of Tennessee and the University of South Florida. His work experience on the professional level includes coaching the Cincinnati Bengals, the Kansas City Royals, the Tampa Bay Buccaneers, and the Berlin Thunder. During his coaching career, McKeefery has been named Collegiate Strength and Conditioning Coach of the Year by the Professional Football Strength and Conditioning Society and the NSCA. In addition to his work experience, McKeefery has a bachelor's degree in Biology and Physical Education from Ottawa University and a master's degree in Adult Education from the University of South Florida. He is also the author of the #1 Amazon International Bestseller *CEO Strength Coach*, and has been published in the *National Strength and Conditioning Journal*. In addition to working with various sports programs, McKeefery was honored as a MSCC by the CSCCa, which is the most esteemed recognition that can achieved as a strength and conditioning coach. This tribute is given to strength and conditioning professionals who display knowledge, experience, expertise and longevity in the field of athletic development. He also possess the CSCS*D from the NSCA. McKeefery's wealth of knowledge on sports performance undoubtedly qualifies him as a worthy SME for athletic performance.

Terry Mitchell. Terry Mitchell currently serves as the Senior Director of Strength and Conditioning for Olympic Sports at Virginia Polytechnic Institute and State University in Blacksburg, VA. He is primarily responsible for the strength and conditioning programs for baseball, wrestling, and men's and women's swimming. He has held this position since 2001 and worked in the private sector as a strength coach before becoming the Senior Director. Mitchell earned his bachelor's degree in Physical Education and his master's degree in Health Promotion, both from Virginia Polytechnic Institute and State University. He is a CSCS through the NSCA and is a Sports Performance Coach through USA Weightlifting. His many years of service as a strength coach on the collegiate level qualifies him to be a SME for athletic performance.

Dr. Sophia Nimphius. Dr. Sophia Nimphius currently serves as an Associate Professor in the School of Medical and Health Sciences at Edith Cowan University in Joondalup, Australia. She is also the Sport Science Manager at the Hurley Surfing Australia High Performance Center and manages High Performance Services for Softball Western Australia. Her professional associations include the ASCA, Exercise and Sports Science Australia, International Society of Biomechanics in Sport, the NSCA, and the UKSCA. Dr. Nimphius has received the Terry J. Housh Young Investigator of the Year Award from the NSCA and is a current member of the NSCA Research and Education Committee. Her research areas and interests include applied biomechanics in strength and conditioning, microtechnology for load quantification in sport, extreme sport performance research, speed, change of direction and agility assessment and performance determinants, and bone adaptations and injury. Dr. Nimphius has acquired various research grants and has published book chapters, journal articles and conference publications in the field of sports performance and sport-related research. Her vast research in biomechanics in

strength and conditioning promotes practical application in various athletic development contexts; therefore, Dr. Nimphius's expertise qualifies her to be an athletic performance SME for this research project.

Dr. N. Travis Triplett. Dr. N. Travis Triplett currently serves as the President-Elect for the NSCA and a Professor and Director of the Strength and Conditioning Concentrations for the undergraduate and graduate degrees in Exercise Science at Appalachian State University in Boone, NC. Prior to her current appointments, Dr. Triplett was the Director of the Strength Centers at the University of Wisconsin-La Crosse, a research assistant in Sports Physiology at the United States Olympic Training Center in Colorado Springs, a postdoctoral fellow at Southern Cross University in Australia, and participated in research at the University of Jyvaskyla in Finland and the University of Valencia in Spain. Dr. Triplett is also a Senior Associate Editor for the *Journal of Strength and Conditioning* Research and past Assistant Editor-in-Chief for the *Strength and Conditioning Journal.* She has been awarded the Terry J. Housh Outstanding Young Investigator Award, the William J. Kraemer Outstanding Sport Scientist Award, and the *Journal of Strength and Conditioning* Research Editorial Excellence Award. Dr. Triplett's teaching specialties and research interest include theoretical and practical aspects of strength and conditioning, neuromuscular and endocrine exercise physiology, resistance training in the elderly and neuromuscular aspects of strength and power. Over the years, Dr. Triplett has had many publications including books, book chapters and journal articles in national and internationally recognized peer-reviewed research journals. She is also a co-editor of *Essentials of Strength Training and Conditioning; 4th Edition* which is the textbook published by the NSCA. She is a CSCS*D and a Certified Sports Performance Coach though USA Weightlifting. Other professional affiliations include the American College of Sports

Medicine (ACSM), the American Society of Phlebotomy Technicians and the Southeastern Chapter of the American College of Sports Medicine. Her expertise in athletic performance is evident through her many years of research and instruction which qualifies her as a qualified SME.

Subject Matter Expert Feedback

This portion of the chapter will discuss the feedback provided by the SMEs of either IDT or athletic performance. The experts have extensive knowledge in their respective fields that provide insightful perspective on the theoretical and applicable nature of the instructional guidelines.

IDT Feedback

The IDT SMEs were asked a series of questions that solicited their professional opinion on specific aspects the guidelines. After reviewing the responses, there were common themes from the SMEs. Firstly, the participants thought the guidelines were clear and concise, yielding no misinterpretation of purpose of the guidelines, the alignment with Gagne's Nine Events (Gagne, 1985), and suggested actions associated with each event.

Dr. Cennamo:	"I think they [guidelines] would be quiet helpful." "They are well grounded in recent research in psychomotor skill development."
Dr. Gentry:	"The purpose is clearly defined as is the alignment to psychomotor skill development for athletic performance." "The cues, guidelines and connection to relatable experience work well."

There were some concerns however, that surrounded the physical presentation of the guidelines during instruction and the level of engagement with the learner.

Dr. Gentry: "It is a thorough design. However, while the written guidelines would aid understanding it could be…cumbersome to implement without losing the athlete's interest."

The IDT SMEs also provided suggestions on ways to improve the verbiage of the guidelines (Table 2), the overall structure of the guidelines and potential delivery methods that could facilitate efficient learning.

Table 2. Suggestions for Guidelines by Dr. Cennamo

G9E	Instructional Guideline for PSL in Athletic Performance	IDT SME Feedback
#3-Stimulating recall of prerequisite learning Ask about previous experiences	**WHAT DO THEY KNOW (PAST EXPERIENCE)** Beginners have no formal training in the skill to be learned; therefore, stimulating relatable experiences in will assist in promoting familiarity for the athlete. Recollection of any previous knowledge that is associated with the skill aids in bridging the gap between old and new skills to enhance athletic performance.	Dr Cennamo: "Would you also point out how these experiences are applicable to the new skill/situation?
#4-Presenting the stimulus material Demonstrations Examples and vocabulary	**HOW DO THEY DO IT (DEMOS)** When demonstrating the skill to the athlete, provide visual, verbal and written explanation prior to instruction. This ensures that all means of communication are addresses to encourage an efficient learning process. Describe important components of the skill for full understanding of the physical and mental demands that are being expected. This includes specifics on movement quality, terminology, and movement sequences for skills that have several steps. Demonstrations can display the learning process and/or an expert performer and can be done in person or with an audiovisual medium.	Dr Cennamo: "…And do you need visual, verbal AND written? Or do you want to say "and/or...Make sure you are precise in your recommendations."

Dr. Gentry: "It may be appropriate to have tiers based [on] the complexity of the skills. For example, if the skill requires complex and fine movements, written feedback could be especially useful."

"While I am not sure how the written explanations are intended to work in practice, I recommend including simple cue cards with large text and arrows to show key points. The use of mirrors could help the athlete correct behavior."

Dr. Cennamo: "Feedback that the athlete can take with them to track improvement may be helpful as well."

From a theoretical and structural standpoint, the IDT SMEs were able to provide valuable feedback on the guidelines for psychomotor instruction. Their overall validation of the guidelines is based on their expertise in the learning sciences and effective educational methods to facilitate the learning process. In the following section, the athletic performance SMEs will provide their opinion on the practicality of the guidelines based on their familiarity with the realm of sports and athletic coaching.

Athletic Performance Feedback

The athletic performance SMEs were asked a series of questions that solicited their professional opinion on specific aspects the guidelines. After reviewing their responses, there were several areas where all the SMEs agreed. They all believed that the guidelines seem to provide clear instruction for psychomotor skill learning in athletic performance, support effective sport skill learning and parallel successful coaching practices.

Dr. Triplett: "The steps presented are in an appropriate and logical order to best learn a motor skill. The steps build on existing knowledge/ability and the emphasis is on demonstrations and other visual cues."

Mr. McHenry: "It is a step-by-step process with all the correct (in my opinion) ways to teach the athlete."

Dr. Mann: "Seems like a basic and good template for someone new to slow down and realize where an individual is at."

Several SMEs also believe the guidelines are not necessary exclusive to novice learners; in fact, some believe it can be applied to moderate or advanced learners who are re-learning a particular sport skill.

Dr. Nimphius: "At times, this may be relevant to perceived expert learners when trying to explore a new motor pathway or provide an opportunity for differential learning in an effort to re-learn a 'known' movement in moderate to advanced learners."

Mr. Mitchell: "I believe these guidelines are specific to all levels of athletes attempting to learn a new skill…"

Dr. Triplett: "I believe these guidelines will work best with novice learners. While most of the steps will still be effective for advanced learners, the emphasis will likely be on step 5-7. With individuals who already have learned a skill, if changes need to be made to the skill performance (i.e. correct errors), then some different strategies may need to be employed before using the guidelines to re-learn the skill correctly."

The SMEs were asked to describe aspects of the guidelines that they believed would work well based on their years of coaching experience. This was an open-ended survey item and some of their responses are mentioned below.

Mr. Caulfield: "Building off previous experience and demonstrations make most sense to me as a coach, and of course helping them by cueing."

Mr. Mitchell: "Gaining the attention of the athlete, informing the athlete of the objective, verbal and written explanation, providing feedback, and assessing performance have worked well for me."

In addition to the positive attributes of the guidelines, the SMEs expressed their concerns regarding the delivery and time constraints associated with utilizing the guidelines in practice.

Mr. Kenn: "My concern is the chart is very to the point in its directive. A new coach could sound very 'mechanical' if he/she is utilizing this information verbatim. The information is very sound, my concern will always be the delivery."
"On the floor coaching, you will very rarely utilize written information as a form of skill learning on a day-to-day basis."

Mr. McKeefery: "I think they all work well, a skilled coach would need to be able to transition between the steps seamlessly, as not to be robotic."

Mr. Mitchell: "Because of time restraints, all the guidelines may not be addressed each session but should be revisited."

Other concerns include the lack of consideration for environmental factors that could affect the learning process and that these guidelines are specific to athletic movement, not necessary the athletic performance in the field of play.

> Dr. Nimphius: "I believe more reflection on how changing the environment, often done within the task could be made clear. The environment is only discussed initially but not the manipulation of environment often done in practice."
>
> Mr. McKeefery: "It mentions being within the environment, but not sure it discusses external stresses that could occur while doing the movement in competition."
>
> Dr. Mann: "If you would say athletic movement or something like that I would agree. Again, performance is dictated not just by the ability to do something but the ability to respond to stimulus. It's similar to change of direction vs. agility. This is completely appropriate for change of direction, but most likely will not impact true agility as the response to the speed of stimulus may be more important…"

The survey solicited suggestions for ways to improve the guidelines. These recommendations addressed various aspects of guidelines from content to usability.

> Mr. Kenn: "The guidelines are solid, but I need to see more of HOW are we going to implement this in the team setting."
>
> Dr. Nimphius: "#5 in Helping them do it has a shortened suggestion of 'cueing' and although this is definitely a major part of the assistance, either in #5 or in #6 a critical part of teaching the skill is the use of specific tasks or the use of constraints. In S&C, this often is some type of physical constraint such as lines to remain in or the task has an additional element (e.g. overload one side) to place focus on the movement you are trying to elicit (e.g. squatting with knees out, one may place bands or to learn to cut effectively, we have individuals lean into a tackle pad). Therefore, the addition of task/constraint can be considered either part of #5 or becomes an additional part of #6 when performing block to serial to random practice."
>
> Dr. Mann: "It's all about drilling and improving cognitive aspects of sport as well. Things like quiet eye and other things to enhance anticipatory skills."

Mr. McHenry: "You may want to work on wording for physical education teacher/sport coach but that is more wordsmithing than content."

Mr. McKeefery: "I would add kinesthetic (feel) step, also discuss the difference between internal and external cueing…I would also discuss how stress may affect the movement and create strategies for success."

The athletic performance SMEs were able to provide valuable feedback on the guidelines for psychomotor instruction from a practical standpoint. Their validation of the guidelines is based on their expertise in sport coaching and effective teaching practices in athletic settings. Gaining the opinion of practitioners in the realm of sport was invaluable in this study and their feedback was very influential in the revisions to the guidelines.

Suggestions for Amendments

Based on the feedback, there were several suggestions presented that would enhance the guidelines and assist in promoting an efficient learning process. Dr. Cennamo and Dr. Gentry presented recommendations that assist in being clear and intentional in the components of the guidelines. These are itemized in Table 3.

Table 3. IDT SME Suggestions Used in Revisions: Specific to Event

Original Guideline Item	SME Suggestions
WHAT DO THEY KNOW (PAST EXPERIENCE) Beginners have no formal training in the skill to be learned; therefore, stimulating relatable experiences in will assist in promoting familiarity for the athlete. Recollection of any previous knowledge that is associated with the skill aids in bridging the gap between old and new skills to enhance athletic performance.	Point out how these experiences are applicable to the new skill/situation. (Dr. Cennamo)
HOW DO THEY DO IT (DEMOS) When demonstrating the skill to the athlete, provide visual, verbal and written explanation prior to instruction. This ensures that all means of communication are addressed to encourage an efficient learning process. Describe important components of the skill for full understanding of the physical and mental demands that are being expected. This includes specifics on movement quality, terminology, and movement sequences for skills that have several steps. Demonstrations can display the learning process and/or an expert performer and can be done in person or with an audiovisual medium.	Specify if there is a need for visual, verbal, and written demonstration of the skill. Be precise in your recommendations. (Dr. Cennamo) For the written methods, the use of cue cards with large text and arrows could guide the learner. (Dr. Gentry)
HOW CAN THEY FIX IT (FEEDBACK) While beginners practice the new skill, feedback is given by coaches and instructors. This information is provided in the form of demonstrations or cues that are task relevant and correct errors in technique. Inform the athlete of how the skill can be corrected visually, verbally, and in writing. In order to promote autonomy with the new skill, manipulate feedback occurrences by avoiding 100% feedback. This discourages instructor-dependency when learning new skills.	Specify if there is a need for visual, verbal, and written demonstration of the skill. Be precise in your recommendations. (Dr. Cennamo) For the written methods, the use of cue cards with large text and arrows could guide the learner. (Dr. Gentry) Provide ways to provide feedback the athlete can take with them to track their progress. (Dr. Gentry)

Other suggestions provided by the athletic performance SMEs were practical in nature. These recommendations surrounded areas that directly affected one's ability to deliver the information and ways to make the guidelines work in the context of coaching. One suggestion is shown in Table 4.

Table 4. Athletic Performance SME Suggestions Used in Revisions: Specific to Event

Original Guideline Item	SME Suggestions
WORKING AT IT (PRACTICE) Provide a structured practice schedule when beginners practice a new skill. Allotting time to practice encourages athletes to maximize attempts and strive for successful trials. While athletes practice, give demonstrations, cues, and feedback of performance to promote accurate practice attempts. Utilizing blocked and serial practice methods assist in skill acquisition with beginners as well.	The addition of specific tasks or the use of constraints would assist in the learning process. Giving the athlete some physical constraints/conditions to avoid/strive for will assist learning during practice trials. (Dr. Nimphius)

Other propositions were not specific to a particular guideline. Instead, they were general recommendations that would enhance the guidelines making them more comprehensive and functional. They are listed below:

- There should be a kinesthetic or "feel" element added to the guidelines. This is an important part of the learning process. (Mr. McKeefery)
- Provide examples of how to implement each step of the guidelines. (Mr. Kenn, Mr. McKeefery)
- Add elements of praise and encouragement in the guidelines (Mr. Mitchell)
- Differentiate between basic sports movements, and sport performance. These guidelines can assist in teaching basic movement, like change of direction, not necessarily the skill in play, like agility and responses to various stimuli in a game setting. (Dr. Mann)
- Consider changing the wording and verbiage so it can be easily understood by physical education teachers and sport coaches. (Mr. McHenry)
- Elaborate on environmental factors that may or may not affect the learning process. (Dr. Haff, Mr. McKeefery, Dr. Nimphius)

Summative Overview

There was an overall positive response to the presented instructional guidelines for psychomotor skill learning for athletic performance. Although the SMEs provided suggestions for instructional clarity, potential time constraints and practical application, the guidelines proved to be useful and beneficial for skill acquisition in novice learners. The theoretical underpinning of Gagne's Nine Events of Instruction (Gagne, 1985) were exhibited based on the perspective of the IDT SMEs, and the contextual application in sport skills were validated by athletic performance SMEs from various levels of sports. The goal to bridge theory and practice was accomplished in this design and development study by establishing internal validation using SMEs for model validation (Richey & Klein, 2007). The reviewers provided insightful feedback that will be incorporated in the revised version on the guidelines. The revised version can be found in Appendix I.

CHAPTER FIVE: DISCUSSION

Introduction

This chapter restates the purpose of the study and provides a summary of the design and development study. The theoretical and practical implication of this study are discussed in addition to contribution of the study in the field IDT and athletic performance. Lessons learned and suggested next steps for research in psychomotor skill instruction for athletic performance is discussed in the final portion of this chapter. .

Purpose of the Study

This study was conducted to operationalize Gagne's Nine Events of Instruction (Gagne, 1985) for PSL for athletic performance. This instructional framework has been utilized in various settings by establishing and implementing specific events that are vital in the instruction process (Al-Shalabi, Andraws, Alrabea, & Kumar, 2012; Belfield, 2010; Buscombe, 2013; Condell & Elliott, 1989; Gokdemir, Akdemir, & Vural, 2013; Ilie, 2014; Khadjooi, Rostami, & Ishaq, 2011; Krull, Oras, & Pikksaar, 2010; Ng, 2014; Woo, 2016). Prior to this study, it has yet to be utilized in psychomotor skills generally and athletic performance specifically. This research propositioned to inform the ID knowledge base through validation of this framework for use in psychomotor skill instruction in the context of athletics. This was accomplished by the selection of instructional guidelines specific to PSL that align with the Gagne's Nine Events (Gagne, 1985).

Summary of the Study

Like other learning domains, psychomotor skill instruction for athletic performance should be supported by IDT principles. Many instructional frameworks and models are currently utilized in school education, military training and corporate training (Reiser, 2001a; Reiser,

2001b). These methods have proved to be productive and produce successful outcomes with systematic implementation of its instructional constituents; however, no validation of guidelines have occurred for the purpose of PSL in athletic performance. This study strived to use Gagne's Nine Events (Gagne, 1985) as a framework for developing instructional guidelines for PSL for athletic performance. Throughout this Type 2 DDR study, model research was conducted through the process of model development and model validation that occurred in four phases (Richey & Klein, 2014). Phase One, the analysis phases, began the model development step and consisted of an extensive literature review that explored the theoretical and practical application of IDT and PSL for athletic performance. The data was then collected and organized to align with the events described in Gagne's Nine Events (Gagne, 1985). In Phase Two, the design and development phases, the data gathered from the analysis phase was synthesized and the instructional guidelines were created. Items within the guidelines aligned with the Nine Events (Gagne, 1985) and provided suggestions for instruction based on the thorough literature review on PSL for athletic performance. In Phase Three, the evaluation phase, a formative evaluation process involving SMEs launched the model validation portion of the study. These experts in IDT and athletic performance critiqued the proposed guidelines and provided feedback and suggestions based on their respective fields. The fourth and final phase, revision phase, concluded the study providing a summative evaluation and revision of the instructional guidelines. Feedback from the evaluation phase was synthesized and considered in modifications of the original instructional guidelines.

Theoretical Implications

Gagne's Theory of Instruction (Gagne, 1985) is based on concepts of cognitivism and the CIP model (Atkinson & Shiffrin, 1968) that emphasis the existence of mental processes that assist in the receiving, processing, storage, and output of information. In order to activate these internal processes, Gagne and Driscoll (1988) established the Conditions for Learning, a list of external conditions that influence the leaners ability to display particular learning outcomes. The Conditions of Learning (Gagne & Driscoll, 1988) for motor skills include the following:

- Present verbal or other guidance to cue the executive subroutine
- Arrange repeated practice
- Furnish immediate feedback as to the accuracy of performance
- Encourage the use of mental practice.

These and other external conditions were used to develop the Nine Event's (Gagne, 1985) which is the instructional framework explored in this study.

Gagne's Nine Events (Gagne, 1985) provide a systematic approach to deliver instruction to learners. These steps serve as external events to trigger internal processes within the learner that support the learning process based on the principles of cognitivism and the CIP model (Atkinson & Shiffrin, 1968). If these events are modified to apply to a specific context, and instructional strategies are properly assigned, the learning process can occur more efficiently. The instructional guidelines presented in this study contain the Conditions of Learning (Gagne & Driscoll, 1988) and mirror Gagne's events (Gagne, 1985) which would imply that with the selection of appropriate instructional strategies, the learning process would be advantageous for skill acquisition for novice learners in sport. This stance was validated by the IDT SMEs who

stated that the guidelines successfully adopt the characteristics and goals of the Nine Events (Gagne, 1985) as it relates to this particular context, athletic skill acquisition.

Although cognitivism is the learning theory under which this study is based, one could argue that constructivism also has a place in psychomotor skill learning in athletic performance. Research has explored using instructional methods that align with this theory in areas of physical education in order to promote sport skill competence, social responsibility and interactions, personal empowerment, identification of misconceptions in skill acquisition, and decision making tasks in team sport settings (Chen & Rovegno, 2000; Chen, Rovengo, Cone, & Cone, 2012; Darnis-Paraboschi, Lafont, & Menaut, 2005; Hare & Graber, 2007; Hastie & Buchanan, 2000). Special attention is placed on the instructors' ability to foster social interactions and promote the creation of knowledge in these courses. However, as it relates to the acquisition of motor skills needed for sport, the literature displays little evidence that methods founded in constructivism are effective. In order to learn the required task, concepts of cognitivism, specifically the CIP, must be utilized. Once this has occurred, learners can begin to explore other abilities that affect performance of that motor skill in the real-life sport. These aspects include decision making, strategies, and tactical approaches that work alongside the skill that has been learned.

Practical Implications

It is important to mention the difference between sport movements and sport performance. The U.S. National Library of Medicine (2008) defines athletic performance, also known as sports performance, as the act of "carrying out of specific physical routines or procedures by one who is trained or skilled in physical activity. Performance is influenced by a combination of physiological, psychological, and socio-cultural factors" (para 1). This study

explores the instruction of psychomotor skills that are used in athletic performance, also known as the athletic movement or sports movement. An example of an athletic skill would be linear acceleration in sprinting, while an example of athletic performance would be one's ability to perform a linear acceleration during a football game striving to score a touchdown. The proposed guidelines in this study are geared towards teaching novice learners how to acquire the skill that is to be used in athletic performance.

An element that can positively affect the guidelines is acknowledgement and manipulation of task constraints during practice trials. "Task constraints are those constraints that are specific to the task being performed and are related to the goal of the task and the rules governing the task" (Glazier, 2017). According to McGinnis and Newell (1982), task constraints "are not physical, rather they are implied constraints or requirements which must be met within some tolerance range in order for the movement to produce a successful action" (p. 299). These can be in the form of spatial-temporal constraints (Correia, Araujo, Duarte, Travassos, Passos, & Davids, 2012; Rosey, Keller, & Golomer, 2007), instructional constraints, (Newell & Ranganathan, 2010), and physical object constraints (Breslin, Garner, Rudisill, Parish, St. Onge, Campbell, & Weimar, 2009; Stodden, Langendorfer, Fleisig, & Andrews, 2006). Implementing these during practice trials supports Newell's ecological theory (1991) that emphasizes the relationship between the learner, the task, and the environment. The environment is anything that occurs outside of the learner and the task, including task constraints, and can be manipulated to promote adaptation to the constraint and successful practice trials.

The practicality of the guidelines are verified by its usability in the field of practice. The athletic performance SMEs provided internal validity for these guidelines by stating that they can be applied in the realm of athletic coaching on multiple levels. Based on their expertise, these

guidelines seem to be manageable in practice and reflect successful coaching methods implemented in the past. With the suggestions and recommendations from the SMEs, revisions were made to the guidelines in order to address concerns regarding verbiage, user readability and contextual examples in practice.

Contributions of the Study

This study contributes to the field of IDT by bridging theoretical foundations with practical methods for instruction. The validation of an existing instructional framework founded on educational psychology and ID practices determines its applicability in various contexts, including, psychomotor skills for athletic performance.

Contribution to IDT

Professionals in IDT implore researchers to conduct studies to discover empirical evidence of ID models and frameworks to validate its utility in various educational settings. "While instructional design models have been applied to many situations over the decades, a rigorous evaluation during the implementation of those instructional design models rarely included collecting empirical evidence about the model's effectiveness" (Branch & Kopcha, 2014, p.85). This study aimed to answer the call of IDT professionals and collect valuable information regarding Gagne's Nine Events (Gagne. 1985) in the context of athletics.

Through the DDR methodology, this study provided model research through model development and validation (Richey & Klein, 2014). Using Gagne's Nine Events (Gagne, 1985) as the foundational framework, the instructional guidelines for PSL for athletic performance was the model developed and the model validation came from the SMEs who evaluated the proposed guidelines. The study revealed that the principles behind Gagne's Nine Events (Gagne, 1985) can be applied to skill acquisition in the context of sports. These events have been used in other

realms of education; now, with this evidence provided in this study, Gagne's Nine Events (Gagne, 1985) has the potential to be applicable in the realm of athletics. This contributes to IDT by adding another context that can benefit from effective systematic instruction to promote the learning process.

The goal of ID is to design a system of procedures for developing education and training in a consistent and reliable way (Branch & Merrill, 2011). This process works best when the procedures relate to the context in which it is situated. Although some educational contexts may be complex, it is imperative that the models created in ID are versatile within the teaching and learning situation (Branch & Kopcha, 2014). The guidelines presented in this study align with these requirements by addressing the specific context of athletic movement in sports, while being generalizable to various sport types, levels, and skills. Keeping the context in mind, the activities, instructional strategies, sequencing, motivation and learner actions should also cater to what is most beneficial for the athlete in that setting.

Contribution to Athletic Performance

Many of the SMEs in this study were experts in the realm of athletic performance and stated that the guidelines were not only useful and necessary, but manageable when coaching a skill used in the context of sports. These guidelines provide a systematic model based in educational psychology that can facilitate psychomotor skill learning for learners of all ages and expertise level. As coaches utilize this framework, it is advised that the activities, instructional strategies, and sequencing of the steps occur in a seamless fashion. The art of coaching along with these guidelines allow information to be taught and learned with great efficiency. With the recommendations and suggestions from the SMEs, the guidelines can be enhanced and modified to meet the needs of sport coaches everywhere. The guidelines can then be a commonly used

coaching tool implemented during various coaching settings to promote an efficient learning process for athletes.

Lessons Learned

During this study, there were several areas that served as learning points. One area included the importance of terminology and establishing definitions that were clear and concise for the researcher and the participants. This could have minimized or completely eliminated any confusion or misconceptions on details of the study. Specifically, establishing the difference between athletic movements and athletic performance was a distinction that could have beneficial for SMEs and committee members alike. Another element that could have been advantageous for the study would have been the presentation of tangible examples that were a part of the initial guidelines. This would have given SMEs real-life applications of how the guidelines would be utilized in practice. If these examples were provided initially, many of the SMEs concerns may have been addressed. These lessons speak to the importance of clarity and consistency when conducting research and gathering data from participants.

The Next Step

The next step in DDR is model implementation (Richey & Klein, 2014). This involves utilizing the proposed guidelines in the field of practice in a replicable fashion. In this case, the proposed instructional guidelines for psychomotor skill learning for athletic performance would be used to teach novice learners a skill needed for athletic performance. The data collected from this portion of the study would include detailed account of the components of the model, systematic data collection concerning their procedures, report of impact on performance, and detection of possible discrepant or negative data (Branch & Kopcha, 2014). This process would then yield further empirical findings that promote the credibility and validity of Gagne's Nine

Events (Gagne, 1985) generally and specifically in the context of motor skill learning in the realm of athletics. According to the SMEs, the guidelines are manageable and are able to be implemented once the instructional strategies were assigned and delivered appropriately. An initial pilot study would be conducted to assess the components of the methodology and elements of the guidelines. Revisions can then be made for further enhancements of the proposed guidelines to promote effective skill acquisition for athletic performance.

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APPENDIX A

LETTER OF PERMISSION FROM PEARSON EDUCATION INC.

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Dear Allison

You have our permission to include content from our text, ***ESSENTIALS OF LEARNING FOR INSTRUCTION, 2nd Ed. by GAGNE, ROBERT M.; DRISCOLL, MARCY P.,*** in your dissertation at Virginia Tech.

Content to be included is:

Figure 1.2 on page 13 and Table 5.2 on page 103

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Sincerely,

Allison Bulpitt, Analyst

APPENDIX B

GUIDELINES FOR PSYCHOMOTOR SKILL INSTRUCTION FOR ATHLETIC PERFORMANCE

G9E	Key Concepts in the Literature	Instructional Guideline for PSL in Athletic Performance
#1-Gaining attention • Stimulate students interests • Pose questions	• Explanation of the benefits of the skill is explained to the learner. The shows how the skill is useful to the learner (Duba et al., 2007) • Participants were exposed to the environment and surroundings where the task would be learned and performed (Marchant et al., 2009)	**FOCUS IN (ATTENTION)** Explaining the usefulness of the skill grabs the athletes' attention. Express how the skill can enhance athletic performance to gain their interest. Expose the athlete to the environment and/or equipment before instruction to allow for comfortability when acquiring the new skill.
#2-Informing learner of the objective • Describe performance and end goals • Explain criteria	• Participants were informed of the skill to be learned prior to the study (Arripe et al, 2002; Asadi et al, 2014; Herbert & Williams, 2017; Lawrence et al., 2011; Marchant et al., 2009; Munzert et al., 2014; SooHoo et al., 2004; Wu et al., 2012; Wulf et al., 2002) • Participants receive verbal explanation of each step and its purpose/function in the complete movement (Duba et al., 2007)	**WHAT WILL THEY DO (THE SKILL)** Learning goals are presented to provide an overview of the skill to be learned. Include a description of player characteristics (who is doing it), the skill (what is being done), and performance criteria (how it will done). This sets a framework for the athlete to operate within during the learning process.
#3-Stimulating recall of prerequisite learning • Ask about previous experiences	• Participants were novice of the motor skill to be learned. They had some prior exposure to the idea of the movement, but not specific training in the particular skill to be learned (Arripe et al, 2002; Asadi et al, 2014; Hastie et al., 2011; Marchant et al., 2009; Memmert et al., 2009; Munzert et al., 2014; Rousanoglou et al., 2015; SooHoo et al., 2004; Wu et al., 2012; Wulf et al., 2002)	**WHAT DO THEY KNOW (PAST EXPERIENCE)** Beginners have no formal training in the skill to be learned; therefore, stimulating relatable experiences in will assist in promoting familiarity for the athlete. Recollection of any previous knowledge that is associated with the skill aids in bridging the gap between old and new skills to enhance athletic performance.
#4-Presenting the stimulus material	• Visual, verbal and written explanations of the skill are provided to the learners prior to instructions (Arripe et al,	**HOW DO THEY DO IT (DEMOS)**

• Demonstrations • Examples and vocabulary	2002; Rucci & Tomporowski, 2010; SooHoo et al., 2004; Wulf et al., 2002) • Participants are presented with elements of the skill that are important to understanding and performing the skill correctly. This includes general characteristics of the skill and specific procedural steps needed to acquire the skill in its totality (Asadi et al, 2014; Duba et al., 2007; Herbert & Williams, 2017; Wulf et al., 2002) • Models are presented to the learners in order to demonstrate the skill to be learned. These models can be in the form of learning models or expert models and can be viewed in person or using audiovisual technology. (Darden, 1997; Lawrence et al., 2011; Rucci & Tomporowski, 2010; SooHoo et al., 2004; Wulf et al., 2002)	When demonstrating the skill to the athlete, provide visual, verbal and written explanation prior to instruction. This ensures that all means of communication are addresses to encourage an efficient learning process. Describe important components of the skill for full understanding of the physical and mental demands that are being expected. This includes specifics on movement quality, terminology, and movement sequences for skills that have several steps. Demonstrations can display the learning process and/or an expert performer and can be done in person or with an audiovisual medium.
#5-Providing learning guidance • Advise students of strategies • Scaffolding, cues, hints, prompts, mnemonics, concept mapping, visualizing • Examples and non-examples • Metaphors	• Skilled individuals provide visual, verbal and written guidance on how to perform the skill correctly. This occurs in the form of cueing and prompts from the instructor/coach or peer tutors. (Arripe et al, 2002; Darden, 1997; Duba et al., 2007; Marchant et al., 2009; Munzert et al., 2014; Rousanoglou et al. 2015; Rucci & Tomporowski, 2010; Wu et al., 2012) • *Focus of attention* strategies can be used to provide cues on how to maximize performance when performing the skill. These strategies can be presented prior to and during practice trials. Focus of attention can be internal, external or kinesthetic in nature. External focus of attention has proven to be most beneficial with novice learners. (Asadi et al, 2014; Herbert & Williams, 2017; Lawrence et al., 2011; Marchant et al., 2009; Munzert et al., 2014; Wu et al., 2012; Wulf et al., 2002)	**HELP THEM DO IT (CUEING)** Skill guidance comes from a coach and/or peer who is skilled and knowledgeable in the skill. These cues are given in visual, verbal, and written forms when presented to the athlete. Cues are given to focus the athletes' attention to specific aspects of the skill. Beginners benefit from external focus of attention during skill acquisition. For example, in the long jump, coaches should say "jump and try and reach this line", instead of "jump and send your hips forward".

#6-Eliciting the performance • Students practice	• Practice trials are most successful when there are temporal constraints and supervision from instructors. (Arripe et al, 2002; Asadi et al, 2014; Lawrence et al., 2011; Rousanoglou et al. 2015; Rucci & Tomporowski, 2010 • During practice trials, demonstrations, cues, and feedback can increase productivity during skill acquisition. (Darden, 1997; Herbert & Williams, 2017; Marchant et al., 2009; SooHoo et al., 2004; Wu et al., 2012; Wulf et al., 2002) • Blocked, serial, and random practice methods can be used when learning a new skill. (Duba et al., 2007; Hastie et al., 2011; Memmert et al., 2009)	**WORKING AT IT (PRACTICE)** Provide a structured practice schedule when beginners practice a new skill. Allotting time to practice encourages athletes to maximize attempts and strive for successful trials. While athletes practice, give demonstrations, cues, and feedback of performance to promote accurate practice attempts. Utilizing blocked and serial practice methods assist in skill acquisition with beginners as well.
#7-Providing feedback about performance correctness • Knowledge of performance and/or results	• Any corrections of feedback should be guided by the instructors and/or skilled tutors that are familiar with the skill to be learned. (Arripe et al, 2002; Duba et al., 2007) • Feedback can be presented in the form of demonstrations and cues that are task relevant and address error correction. (Darden, 1997; Duba et al., 2007; Wulf et al., 2002) • Feedback on knowledge of performance is used to correct the skill during practice trials. This feedback can take the form of visual, verbal, and written methods. (Arripe et al, 2002; Duba et al., 2007; Rucci & Tomporowski, 2010) • Feedback schedule can be manipulated in order to allow for student autonomy when practicing the skill. This can lead to more successful practice trials (Hastie et al., 2011; Memmert et al., 2009)	**HOW CAN THEY FIX IT (FEEDBACK)** While beginners practice the new skill, feedback is given by coaches and instructors. This information is provided in the form of demonstrations or cues that are task relevant and correct errors in technique. Inform the athlete of how the skill can be corrected visually, verbally, and in writing. In order to promote autonomy with the new skill, manipulate feedback occurrences by avoiding 100% feedback. This discourages instructor-dependency when learning new skills.

#8-Assessing the performance • Pre and post testing • Objectives are measured	• Pretest, midpoint test, posttest, and retention tests are used to assess the skill to be learned. They are all similar in content and are designed to assess the skill based on the objective and task analysis. (Arripe et al, 2002; Lawrence et al., 2011; Memmert et al., 2009; Rucci & Tomporowski, 2010; • Quantitative and qualitative assessment methods are used to measure the task outcome, kinematic components, self-efficacy, and other information pertaining to instructional delivery during the learning process. (Arripe et al, 2002; Asadi et al, 2014; Duba et al., 2007; Hammond & Perry, 2005; Lawrence et al., 2011; Marchant et al., 2009; Munzert et al., 2014; Rousanoglou et al. 2015; SooHoo et al., 2004; Wu et al., 2012; Wulf et al., 2002)	**HOW WELL DO THEY DO IT (ASSESSMENT)** When assessing the new skill, the pretest, midpoint test, posttest, and retention test should be the same. They must address the learning goals and technical elements specific to the skill. Use quantitative and qualitative testing to gather thorough information on athletes' outcome of the skill, movement patterns, confidence level, and other information pertaining to the learning process.
#9-Enhancing retention and transfer • Internalize new knowledge • Obtain ownership of new skill • Using new knowledge in the future	• Performing the skill regularly after instruction can reinforce proper movement patterns and increase the chance of retention. (Duba et al., 2007) • When the skill is being performed, minimizing augmented feedback from instructors allows for future autonomy and confidence when recalling the acquired skill. (Hastie et al., 2011; Memmert et al., 2009)	**DO THEY KNOW IT AND CAN THEY USE IT (RECALL AND TRANSFER)** Establish opportunities for athletes to recall and perform the new skill after instruction. Limit feedback to allow autonomy and ownership of the skill. This will promote confidence in performing the new task and reassure the athletes' ability to utilize the skill in current and future athletic performance settings.

APPENDIX C

SURVEY QUESTIONS FOR IDT SUBJECT MATTER EXPERTS

Expert Review Survey Instrument: Instructional Design and Technology Experts

Please answer the following questions based on the "Guidelines for Psychomotor Skill Learning for Athletic Performance for Novice Learners" document.

YES or NO QUESTIONS

1. Based on your expertise as an instructional designer, do the guidelines seem to provide instruction for psychomotor learning for athletic performance?
   - Yes
   - No

   Comments/Feedback:

2. Based on the qualities of instructional design models, do the guidelines seem to possess attributes that support the goal of instructional design models in IDT?
   - Yes
   - No

   Comments/Feedback:

3. Based on other commonly used instructional design models, do you believe the guidelines will facilitate an effective learning process?
   - Yes
   - No

   Comments/Feedback:

4. Do the guidelines possess the same themes as Gagne's Nine Events of Instruction?
   - Yes
   - No

   Comments/Feedback:

OPEN ENDED QUESTIONS

1. From your perspective as an instructional designer, what aspects of the guidelines work well?
2. How would you improve the guidelines?
3. How well do you believe these proposed guidelines for psychomotor skill learning reflect Gagne's Nine Events of Instruction?
4. What additional feedback do you have about the guidelines?

APPENDIX D

SURVEY QUESTIONS FOR ATHLETIC PERFORMANCE SUBJECT MATTER EXPERTS

Expert Review Survey Instrument: Athletic Performance Experts

Please answer the following questions based on the "Guidelines for Psychomotor Skill Learning for Athletic Performance for Novice Learners" document.

YES or NO QUESTIONS

1. Based on your expertise as an athletic performance specialist, do the guidelines seem to provide instruction for psychomotor skill learning in athletic performance?
   - o Yes
   - o No

   Comments/Feedback:

2. Based on the qualities of successful coaching practices, do the guidelines seem to possess attributes that support the effective sport skill learning for athletic performance?
   - o Yes
   - o No

   Comments/Feedback:

3. Based on other coaching methods, do you believe the guidelines will facilitate an effective learning process?
   - o Yes
   - o No

   Comments/Feedback:

4. Are these guidelines specific to novice learners striving for sport skill acquisition?
   - o Yes
   - o No

   Comments/Feedback:

5. Do the contents of the guidelines parallel with successful coaching practices in athletic performance?
   - o Yes
   - o No

   Comments/Feedback:

6. Are all the steps in the guidelines necessary for sport skill instruction and learning?
   - o Yes
   - o No

   Comments/Feedback:

7. Can these guidelines be used in a variety of settings that focus on sport skill instruction and learning for athletic performance?
   - o Yes

- No

Comments/Feedback:

8. Are the steps manageable in the order they presented?
   - Yes
   - No

   Comments/Feedback:

9. Do the guidelines address environmental factors that may be presented during the learning process?
   - Yes
   - No

   Comments/Feedback:

OPEN ENDED QUESTIONS

5. From your perspective as an athletic performance coach, what aspects of the guidelines work well?
6. How would you improve the guidelines?
7. How well do you believe these proposed guidelines for psychomotor skill learning reflect Gagne's Nine Events of Instruction?
8. What additional feedback do you have about the guidelines?

APPENDIX E

SURVEY RESPONSES FOR IDT SUBJECT MATTER EXPERTS

Survey Question	Survey Response
Question 1: Based on your expertise as an instructional designer, do the guidelines seem to provide instruction for psychomotor skill learning for athletic performance?	Dr. Cennamo: Yes. I think they would be quiet helpful. I have a few comments and questions that I will send as an attachment. Dr. Gentry: Yes. I think they would be quiet helpful. I have a few comments and questions that I will send as an attachment
Question 2: Based on the qualities of instructional design models, do the guidelines seem to possess attributes that support the goal of instructional design models in IDT?	Dr. Cennamo: Yes. I'd prefer to think of them as supporting instructional theory (which is what Gagne's theory is) rather than a part of an instructional design model (which typically dictate a process more than instructional strategies). It would be more precise to say that the guidelines support the selection of instructional strategies within an instructional design model. Dr. Gentry: Yes. The framework aligns to Gagne's Events of Instruction
Question 3: Based on other commonly used instructional design models, do you believe the guidelines will facilitate an effective learning process?	Dr. Cennamo: Yes. Hmm... I'm not sure what you mean by this question. What do you mean by "based on other instructional design models"? I'm sorry Allison, but other than what? If what you mean is "in relation to other instructional theories, do I believe the guidelines will facilitate an effective learning process?" then I'd say yes. Dr. Gentry: Yes. It is a thorough design. However, while the written guidelines would aid understanding it could be It may be a cumbersome to implement without losing the athlete's interest.
Question 4: Do the guidelines possess the same themes as Gagne's Nine Events of Instruction?	Dr. Cennamo: Yes. Gagne (or Gagne and Briggs-- I don't remember which and don't have the books at home) has also outlined conditions for learning psychomotor skills, much as you do. His work would not be based on recent research like yours, so your work still has much to contribute to the literature, but please make sure you acknowledge Gagne's prior work in your dissertation-- and it's quite possible that you have already situated your work in that context. Dr. Gentry: Yes. Yes. All nine elements are included.
Question 5: From your perspective as an instructional designer, what aspects of the guidelines work well?	Dr. Cennamo: They are well grounded in recent research in psychomotor skill development Dr. Gentry: The cues, guidelines and connection to relatable experiences work well

Question 6: How would you improve the guidelines?	Dr. Cennamo: I will send you an attachment with suggestions on ways to add clarity Dr. Gentry: While I am not sure how the written explanations are intended to work in practice, I recommend including simple cue cards with large text and arrows to show key points. The use of a mirror could help the athlete correct behavior
Question 7: How well do you believe these proposed guidelines for psychomotor skill learning reflect Gagne's Nine Events of Instruction?	Dr. Cennamo: They align well Dr. Gentry: The alignment is thorough and easy to follow
Question 8: What additional feedback do you have about the guidelines?	Dr. Cennamo: Also, as noted in a previous question, please make sure you also acknowledge Gagne's recommendations for learning psychomotor skills and situate your work in that context Dr. Gentry: It may be appropriate to have tiers based the complexity of the skills. For example if the skill requires complex and fine movements, written feedback could be especially useful. Feedback that the athlete can take with them to track improvement may be helpful as well

APPENDIX F

SURVEY RESPONSES FOR ATHLETIC PERFORMANCE SUBJECT MATTER EXPERTS

Survey Question	Survey Response
Question 1: Based on your expertise as an athletic performance specialist, do the guidelines seem to provide instruction for psychomotor skill learning in athletic performance?	Mr. Caulfied: Yes. Yes they seem to follow steps that would apply to athletic performance as well. Dr. Haff: Yes. These guidelines provide some guidance Mr. Kenn: Yes. My concern is this chart is very to the point in its directive. A new coach could sound very "mechanical" if he/she is utilizing this information verbatim. The information is very sound, my concern will always be the delivery Dr. Mann: Yes. Seems like a basic and good template for someone new to slow down and realize where an individual is at. Mr. McHenry: Yes. Yes I feel they do a good job Mr. McKeefery: Yes. Yes, I believe it is missing Kinesthetic (Feel) as part of the learning process Mr. Mitchell: Yes. Yes but all are not always necessary for every athlete Dr. Nimphius: Yes. #5 in Helping them do it has a shortened suggestion of "cueing" and although this is definitely a major part of the assistance, either in #5 or in #6 a critical part of teaching the skill is the use of specific tasks or the use of constraints. In S&C, this often is some type of physical constraint such as lines to remain in or the task has an additional element (e.g. overload one side) to place focus on the movement you are trying to elicit (e.g. squatting with knees out, one may place bands or to learn to cut effectively, we have individuals lean into a tackle pad). Therefore, the addition of task/constraint can be considered either part of #5 or becomes an additional part of #6 when performing block to serial to random practice. Dr. Triplett: Yes. The steps presented are in an appropriate and logical order to best learn a motor skill. The steps build on existing knowledge/ability and the emphasis is on demonstrations and other visual cues.
Question 2: Based on the qualities of successful coaching practices, do the guidelines seem to possess attributes that support the effective sport skill learning for athletic performance?	Mr. Caulfied: Yes. Yes they do. Dr. Haff: Yes. Aspects of these guidelines may be useful. Mr. Kenn: Yes. On the floor coaching, you will very rarely utilize written information as a form of skill learning on a day to day basis. This information would be utilized in a playbook format, where the athlete can review bullet point list for skills on his/her own. Dr. Mann: Yes. Same. Mr. McHenry: Yes. Yes it is a step by step process with all the correct (in my opinion) ways to teach the athlete. Mr. McKeefery: Yes. Yes, needs to happen quickly but should be the process. Mr. Mitchell: Yes. Praise and encouragement are important for some athletes. The art of coaching is knowing when and with which athletes to use these.

	Dr. Nimphius: Yes. Overall, yes, some minor additions can assist as described. Dr. Triplett: Yes. Nearly half the steps focus on demonstrations and other visual cues, which is essential for learning a motor skill and more effective than verbal-only cues.
Question 3: Based on other coaching methods, do you believe the guidelines will facilitate an effective learning process?	Mr. Caulfied: Yes. I think it would be a valuable step process. Dr. Haff: No. there are multiple ways that people learn, this is only one dimension of it. Mr. Kenn: Yes. If the coach can develop a solid level of communication and find the proper verbiage to utilize on an individual basis. Dr. Mann: Yes. For basic movements, yes. Mr. McHenry: Yes. Yes, the process as well as the message are important. This gives the coach the process. Mr. McKeefery: Yes. Provides a good map. Mr. Mitchell: Yes. Because of time restraints, all of the guidelines may not be addressed each session but should be revisited. Dr. Nimphius: Yes. Definitely. Dr. Triplett: Yes. These guidelines cross over many different teaching methods as the basic principles are the same. For example, these guidelines can be used whether a coach wishes to teach the Olympic lifts from the bottom up or the top down.
Question 4: Are these guidelines specific to novice learners striving for sport skill acquisition?	Mr. Caulfied: Yes. Makes sense to me that it would work for novice learners. Dr. Haff: No. Could be used for multiple levels of athletes. Mr. Kenn: No. The guidelines are for any level of learner. Dr. Mann: No. This depends on the skill, because much of sport is not going to be a specific movement but responding to an opponent. Mr. McHenry: Yes. Yes because you don't want to make or force the coach into teaching specific steps for a skill you want them to take their information and put it into a process you outlines the process Mr. McKeefery: Yes. Excellent for novice, however I believe a novice is relative to the number of attempts they have. Mr. Mitchell: Yes. I believe these guidelines are specific to all levels of athletes attempting to learn a new skill acquisition. Dr. Nimphius: No. At times, this may be relevant to perceived expert learners when trying to explore a new motor pathway or provide an opportunity for differential learning in an effort to re-learn a "known" movement in moderate to advanced learners. Dr. Triplett: Yes. I believe these guidelines will work best with novice learners. While most of the steps will still be effective for advanced learners, the emphasis will likely be on steps 5-7. With individuals who already have learned a skill, if changes need to be made to the skill performance (i.e., correct errors), then some

	different strategies may need to be employed before using the guidelines to re-learn the skill correctly.
Question 5: Do the contents of the guidelines parallel with successful coaching practices in athletic performance?	Mr. Caulfied: Yes. These may be more detailed and thought out better than many coaches in athletic performance currently do. Dr. Haff: Yes. There are some parallels with what we do in coaching. Mr. Kenn: Yes. Yes. Dr. Mann: Yes. Performance no, movement acquisition yes. Mr. McHenry: Yes. I feel they do. Mr. McKeefery: Yes. Yes, models successful coaching practices. Mr. Mitchell: Yes. Some skills are learned during practice by taken part in team drills and watching others. Some athletes, especially one with lots of talent do not like to feel singled out during teaching sessions. Egos can be very fragile with successful athletes. Dr. Nimphius: Yes. In my opinion. Dr. Triplett: Yes. While some aspects of coaching go beyond the teaching of movement skills, the guidelines do match well with the part of coaching that is focused on skill performance.
Question 6: Are all the steps in the guidelines necessary for sport skill instruction and learning?	Mr. Caulfied: Yes. I believe these steps are necessary. Dr. Haff: No. Not convinced that this is critical for instruction as there are many ways to instruct sports skills. Mr. Kenn: Yes. This is a solid template. Dr. Mann: Yes. Same. Mr. McHenry: Yes. Yes, if a step is skipped it can cause problems later on. The process is important. Mr. McKeefery: Yes. I believe so Mr. Mitchell: No. Athletes acquire new skills at different speeds. Some are verbal, visual, or written or a combination of the three. Dr. Nimphius: Yes. In essence, however, some become combined steps or innate. For example, knowledge of performance is written as an aspect that the coach is always providing however, this is not always the case. In fact, to ensure that dependency doesn't occur (as mentioned) many drills/practice should be developed in a way that the knowledge of performance is inherently known (e.g. having a book on one's head while swinging a bat in an effort to ensure a stable head while the body still generates power for the swing. If the book falls, they have a "knowledge of performance") without actual feedback provided by the coach. This likely goes back to the addition of task and constraint stated above. Dr. Triplett: Yes. I believe so, to be most effective. Other methods of teaching motor skills may not utilize all the proposed steps but I believe that those methods will fall short with either the learning portion or the retention portion of motor skill acquisition.

Question 7: Can these guidelines be used in a variety of settings that focus on sport skill instruction and learning for athletic performance?	Mr. Caulfied: Yes. I think you could apply this to a lot of different areas. Dr. Haff: Yes. These could be used in athletics. Mr. Kenn: Yes. This process would be successful in any setting. Dr. Mann: No. If you would say athletic movement or something like that I would agree. Again, performance is dictated not just by the ability to do something but the ability to respond to a stimulus. It's similar to change of direction vs agility. This is completely appropriate for change of direction, but most likely will not impact true agility as the response to the speed of stimulus may be more important than the other. Mr. McHenry: Yes. I feel they can fit into anything. Mr. McKeefery: Yes. Yes, can be applied to all sports or skills. Mr. Mitchell: Yes. Youth coaches do not take enough time to adequately address these guidelines because of pressure or desire to win. Dr. Nimphius: Yes. In the way they are written, yes, they should be easily manipulated for any skill. Dr. Triplett: Yes. I believe these guidelines are general enough to cross over many different settings where sport skill instruction is the goal. The guidelines are tied more to how the brain and body learn and less about the specific skill being learned.
Question 8: Are the steps manageable in the order they presented?	Mr. Caulfied: Yes. Makes sense to me. Dr. Haff: Yes. The steps seem manageable. Mr. Kenn: No. I prefer to see #3 first, I would want to know previous history before gaining attention. I will already have their attention if they want to improve. Dr. Mann: Yes. Yes. Mr. McHenry: Yes. You may want to word on wording for a physical education teacher / sport coach but that is more wordsmithing then content. Mr. McKeefery: Yes. Yes, but needs to happen quickly. Mr. Mitchell: Yes. I agree with the order but I personally change according to the athlete I am working with. Dr. Nimphius: Yes. Yes. Dr. Triplett: Yes. The steps presented are in an appropriate and logical order to best learn a motor skill. At first glance 9 steps seems like a lot but if the practitioner looks more closely, the steps simply break down the learning process into easily digestible units for the learner and for the teacher.

Question 9: Do the guidelines address environmental factors that may be presented during the learning process?	Mr. Caulfied: Yes. Yes. Dr. Haff: No. Not sure that these guidelines address environmental factors. Mr. Kenn: No. This seems to present a process that can be utilized regardless of location. Dr. Mann: During the learning process yes, but during sports performance, no. Mr. McHenry: Yes. I feel they do. Mr. McKeefery: No. It mentions being within the environment, but not sure it discusses external stresses that could occur while doing the movement in competition. Mr. Mitchell: Yes. It is the coach's responsibility to recognize and discuss the environmental factors with the athletes. It is important to recognize the learning environment but also the environment the athlete was raised in. Dr. Nimphius: No. Not to the degree expected (see above statements). I believe more reflection on how changing the environment, often done within the task could be made clear. The environment is only discussed initially but not the manipulation of environment often done in practice. Dr. Triplett: Yes. Especially in steps 1 and 5, external factors that affect learning are addressed.
Question 10: From your perspective as an athletic performance coach, what aspects of the guidelines work well?	Mr. Caulfied: Building off previous experience and demonstrations make most sense to me as a coach, and of course helping them by cueing. Dr. Haff: As a coach it is clear that people have different learning styles. Descriptions work for some others may learn from reading text or modelling movements. Mr. Kenn: It will depend on how the coach presents the information to the athlete. Dr. Mann: I think that for basic movement acquisition it would work well. Mr. McHenry: The process it is step by step, you give the "why" and you have feedback. Mr. McKeefery: I think they all work well, a skilled coach would need to be able to transition between the steps seamlessly, as not to be robotic. Mr. Mitchell: Gaining the attention of the athlete, informing the athlete of the objective, verbal, and written explanation, providing feedback, and assessing performance have worked well for me. Dr. Nimphius: All aspects on the guidelines work well, however, depending on the athlete or scenario certain areas may have more focus (e.g. assessment may be a critical aspect for some skills where with others the process is leading to something larger that will ultimately be more of the required assessment).

	Dr. Triplett: I particularly like steps 3,4,5, and 7. These focus on the teaching aspect. Steps 6, 8, and 9 are typical of any learning model.
Question 11: How would you improve the guidelines?	Mr. Caulfied: I think it's good like it is. Dr. Haff: I would consider other learning styles. Mr. Kenn: The guidelines are solid, but I need to see more of HOW are we going to implement this in the team setting. Dr. Mann: It's all about drilling and improving cognitive aspects of sport as well. Things like quiet eye and other things to enhance anticipatory skills. Mr. McHenry: As I said before, making it a little easier to read for sport coaches / P.E. teachers. Mr. McKeefery: I would add Kinesthetic (Feel) step, also discuss the difference between internal and external cueing see Nick Winkleman. I would also discuss how stress may affect the movement and create strategies for success. Mr. Mitchell: A coach really just needs to know how to when to use them. Dr. Nimphius: Already stated with respect to task/constraint/environment. Dr. Triplett: I can't think of anything to add or change.
Question 12: How well do you believe these proposed guidelines for psychomotor skill learning reflect Gagne's Nine Events of Instruction?	Mr. Caulfied: Very well it's a close model. Dr. Haff: I am not familiar with Gagne's Nine Events of Instructions.... Mr. Kenn: This was well thought out and you can see the true effort that was taken to put together a manageable plan for learning to take place. Dr. Mann: I can't answer this, as it has been a very long time since I went through that. Mr. McHenry: This was the first time I heard about the nine events of learning. I like them and this it is a great way of teaching. I have done many of the steps but not called it this. Mr. McKeefery: Very similar and applicable. Mr. Mitchell: I believe these guidelines accurately reflect the nine events of instruction. Dr. Nimphius: Very good parallel. Dr. Triplett: The proposed guidelines seem to follow Gagne's instruction events precisely. The examples provided are excellent.
Question 13: What additional feedback do you have about the guidelines?	Mr. Caulfied: I like it and would like to see it put into action by other coaches. Dr. Haff: I can think no other additional feedback. Mr. Kenn: What type of teaching models will be utilized, whole part whole etc. Dr. Mann: Motor acquisition this is great. I am unsure if it will enhance actual performance in sports where anticipatory and reactionary skills are needed. Track and swimming it would be fantastic- football, etc., maybe less so.

	Mr. McHenry: I would like to use them in a real life situation. I have seen things that look good on paper but do not work well in real life. I think this would work well. Mr. McKeefery: I would provide more examples of how a coach can use these steps through questions and situations. Mr. Mitchell: It is important to be able to apply these guidelines in real life situations. The coach must go by a case by case situation. Dr. Nimphius: As stated above. Dr. Triplett: I like how these are presented and would like to use something similar in my future teaching.

APPENDIX G

PARTICIPANT INVITATION LETTER

GUIDELINES FOR PSYCHOMOTOR SKILLS INSTRUCTION FOR ATHLETIC PERFORMANCE: A DESIGN AND DEVELOPMENT STUDY

January ___, 2018

Dear _____,

My name is Allison Randall. After research and several discussions with my advisor and doctoral committee, it was recommended that I contact you. I am a PhD candidate in the Instructional Design and Technology program at Virginia Tech. I am also a graduate assistant in the Strength and Conditioning department for Olympic Sports at Virginia Tech where I coach student-athletes through activities to improve sports performance.

I plan to defend my dissertation during the spring semester of 2018. My dissertation is a design and developmental study that establishes guidelines for psychomotor skill instruction for athletic performance. These guidelines mirror the themes used in Gagne's Nine Events of Instruction yet focus specifically on instructional strategies for novice learners in skill acquisition. The guidelines were developed from an extensive literature review and establishes specific action items that facilitate instruction and learning.

In order to determine the content and construct validity, I require expert reviewers in the areas of instructional design and technology, psychomotor skill learning, and athletic performance coaching. Therefore, this letter serves as an invitation to participate in my study.

I am aware that you are extremely busy and greatly appreciate your consideration to potentially participate in my research. This letter is intended to determine your willingness to serve as an expert reviewer. With your agreement to participate in this study, you will receive an interview package that contains a copy of the informed consent form, a copy of the guidelines, and the expert reviewer survey to assess the guidelines. The survey will take approximately 20 to 30 minutes to complete. You will have until January 20, 2018 to review the guidelines and submit your responses. Once I have received your responses, there may be a follow-up interview in order to gain clarity on any responses you have submitted. The interview will be via video or voice call and will take between thirty minutes to one hour. Your participation in this study will not be anonymous. Data will be analyzed, reported and described for a doctoral committee and dissertation/publications, using your identity. As an expert reviewer, your identity as an expert will bring validation and credibility to my study. Your participation is voluntary and you have the right to withdraw at any time.

I would greatly appreciate your participation in this process. Your expertise in your respective area is of great value for this research and will assist me in adding knowledge to the realm of education and skill acquisition. I look forward to hearing from you soon. Thank you in advance for your consideration.

Sincerely,

Allison Randall

APPENDIX H

INSTITUTIONAL REVIEW BOARD APPROVAL LETTER

VirginiaTech

Office of Research Compliance
Institutional Review Board
North End Center, Suite 4120, Virginia Tech
300 Turner Street NW
Blacksburg,
Virginia 24061
540/231-4606
Fax 540/231-0959 email
irb@vt.edu
website
http://www.irb.vt.edu

MEMORANDUM

DATE: December 13, 2017

TO: Barbara B Lockee, Allison Randall

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires January 29, 2021)

PROTOCOL TITLE: Guidelines for Psychomotor Skill Instruction for Athletic Performance: A Design and Development Study

IRB NUMBER: **17-911**

Effective December 13, 2017, the Virginia Tech Institution Review Board (IRB) approved the New Application request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at: http://www.irb.vt.edu/pages/responsibilities.htm

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As: **Expedited, under 45 CFR 46.110 category(ies) 6,7**

Protocol Approval Date: **December 13, 2017**

Protocol Expiration Date: **December 12, 2018**

Continuing Review Due Date*: **November 28, 2018**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

Date*	OSP Number	Sponsor	Grant Comparison Conducted?

* Date this proposal number was compared, assessed as not requiring comparison, or comparison information was revised.

If this IRB protocol is to cover any other grant proposals, please contact the IRB office (irbadmin@vt. edu) immediately.

APPENDIX I

REVISED GUIDELINES FOR PSYCHOMOTOR SKILL INSTRUCTION FOR ATHLETIC PERFORMANCE

G9E	Original Instructional Guideline	Revised Instructional Guideline	Example in Practice
#1-Gaining attention • Stimulate students interests • Pose questions	**FOCUS IN (ATTENTION)** Explaining the usefulness of the skill grabs the athletes' attention. Express how the skill can enhance athletic performance to gain their interest. Expose the athlete to the environment and/or equipment before instruction to allow for comfortability when acquiring the new skill.	**NO CHANGE**	• When an athlete enters the weight room for the first time, provide a brief overview of space and equipment they will be using. Also, express how what they will be doing can help them be better athletes in their respective sports.
#2-Informing learner of the objective • Describe performance and end goals • Explain criteria	**WHAT WILL THEY DO (THE SKILL)** Learning goals are presented to provide an overview of the skill to be learned. Include a description of player characteristics (who is doing it), the skill (what is being done), and performance criteria (how it will done). This sets a framework for the athlete to operate within during the learning process.	**NO CHANGE**	• Once you have grabbed their attention, tell them exactly what they will be doing. Explain how as track and field athletes, they will be learning the power clean. This is a lift that assists in power development and will be done in a safe and efficient way.
#3-Stimulating recall of prerequisite learning • Ask about previous experiences	**WHAT DO THEY KNOW (PAST EXPERIENCE)** Beginners have no formal training in the skill to be learned; therefore, stimulating relatable experiences in will assist in promoting familiarity for the athlete. Recollection of any previous knowledge that is associated with the skill aids in bridging the gap between old and new skills to enhance athletic performance.	**WHAT DO THEY KNOW (PAST EXPERIENCE)** Beginners have no formal training in the skill to be learned; therefore, stimulating relatable experiences will assist in promoting familiarity for the athlete. Recollection of any previous knowledge that is associated with the skill aids in bridging the gap between old and new skills to enhance athletic performance. Once these past	• Before providing a demo, ask the track and field athlete if they have ever jumped, sprinted or thrown anything in the past. Explain how all these activities occur by being explosive and moving as fast as you can. This is the idea behind the power clean. This explosive movement will help you generate more power so you can run, jump and throw further.

		experiences are remembered, coaches can point out how these experiences are similar to the new sport skill.	
#4-Presenting the stimulus material • Demonstrations • Examples and vocabulary	**HOW DO THEY DO IT (DEMOS)** When demonstrating the skill to the athlete, provide visual, verbal and written explanation prior to instruction. This ensures that all means of communication are addressed to encourage an efficient learning process. Describe important components of the skill for full understanding of the physical and mental demands that are being expected. This includes specifics on movement quality, terminology, and movement sequences for skills that have several steps. Demonstrations can display the learning process and/or an expert performer and can be done in person or with an audiovisual medium.	**NO CHANGE**	• When showing the athlete how to perform the power clean, be sure to explain it verbally, show a visual demo, and display the name of the lift. Explain the terms of each portion of the lift (lift-off, 1st pull, 2nd pull, catch), body positions and movement (shoulders over the bar, keeping bar close to the body, etc.), and focus of the lift (move quickly, firm catch). This demo can be done in person or using any available video display of a clear view of the power clean being performed.
#5-Providing learning guidance • Advise students of strategies • Scaffolding, cues, hints, prompts, mnemonics, concept mapping, visualizing	**HELP THEM DO IT (CUEING)** Skill guidance comes from a coach and/or peer who is skilled and knowledgeable in the skill. These cues are given in visual, verbal, and written forms when presented to the athlete. Cues are given to focus the athletes' attention to specific aspects of the skill. Beginners benefit from external focus of attention during skill acquisition. For example, in the long	**NO CHANGE**	• Give the athlete cues that help them correct the technique. For example, if the bar is traveling away from their body, tell them to keep the bar close to their body, show them what it looks like, and if possible, write "keep bar close" on their training sheet for them to refer back to.

• Examples and non-examples • Metaphors	jump, coaches should say "jump and try and reach this line", instead of "jump and send your hips forward".		
#6-Eliciting the performance • Students practice	**WORKING AT IT (PRACTICE)** Provide a structured practice schedule when beginners practice a new skill. Allotting time to practice encourages athletes to maximize attempts and strive for successful trials. While athletes practice, give demonstrations, cues, and feedback of performance to promote accurate practice attempts. Utilizing blocked and serial practice methods assist in skill acquisition with beginners as well.	**WORKING AT IT (PRACTICE)** Provide a structured practice schedule when beginners practice a new skill. Allotting time to practice encourages athletes to maximize attempts and strive for successful trials. Emphasizing mental practice will also assist is the athlete's ability to see what they need to do between trials. While athletes practice, give demonstrations, cues, and feedback of performance to promote accurate practice attempts. Utilizing blocked and serial practice methods assist in skill acquisition with beginners as well. The addition of environmental factors can assist in the learning process for beginners. This then forces the learner to adapt in order to overcome the environmental constraint in order to complete the skill correctly.	• Make sure the athlete is able to have several minutes to practice the power clean over several training sessions. Programming in sequential progressions of the power clean can help build on the skills from the last step. Also, between each sets, encourage them to think about being fast, explosive and sharp with their movements during the next set. As they get better with the power clean technique, add weight, starting points, and paused portions of the lift to reinforce good habits. This will make the overall movement pattern more efficient.
#7-Providing feedback about performance correctness	**HOW CAN THEY FIX IT (FEEDBACK)** While beginners practice the new skill, feedback is given by coaches and instructors. This information is	**NO CHANGE**	• As they practice, give them feedback on how well they are doing. Coaches can give additional demos of what the power clean should look like and

• Knowledge of performance and/or results	provided in the form of demonstrations or cues that are task relevant and correct errors in technique. Inform the athlete of how the skill can be corrected visually, verbally, and in writing. In order to promote autonomy with the new skill, manipulate feedback occurrences by avoiding 100% feedback. This discourages instructor-dependency when learning new skills.		give verbal and written cues to make corrections. Be sure not give the athlete feedback on every attempt. This will cause them to rely more on the coach's cues than how they feel doing the movement.
#8-Assessing the performance • Pre and post testing • Objectives are measured	**HOW WELL DO THEY DO IT (ASSESSMENT)** When assessing the new skill, the pretest, midpoint test, posttest, and retention test should be the same. They must address the learning goals and technical elements specific to the skill. Use quantitative and qualitative testing to gather thorough information on athletes' outcome of the skill, movement patterns, confidence level, and other information pertaining to the learning process.	**NO CHANGE**	• Make sure that athletes are using the same type of equipment as they use in practice. If they use an Olympic bar and rubber plates during practice sets, use the same thing when testing their strength and technical performance during the power clean. Ask the athlete if they are feeling more confident in the new movement and see how well they perform the skill. With this information, you can make adjustments to the training program.
#9-Enhancing retention and transfer • Internalize new knowledge	**DO THEY KNOW IT AND CAN THEY USE IT (RECALL AND TRANSFER)** Establish opportunities for athletes to recall and perform the new skill after instruction. Limit feedback to allow autonomy and ownership of the skill.	**NO CHANGE**	• Once the athlete has learned how to power clean, allow them to perform a 1 to 3 rep max to see how well they hold their technique. Also, begin implementing other Olympic lifts that use similar principles to

• Obtain ownership of new skill • Using new knowledge in the future	This will promote confidence in performing the new task and reassure the athletes' ability to utilize the skill in current and future athletic performance settings.		complete correctly (shoulders over the bar, keeping the bar close, etc). This would include various power clean variations (hang clean, box clean) or a step in the snatch progression (hang snatch, power snatch).