UNIVERSITY OF EDUCATION, WINNEBA

EFFECTIVENESS OF AUGMENTED FEEDBACK IN THE ACQUISITION OF MOTOR SKILL AMONG PRIMARY SCHOOL PUPILS IN NAVRONGO, GHANA

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A thesis in the Department of Health, Physical Education, Recreation and Sports, Faculty of Science Education, submitted to the School of Graduate Studies in partial fulfilment of the requirements for the award of the degree of Master of Philosophy (Physical Education) in the University of Education, Winneba

JUNE, 2023

DECLARATION

Student's Declaration

I, Prosper Ayimbila Asabia, declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE: …………………………

DATE: ………………………………….

Supervisors' Declaration

I hereby declare that the preparation and presentation of this thesis was supervised in accordance with the guidelines for supervision of thesis as laid down by the University of Education, Winneba.

SUPERVISORS' NAME: REGINA AKUFFO DARKO (PhD)

SIGNATURE: …………………………

DATE: ………………………………….

DEDICATION

I dedicate this work to my parents, Mr & Mrs Asabia, to my lovely wife, Jennifer and kids, Mbobila, Sumboyine, Yinnogema and Pegeyine for their spiritual and financial support.

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To God be the Glory for all the great things he has done in my life, the guidance, protection and health offered me. I would like to express my sincere gratitude to my supervisor Dr. Regina Akuffo Darko for her professional guidance, advice, encouragement, and goodwill with which she guided this work. Importantly, he allowed me to make my own successes and mistakes throughout this research journey whilst expertly steering me in the right direction when required. I am very grateful. I would also like to express my sincere gratitude to the late Prof. Henry Pufaa and late Dr. Baba Jatong for their initial support to the start and completion of this thesis, and the programme as a whole. I am also grateful to Dr. Munkaila Seibu and Mr. Eric Aloko for their generous contributions, encouragement, and support which aided me to complete this work.

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Finally, I am grateful to all authors whose works I consulted while writing this thesis.

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ABSTRACT

This study aimed at determining the effectiveness of knowledge of results (KR) and knowledge of performance (KP) in learning a motor skill. A two-group pretest posttest, quasi experimental design was used. Target population for the study was Primary School pupils in the Kasena Nankana Municipality. A simple random sampling technique was used to sample 60 pupils in the lower grade for the study. Data was collected using Test of Gross Motor Development -2 (TGMD-2) instrument and a self-designed observation checklist instrument. The instruments were used to assess the process and product measure of overhand throwing skill respectively. A paired sample t-test was used to determine the difference in pre-test and post-test results of KP and KR group and an independent sample t-test was used to determine the difference in KP and KR interventions with alpha level set at 0.05 for two tailed. Findings of the study revealed a very low performance in the overhand throwing skill at the pretest phase which suggests that the pupils did not have enough proficiency in the overhand throwing skills. The study also showed an improvement in the mean difference on post-test skill acquisition over pre-test skill acquisition by both the KR ($M= 1.48$) and KP ($M= 3.81$) groups. The results also revealed a significant effect of KP intervention ($M=7.74$, $SD=1.26$) over KR intervention ($M=5.37$, $SD= .99$). Hence, the findings supported the idea that KP is more effective than KR in this current study. It was concluded that, without the knowledge of performance, learning would be very slow and will often stop. It is, therefore, recommended that; lower primary teachers should focus on providing KP in relation to the objective established than KR to their pupils' performances.

CHAPTER ONE

INTRODUCTION

1.0 Background to the Study

It is critical to examine the diverse components of movement for good education. As humans, we desire to fully and actively participate in all aspects of life while simultaneously learning to live in our environment. Living a rewarding and meaningful life demands a constant expansion or alteration of individual abilities and skills. Ability to function has an impact on our ability to survive in the world, and the quality of our functional ability is linked to all aspects of development (physical, social, emotional, and mental), all of which are influenced by our functional movement ability (Donna & Suzanne, 2012).

According to Laura et al. (2011) time, experience and knowledge are the basis for motor skill development among children. It follows a predictable pattern, starting from the inner part of the body to the outermost part of the body. Therefore, to get the best out of children at the early years, efficient movement must be learnt during physical education (PE) practical class. Learning is described as a significant and long-lasting improvement in a person's ability to perform a task as a result of practice (Kohl & Cook, 2013). While learning is described as the process of collecting knowledge about our environment, motor learning is defined as a collection of processes linked to practice that can result in a long-term improvement in a person's ability to perform a motor skill (Yoon et al., 2013). The underlying physiological systems that allow the body or portions of the body to move in space are known as motor skills (Cameron et al., 2016).

A motor skill, according to Magill and Anderson (2013), refer to a task with a specific goal or purpose. Good motor skills are important for childrens' physical, social, and psychological development, and may even serve as the foundation for an active lifestyle. There is a correlation between good motor skills and increased physical activity (Lubans et al., 2010). Furthermore, childhood physical activity (PA) promotes the development of motor skills (Iivonen & Sääkslahti, 2014). As a result, motor skill competency is recognized as an important component in future physical activity engagement and sports, development of positive attitudes toward physical education and participation in physically active play. Hence, motor skill development is inextricably linked to physical activities (Ericsson, 2011; Kara et al., 2019).

Motor skills are commonly divided into two categories: gross motor and fine motor. Gross motor skills, such as sitting, jumping, throwing, and walking, necessitate large muscle movements. Fine motor abilities like gripping and sketching necessitate the use of teeny-tiny muscles (Walle & Campos, 2014). During the early years of childhood, children learn to use more of their big muscles to engage in physical activities than their smaller muscles, even though they never fully master the use of these big muscle abilities at this level. Gross movement abilities are the fundamental movement skills that are required for participation in increasingly complex physical activities (Lubans et al., 2010).

Fundamental motor skills (FMS) are described as learned movement patterns that do not occur naturally and are thought to serve as a basis for more sophisticated and advanced physical and sporting activities (Barnett et al., 2014). Because it is changeable, it is suggested that FMS proficiency is one of the most important predictors of children's physical activity (Logan et al., 2012). Fundamental motor skills are crucial for children's physical, social, and cognitive development in the long run (Lloyd et al., 2014). They can be divided into three categories: Walking, running, hopping, skipping, jumping, dodging, and side stepping are examples of locomotor skills; balancing and landing are examples of non-locomotor skills; catching, throwing, kicking, the underarm roll, and striking are examples of manipulative skills (Hands & McIntyre, 2015).

Experts believe that having a good understanding of FMS is linked to being more active during childhood and adolescence (Lloyd et al., 2014). Typically, lessons focusing on FMS development can lead to higher PA levels (Lee et al., 2020), and structured PA can lead to better FMS mastery (Van Capelle et al., 2017). The mastering of FMS involves achieving appropriate motor skills. Throwing is one common FMS that children acquire at the early years of life.

Throwing is considered one of the most important manipulative skills. Depending on the throwing style, reaching the proper ball throwing distance is necessary for proper execution, but precision is always required (Nakata et al., 2013). Total body movement during throwing necessitates a variety of physical fitness attributes. According to research, ball throwing is linked to total body conditions such as flexibility and endurance, balance, agility, strength, and power (Debanne & Laffaye, 2011). It is therefore, important for physical education teachers to design appropriate task with feedback and instruction to improve children's throwing competences at its finest (Rink, 2014).

Children require feedback from a physical education instructor regarding performance during the process of learning a motor skill, which determines and defines the level of successful execution of the motor activity. In area of motor learning, feedback is regarded as one important factor in skill acquisition as the bodies get sensory instructions from a variety of receptors from feedback (Schmidt & Lee, 2014). When feedback is used effectively in the teaching and learning process, the highest skill level can be achieved in the least amount of time (Sigrist et al., 2011). As a result, physical education teachers must be aware of the types of feedback that are most effective in driving motor skill acquisition in a variety of instructional contexts, as well as the importance of feedback to the learner.

Feedback is what happens when a person receives information about how well they perform a skill. Feedback directs learners' attention to the most important components of the task and keeps them motivated by rewarding or penalizing correct or improper actions (Lauber & Keller, 2014). Furthermore, feedback can be given in a variety of ways, such as verbal, nonverbal, visual, and content categories including correct, incorrect, normative information, and praise (Brennan et al., 2019). When feedback is delivered in a positive manner, it encourages children to self-regulate and progress, but when given in a negative manner, it degrades self-regulate and progress. Mistakes are viewed as crucial learning opportunities in the context of feedback. It encourages students to experiment with different ways and seek out more resources to further their knowledge, understanding, and skills (Cauley & McMillan, 2010). It also assists students in learning about different tactics, taking new directions, and locating additional material to help them progress in their studies (Stronge & Xu, 2016).

Studies have looked at how feedback affects students' motor skill learning in PE classes and concluded that, feedback have a favourable impact on students' motor skill learning (O'Loughlin et al., 2013; Whipp et al., 2015). However, other studies have found that feedback has no effect on pupils' motor skills learning (Kok et al., 2019; Drost & Todorovich, 2017). Other research compared information feedback to praise and found that individual information feedback has a greater impact on students' behavior than praise (Drost et al., 2015). Students' lacrosse skills, on the other hand, showed no significant variations (Drost & Todorovich, 2017). In PE classes, these elements will have a variety of consequences on students' motor skill learning. Because of the discrepancies among studies, more research is needed to determine the impact of feedback on students' motor skill learning in physical education practical lesson.

There are two sorts of feedback that inform students about their performance results and the causes of those outcomes (Magill & Anderson, 2014). Intrinsic feedback is the first sort of feedback, consisting of information provided by the performer's senses while performing the task (i.e., visual, aural, proprioceptive, tactile) and it is inherent and present under normal conditions (Lauber & Keller, 2014; Ives, 2014). The second sort of feedback is augmented or extrinsic or external input, which comes from an external source to supplement intrinsic feedback and it is delivered by a teacher (Magill & Anderson, 2013; Fairbrother, 2010). Augmented feedback is provided for two reasons, regardless of the accuracy of the attempt. Thus, it enables pupils to recognize what aids or inhibits task performance, which speeds up the development of a movement skill. Secondly, it motivates pupils to meet their movement objectives (Magill & Anderson 2013). Not only is augmented feedback beneficial when employed over a long period of time but it can also result in short-term performance improvements (Petancevski et al., 2022).

Augmented feedback can be divided into two forms, thus Knowledge of Results (KR) which is an externally displayed information about the results of a skill attempt or how close the endeavor came to achieving the desired result while Knowledge of Performance (KP) provides detailed information regarding task performance (Kim et al., 2012; Magill & Anderson, 2013). KP refers to certain movement component features of how the learner moves while performing a task (Magill & Anderson, 2017; Schmidt & Lee, 2014). KP information serves as the foundation for determining whether or not a movement is accurate. Young and Schmidt (2010) used a coincidental-timing task with three KP feedback regimens. They observed no significant differences between the three KP schedules, but they were keen to point out that those who received KP after every trial had lower scores than those who received the other two types of feedback.

Tajudin et al. (2016) evaluated the acquisition of performing the squat method with visual and verbal feedback in another study. Results from the study revealed that participants who received both visual and verbal types of feedback improved significantly above the control group, although verbal input was found to be more helpful. Sharma et al. (2016) studied the effects of KP and KR on adults learning a motor skill. Both groups increased their motor skills, although the KP group improved more than the KR group. According to Lauber and Keller (2014), both KR and KP are beneficial to motor skill performance.

Augmented feedback has demonstrated to be a distinct factor that successfully increases the performance and development of motor abilities by facilitating information processing (Sigrist et al., 2013; Wulf et al., 2010). In facilitating the information processing of children, physical education teachers tend to plan activities for children to enjoy games, improve performance and support motor development through instruction and feedback (Negrete et al., 2011). Sharma et al. (2016) concurs that both types of feedback (KR and KP) are beneficial in enhancing the performance of a motor skill (throwing, assessed in distance) in the young adult population, thus, effectives of augmented feedback on pupils' acquisition of overhand throwing skills needs to be ascertained in Ghanaian context, hence this study.

1.1 Statement of the Problem

The benefits derived from throwing activities can be achieved to the fullest if children are given appropriate augmented feedback. However, there is insufficient evidence as to which type of augmented feedback is most beneficial to children for skill acquisition and improvement.

Despite the numerous benefits of Knowledge of Performance (KP) and Knowledge of Results (KR) on the acquisition of motor skills by children, yet, there is paucity in research to that effect in Ghana. Although studies by Darko (2018) and Somiah (2015) looked at effect of traditional games on overhand throwing skill development and gross motor skills development among Ghanaian pupils respectively, thus far, that of effectiveness of KP and KR on overhand throwing skill acquisition is not known.

Moreso, most of the previous studies (Sharma et al., 2016; Lim et al., 2015; Dana et al., 2011) on augmented feedback focused on the acquisition of skill by elite athletes, adults, young adults, or novice young adults in a specific sports context, with a greater emphasis on complex motor skills. Little is known about how augmented feedback affects the acquisition of a simple motor skill by children in lower grades. Hence, this study determined the effectiveness of augmented feedback (Knowledge of Performance and Knowledge of Result) on overhand throwing skill among the lower primary pupils in the Kasena Nankana Municipality in the Upper East Region of Ghana.

1.2 Purpose of the Study

This study aimed at determining the effectiveness of knowledge of results and knowledge of performance in learning a motor skilled activity among pupils in the Kasena Nankana Municipality.

1.3 Objectives of the Study

The study was guided by the following objectives: To determine the;

1. developmental level of overhand throwing skill performance among the lower primary pupils.
2. differences in pre-test and post-test skill acquisition in overhand throwing by KP and KR groups among the lower primary pupils.
3. effect of KP and KR interventions on overhand throwing skill acquisition among the lower primary pupils.

1.4 Research Questions

1. What is the developmental level of overhand throwing skill performance among the lower primary pupils?
2. What is the difference in pre-test and post-test skill acquisition in overhand throw by KP and KR groups among the lower primary pupils?
3. What is the effect of KP and KR interventions on overhand throwing skill acquisition among the lower primary pupils?

1.5 Research Hypothesis

H_0: There is no significant difference in overhand throw between KP and KR groups among the lower primary pupils.

H_1: There is significant difference in overhand throw between KP and KR groups among lower primary pupils.

1.6 Significance of the Study

To begin with, this study can significantly contribute to the expansion of knowledge regarding KP and KR in the acquisition of a motor skill among lower-grade pupils, resulting in a more effective method of teaching physical education to primary school pupils. Secondly, the findings can help teachers at lower primary develop suitable feedback systems in order to maximize students' motor skill acquisition. Finally, the study's conclusions and findings may serve as a useful document for future research as well as contribute to the existing literature in the field. Extend understanding of the effect of augmented feedback (KP and KR) on the learning of motor skills in the teaching of physical education (P.E.)

1.7 Delimitations of the Study

The study was delimited to lower grade pupil at St. John Bosco's Demonstration Practice Primary School in Kasena Nankana Municipality of the Upper East Region. Only lower primary pupils were targeted, with a focus on practical physical education lessons.

The focus in the practical physical education class was on the one-handed overhead throw method, with an emphasis on following the teachers' augmented feedback. The practice sessions for skill acquisition phase lasted one hour per week over a period of 4 weeks.

The results of this study were also delimited to pupils of St. John Bosco's Demonstration Practice Primary School in Kasena Nankana Municipality. The study does not attempt to determine if other pupils in different school would achieve similar results in using this instructional approach.

1.8 Limitations of the Study

This study had some inherent limitations. First, because the study took place in one primary school in a large municipality, the pupil's population may not be representative of all schools in this municipality or Ghana, so the findings of this study cannot be used to make general assumptions about other pupil's populations. Also, the results of this study were also limited by the duration of the study, with the allocated time for physical education class being two (2) periods (1 hour) per week. Research studies that have had a positive impact on lower primary school pupils' improvement included longer interventions. However, due to the time constraints imposed by the participating school, this study was conducted for 4 weeks.

The amount of KP and KR feedbacks given to each participant was not controlled for during this study. In physical education settings, all participants do not receive identical amounts of feedback. Controlling the feedback was therefore not a goal of this study. However, skill appropriate KP and KR feedbacks were provided to the intervention groups on an individual basis.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Overview

The purpose of this study was to compare the effectiveness of knowledge of results and knowledge of performance in learning a motor skilled activity with the dominant upper limb among pupils in the Kasena Nankana Municipality. This chapter constitutes the review of both theoretical and empirical information on the topic under investigation. The chapter provides an extensive review of current and relevant literature in this particular field of study. The conceptual and empirical review takes a critical look at works people have already done on the topic under study while the theoretical review constitutes theories that rally on feedback and its impact on motor skill acquisition in Physical Education.

2.1 Theoretical Review

It is commonly established that educational theories and models provide a framework for generating, comprehending, and implementing interventions (Glanz et al., 2008). To construct this intervention project and explain its findings, the Schmidt's schema theory (1975) was used to guide the targeting of specific components. According to schema theory (Schmidt 1975), the production of a movement pattern involves a generalized motor program (GMP), or GMP that is retrieved from memory and then adapted to a particular situation. According to the theory, the concept of external feedback, which is regarded as a crucial aspect in the learning of effective movement, has an impact on an individual's motor learning behaviour (Wulf et al., 2010). Therefore, in starting children's FMS programs, feedback at all levels of motor learning is seen to be vital, as this positively influence their FMS levels.

2.1.1 Schmidt's theory of learning

Schmidt's theory (Schmidt, 1975) was based on the idea that we refer to abstract relationships or rules governing movement rather than storing actions. According to the theory, an individual does not need a separate motor program for each unique expression of a skill. Instead, the motor program is broad and adaptive to a wide range of situations, allowing the latter to complete the tasks. In general, those who have practiced a range of movements will be better equipped to perform a novel version of the activity than those who have not (Moxley, 1979).

An individual will either create a new generalized motor program or change an old one when learning a new movement. By altering the factors that dictate how movements are generated in that activity, the individual learns how to produce these various movements within that activity. Parameters are characteristics of a movement, such as its duration or overall time, or the amount of force developed in the muscles involved in the action (Haibach et al., 2017). People make variations in their movements by scaling these factors up or down.

People learn the relationship between the parameters of throwing a ball and the outcome of the throw as they practice a movement, such as throwing a ball to a target, improving their awareness of the relationship between the movement's outcome and their control of the movement's parameters. For example, the distance and speed of a throw are adjusted depending on how far the target is from the thrower. The schema theory explains how these parameters are altered when the generalized motor program is selected to allow novel movements.

Generalized Motor Programs (GMP) and Schemes are the two key constructions that support this claim. According to Schmidt (1975), a single GMP would be in charge of controlling work that required similar skills or variations of the same skill. The structure of the movement is governed by information such as the sequencing of sub-movements, relative time, and relative pressures in a generalized motor program (Wulf et al., 2010).

A motor program is a collection of motor commands that specify the key aspects of a skilled action (Schmidt et al., 2018). As a result, the generalized motor program supports the generation of new movements based on previously learned movements, which means it is used and changed anytime a learner performs a new movement. After performing a movement with the generalized motor program, the individual will temporarily store four types of information: initial conditions, such as body position (proprioceptive information), weight of an object; parameters, such as time, strength, force, speed, and direction, which allow the individual to adjust a movement to meet specific environmental demands; and knowledge of results (KR), which is information available after the movement has been completed (Sattler et al., 2012).

The learner can develop two relationships between these four sources of knowledge because they are stored for just long enough (Schmidt, 1988). Schemas are built using the relationships between various pieces of information. A schema is a set of rules that serve as a foundation for making a decision (Schmidt et al., 2018). It is created by combining knowledge from prior experiences to create a rule that may be applied to similar events in the future (Schmidt et al., 2018). In other words, new movement requirements are built on previously developed schemes that are strengthened by previous movement experience (Lage et al., 2015).

The Recall Schema and the Recognition Schema are the two schemas that result from merging information after a movement is performed. The recall schema refers to the generalized motor program's selection of parameters for initiating a desired movement. It requires minimal external feedback and draws information from the baseline conditions and parameters and then generates fresh data to address a new goal using the motor program (Adolph et al,.2015).

A generalized motor program and a movement outcome are linked in the recognition schema (Schmidt, 1982). Initial conditions, prior actual results, and past sensory repercussions make up the recognition memory, which allows the individual to recognize errors. As a result, if an error is found, the schema will be updated depending on the feedback received, resulting in improved performance during the learning process. The recognition schema is in charge of movement evaluation and relies on sensory feedback to determine knowledge of results (KR) and knowledge of performance (KP). The response feedback delivered once the movement is completed is evaluated by recognition memory. More information is acquired each time the schema is employed, and the individual begins to create a relationship that allows them to produce the movement appropriately (Merbah & Meulemans, 2011 & Ariza-Vargas et al., 2011).

According to the theory, an individual does not need a separate motor program for each unique expression of a skill. Instead, the motor program is broad and adaptive to a wide range of situations. The individual will temporarily store four types of information after performing a movement. Namely, the initial movement condition which focuses on the body position, and weight of object, the parameters of a generalized motor program such as force, speed and direction, the outcome of the movement with emphasis on knowledge of results and finally the intrinsic sensory feedback of the movement with emphasis on vision and proprioception (feel sound or look) (Schmidt, 1975). Schemas are built using the relationships between various pieces of information. The recall schema and recognition schema are the two schemas that result from merging information after a movement is performed.

2.2 Motor Skills

An activity or task that has a specified purpose or objective to fulfill, according to Magill and Anderson (2014), is a motor skill. A motor skill is a learned set of movements that work together to produce a smooth, efficient action (Magill, 2010). As a result, the phrase "motor skills" usually refers to the abilities that result in the accomplishment of a practical goal. Because the functional purpose of motor skills may be traced all the way to adulthood, it's critical to understand the elements that support and inhibit motor skill development throughout the lifespan in order to comprehend children's motor patterns as they grow older.

Lloyd et al. (2014) looked at the long-term relationship between motor skill proficiency and self-reported PA and discovered that six-year-old children's motor skills were strongly connected with their perceived motor skill competence as teenagers. Furthermore, teenagers' reported motor skills were linked to their perceived motor skill competency at the age of 26. The findings imply that motor skill proficiency in childhood is a significant predictor of perceived motor skill proficiency in adolescence and adulthood, and that children with high motor skill proficiency at the age of six have a positive relationship with PA at the age of 26 (Lloyd et al., 2014).

Motor learning is required to improve and gain competency in these motor skills. Schmidt and Lee (2011) describe motor learning as a series of procedures, including practice or experience that result in generally permanent changes in movement capabilities. Motor learning, according to Kim at el. (2012) is a series of internal procedures that lead to persistent changes in movement and response skills through repetition. The demonstration of motor learning implies that changes in motor behaviour are maintained even after the skill acquisition time has passed. When a task is practiced, the first feature is a collection of change processes that enable the learner to grow more skilled at it. The second feature of learning is that it occurs as a result of practice or experience. The third trait is that learning cannot be observed directly and must be assessed through changes in behaviour, whether in movement quality or performance. Finally, the fourth characteristic is that learning causes a movement to change in a generally permanent way (Magill, 2010).

Motor learning can take place in two ways: explicitly or implicitly. Explicit learning is a conscious process in which the person is aware of the task and engages in cognitive processing, whereas implicit learning occurs when the person is not actively thinking about the task (Schmidt & Lee, 2011). It is the most prevalent type of motor learning since it requires less attention (Schmidt & Lee, 2011).

Many motor skills are learnt through the use of instructions, which usually break down lengthier, more intricate sequences of actions into simpler, more readily recalled and practiced components. As a result, instructions assist in the formation of an initial cognitive representation of the motor skill, which then directs physical practice (Meier et al., 2020). The three general phases of the learning process when the cognitive representation of the motor skill can be measured are acquisition, retention, and transfer (Land et al., 2014). The early practice (motor performance) of the new skill is referred to as the acquisition phase. The observed behaviour of a voluntary activity is known as motor performance.

The retention phase, which is done after a set amount of time has passed after the acquisition phase is the same for all learners and assesses how much of the acquired skill has been retained. The transfer phase follows the retention phase and is the same for all learners; however, it evaluates how well the internal mechanisms developed during acquisition can impact the execution of a new task that the learner has never encountered before (Schmidt & Lee, 2011). This is to say, every motor skill has its own array of skills, each with its own set of characteristics that alter depending on the situation in order to achieve effective and productive movement. The bodily engagement, pace of the skill, how continuous the skill is, the environmental conditions, and the cognitive involvement of the skill all influence a person's ability to meet the demands of the circumstance (Button et al., 2020). By this, the experiment presented in this thesis was developed to provide a full overview of the motor skill acquisition phase, as the goal of this thesis is to study how specific augmented feedback manipulations influence the learning of a motor skill.

2.3 Fundamental Motor Skills (FMS)

The psychomotor domain of PE is unique in that it comprises of developing neuromuscular abilities as well as fitness skills, which make up the health and performance-related skills. P.E.'s psychomotor component consists mostly of practicing various fundamental movement skills (Shimon, 2011). In PE, the emphasis is on FMS, which is the foundation of movement and being physically active in general, as well as all of the skills required in various sports. Basic movement skills support an active lifestyle throughout a person's life, and embracing those skills at a young age can be a vital component in combating the modern world's inactive lifestyle. Practicing basic movement skills has a wide range of benefits for children's overall well-being (Jaakkola et al., 2016).

Children are motivated in PE because they enjoy anything physical. They frequently fail to learn how to perform motor skills effectively because they are so fascinated with the abilities and feats they can do. These incorrect motor patterns may develop into habits that are difficult to correct later if they are not corrected properly (Colvin et al., 2016). In that event, it is critical for teachers to concentrate on how children engage in motor skill activities, particularly FMS, which is the foundation for future physical activities.

Children's fundamental movement skills are frequently underdeveloped when they enter school. In respect to that, inadequate FMS in childhood can lead to a sedentary lifestyle, which might raise the likelihood of developing certain health problems later in life (Lopes et al., 2012). Therefore, FMS should be intentionally taught to children rather than being considered to come naturally to them as they grow and develop. During the teaching process, the atmosphere must be provided to allow the child to practice the correct method while also providing adequate feedback to help the youngster progress and enhance the learned skills (Mukherjee et al., 2017). Because there is longitudinal evidence that motor skills track through childhood and into adolescence, the primary grades provide a great opportunity to develop fundamental movement skills to a desirable level.

Fundamental motor skills (FMS) are the fundamental movement skills that are necessary for the eventual acquisition of more sophisticated skills required in games, dance, sports, gymnastics, and leisure. They are major components of elementary school physical education curricula (Lubans et al., 2010). Fundamental motor skills are thought to be the foundations for movement and physical activity. They lay the groundwork for the specialized skills and advanced motor actions that are necessary in various games and sports (Payne & Isaacs, 2011).

Fundamental motor skills, according to Hurmeric (2010), are also the foundation for more advanced levels of movement activities that are required to participate in physical activities, games, and sports. The most widespread misconception about FMS is that children acquire those skills as a natural part of their development. However, in order for children to achieve a high degree of skill in FMS, it must be taught in a developmentally appropriate manner. Consequently, learning FMS is relatively persistent, implying that learned skills can be recalled and repeated even after extended periods of time away from practice (Jaakkola et al., 2010). The definition of what constitutes a fundamental motor skill has been influenced by whether the classification is done from the perspective of a basic multidisciplinary science of motor development over time or from the more practical concerns of education, fitness, and sport.

FMS involving a more specific movement occurs in the fourth phase of motor development, which occurs over a period of seven to fifteen years and demands good FMS control. Physical development is rapid at this age, and children are experimenting with new motor skills. Children acquire the majority of the FMS at this phase, which promotes future specialized skill performance (Kalaja & Jaakkola, 2015). As a result, the motor task should be varied, coordinated, and focused on establishing general characteristics of movement while managing objects (Kauranen, 2011). FMS provides the foundation for effective and competent mobility, allowing children to explore their surroundings and learn about the world. Children's ability to move and gain FMS is ensured when they develop fundamental motor competence during their early years (Gallahue et al., 2012).

According to research, FMS proficiency is linked to increased physical activity (Saunders at el., 2014). Children's FMS proficiency is low in a lot of nations, according to Barnett et al. (2013), with many children entering adolescence having not acquired these basic movement skills. Because of the obstacles that children confront in the twenty-first century and the quick shift in everyday life as a result of developing technology, it has been observed that children are unable to gain FMS at the appropriate level throughout their early years (Bryant et al., 2014; Hardy et al., 2013).

Research also shows that school-aged children have poor levels of FMS proficiency (Brian et al., 2018; O'Brien et al., 2016, Darko, 2016) and physical activity (Guthold et al., 2020). This is supported by the fact that children will have had fewer opportunities to develop FMS as a result of the ongoing COVID-19 pandemic, as they will have been confined to their homes for months, possibly with limited access to outdoor space and no physical education lessons or planned active breaks (Guan et al., 2020). On this backdrop, the researcher wishes to determine the developmental level of overhand throwing skill performance among lower grade pupils in Kasena Nankana Municipality.

Children with a high FMS proficiency have a lower decline in physical activity. Individuals with greater levels of FMS are more physically active in childhood than those with lower levels (Estevan et al., 2017; Lopes et al., 2012). Because motor proficiency is multidimensional and is based on the performance of flexion, extension, and rotational movements that lead to the successful performance of locomotor, balance, and manipulative skills, the promotion of motor proficiency, even in fundamental motor skills, should be emphasized at an early age. This is of special concern because a recent systematic evaluation of the health advantages of FMS proficiency demonstrated a constant and favorable relationship between FMS proficiency and physical activity and fitness levels, as well as an inverse relationship with weight status (Lubans et al., 2010). Fundamental motor skill development necessitates that children be exposed to the opportunity, encouragement, and environment necessary for the skills to go beyond the elementary stage of performance (Ghaly, 2010).

Even while childhood is focused on the acquisition of FMS, Gallahue et al. (2012), claim that the importance of high-quality skills is not as important in childhood. The emphasis should ideally be on improving fundamental motor skills and appropriate body mechanics in a wide range of movement skills and settings. The characteristics of the individual, the task, and environmental needs are the three types of demands that aids in the improvement of fundamental motor skill. Various mediators, including parental support, practice opportunities, and availability of proper equipment, might also encourage children to practice their FMS competence.

Furthermore, FMS development is not exclusively based on biological factors; FMS must be nurtured via practice (Hardy et al., 2012). Teachers are well aware that children learn best through teaching, particularly when they are given precise feedback on their efforts. Teachers must provide feedback to children in order to help them master essential motor skills. When feedback is specific and given shortly after a learning action, it is most effective. When a teacher gives a child specific feedback, the teacher identifies how the child performed in comparison to what was expected.

Teachers should evaluate the child's performance according to their knowledge of the components of fundamental motor skills when it comes to the fundamental motor skills being taught. Teachers should educate individuals on the aspects of the fundamental motor skills they have learned and which aspects they need to work on.

The psychomotor component of P.E. consists mostly of training basic movement skills. The benefits of practicing basic movement skills for children's general well-being are numerous. The focus in PE is on FMS, which is the foundation for movement and physical activity. The basis for successful and competent mobility is laid by a child's motor abilities. They lay the foundation for specific abilities and sophisticated motor actions required in a variety of games and sports. FMS learning is relatively durable, which means that taught abilities may be retained and repeated even after long periods of time away from practice. Motor competency, even in fundamental motor abilities, should be encouraged from a young age.

It takes a long time to perfect fundamental motor skills. According to available information, teaching children to correctly perform fundamental motor skills takes between 240 and 600 minutes of instruction (Hardy et al., 2012). The length of time it takes to master the fundamental motor skills is determined by the conditions of instruction (i.e., teacher expertise, equipment, class size, age of learner, teaching methodology, complexity of the skill being taught, etc. (Hardy et al., 2012). Many teachers fail to understand how long it takes to acquire fundamental motor skills and try to teach too much too soon. When teachers underestimate these factors, they end up teaching for awareness or participation rather than mastery. Fundamental motor skills are divided into two categories: gross and fine motor skills.

2.3.1 Fine motor skills

A fine motor skill is defined as "a motor skill that demands the control of small muscles to achieve the skill's aim. It often requires eye-hand synchronization and a high degree of precision in hand and finger movement" (Magill & Anderson, 2014, p. 11). When a child writes with a pen or pencil, holds little objects or buttons a garment, fine motor skills are used. The foundation for fine motor skill development is laid during a child's first 6 years of life. The amount of time children are exposed to technological products is increasing day by day as a result of technological advancements (Lauricella et al., 2015), limiting the movement experiences required for children to maintain their everyday lives (Maitland et al., 2013).

Some research, however, claims that fine motor skills are unaffected since fine motor skills are essential to use technological devices (Adams et al., 2012). Nonetheless, these skills are pushed into a different orbit, resulting in the loss of fine motor skills that are required in daily life (Coll, 2015). Many fine motor skills may be considered at risk, given that an individual must master motor skills by the age of ten (Gallahue et al., 2012). In order for children to complete these tasks properly, they must first have well-developed gross motor skills.

2.3.2 Gross motor skills

A gross motor skill is one that necessitates the use of large muscles in order to attain the skill's aim (Magill & Anderson, 2014). According to Haywood and Getchell (2010), gross motor skills are the consequence of motor development involving a cumulative effort of bigger muscle groups. This comprises large-and whole-body movements including walking, jumping, hopping, jogging, skipping, throwing, and catching.

Gross motor skills develop in typically growing children between the ages of two and seven years. Gross motor skills, in general, do not develop naturally and must be taught. Without sufficient education and opportunity for practice, encouragement, and feedback, mastery of these skills is impossible (Jones & Okely, 2016). For optimal development to occur, these gross motor skills must be mastered on a regular basis. The child refines his or her gross motor skills during early childhood development, especially between the ages of three months and six years. Furthermore, there is an accelerated development of these skills between the ages of five and ten years (Westendorp et al., 2011). Whenever a child grows older, his or her gross motor skills get more perfected. The child's capacity to acquire gross motor skills such as crawling, walking, and running may be aided by repetition of these movements.

Gross motor skills are split into locomotor skills, object control skills, and stability skills because they require the use of the major muscles in the body to produce movement. Walking, running, jumping, leaping, skipping, galloping, and hopping are examples of locomotor skills that children use to move their bodies from one point to another in the physical environment (Humeric, 2010). Object control skills are motor skills in which a child manipulates an object with his or her hands and/or feet, whereas stability skills are the ability to sense and react to changes in relationship between body parts that alter a person's balance, such as twisting, and turning (Humeric, 2010). Stability skills can also refer to any movement that is based on attaining and maintaining balance in relation to gravity, as well as axial movements typically utilized for non-locomotor movements and inverted or body-rolling positions. Both locomotor and object-oriented skills are highly necessary during specialized movements in sport and complex skills employed in sports and games, and are thus acknowledged to play a very vital role in a person becoming an elite athlete or maintaining a physically active lifestyle in life (Lubans et al., 2010).

Every year, children aged three to six years old improve their locomotor and object-control skills. Locomotor skills had a higher yearly growth score than object-control skills, and their annual growth rate was also higher (Ning et al., 2016). Gabbard (2018) supported this by discovering that object-control skills grew faster than locomotor skills in 3–6-year-old children. It was discovered that, as with more complex skills, object-control skills develop slower than locomotor skills in the beginning, but that as the nervous system matures, object-control skills develop faster and may even surpass locomotor skills. As a result, after the age of three, children should be given appropriate ball games to help them develop their object-control skills.

Children's basic motor development, according to Yi (2017), follows the principle of progressing from simple to complex movements and from low-level skill to high-level skill. Without sufficient instruction and opportunities for practice, encouragement, and feedback, mastery of these skills is impossible (Jones & Okely, 2016). Poor gross motor skill competency is a developing concern among children, as gross motor skills are critical for healthy growth and development. Cognitive ability, cardio-respiratory health, self-perceptions, physical activity, and weight status have all been connected to gross motor skills (Logan et al., 2015; Lubans et al., 2010; Robinson et al., 2015; van der Fels et al., 2015).

According to Robinson et al. (2015), higher levels of gross motor skill competence are positively connected with health-related parameters such as physical activity and fitness, as well as perceived motor competence in children. Hence, boosting gross motor skills at a young age could be a useful strategy for addressing poor gross motor skill competence. Despite the multiple benefits of gross motor skills in the early years of life, research has revealed that levels of gross motor skill competence have declined in recent decades, and more children are delayed or in danger of gross motor skills acquisition (Bardid et al., 2016; Hardy et al., 2010; Hardy et al., 2012).

According to study reports, between 3% and 6% of children have gross motor skill delays (Ghazavi et al., 2015; Sajedi et al., 2014; Yaghini et al., 2015). In Ghana, 7% of children had gross motor delays, while in France, 5% had gross motor delays (Troude et al., 2011). When looking at the percentage of children with delayed gross motor abilities, it is important to look into the possible risk factors that could lead to gross motor delays. Child characteristics such as low birth weight (Saccani et al., 2013), prematurity (Bello et al., 2013; Kerstjens et al., 2011), and family characteristics such as low parental education (Bello et al., 2013) and low family socio-economic status are all linked to gross motor delay in children (Wei et al., 2015). It is based on these assertions that the researcher want to determine the developmental level of overhand throwing skill performance among lower grade pupils in Kasena Nankana Municipality.

2.4 Importance of Fundamental Motor Skills

Competence in FMS is one of the most important sets of skills that children should start learning in early life (Gallahue et al., 2012). The importance of FMS in childhood extends beyond motor skills alone, as it has an impact on a variety of areas of a child's development. As a result, it is critical to allow time for children to acquire their FMS. Thus, FMS are an important part of a child’s health and development, with these skills being linked to a variety of health outcomes such as physical fitness

(Holfelder & Schott, 2014; Logan et al., 2015); weight status (Lubans et al., 2010); cardiorespiratory fitness (Cattuzzo et al., 2016); and perceived motor competence (Robinson, 2011).

A potential underlying mechanism for regular participation in PA has been identified as FMS competency (Lubans et al., 2010). Children must be physically active in order to acquire FMS. Hence, the relationship between FMS and PA is reciprocal. Logan et al. (2015) investigated the connection between fundamental motor skills and physical activity in children and adolescents (aged 3 to 18 years). The findings demonstrated a beneficial link between FMS and physical activity, with connections found in people of all ages. Given these findings, intervening early to enhance object handling skills may be crucial in averting the decline in moderate to vigorous physical activity (MVPA) and structured physical activity that occurs during adolescence (Hallal et al., 2012). When Holfelder and Schott (2014) and Barnett et al. (2016) looked at the link between PA and the FMS subtests, they found the same results as Hallal et al. (2012). Only 45 percent (Barnett et al., 2016) and 26 percent (Holfelder & Schott, 2014) of the participants showed a positive association between object control (OC) skill proficiency and PA levels, respectively. Lack of proficiency in FMS, according to Stodden et al., (2014) may significantly limit youth involvement in a variety of leisure physical activities, games, and sports.

However, if children are unable to run, jump, catch, kick, or throw, they will have fewer opportunities to engage in physical activities later in life since they lack the necessary skills. For this reason, children who do not learn FMS competency are more likely to fail in the motor domain and are less likely to participate in sports and games during childhood and adolescence (Hardy et al., 2010).

Another study by Nervik et al. (2011) indicated that the proportion of overweight children (50 percent) that scored below average on the gross motor quotient using the Peabody developmental motor scales second edition (PDMS-2) was more than three times greater than non-overweight children (15 percent). The correlations between the gross motor quotient and body mass index (BMI) were extremely strong. Logan et al. (2012) also found significant differences in gross motor skills and BMI in five-year-old children. Children with a high BMI had lower FMS competence than those with a low or medium BMI, according to their findings (Logan et al., 2012).

Siahkouhian et al. (2011) compared the relationship between FMS and BMI in overweight and obese children to a normal weight sample, finding significant negative correlations between the locomotor skills subtest and BMI for the run ($r = -0.46$; p 0.01), gallop ($r =-0.14$; p 0.05), hop ($r =-0.38$; p 0.01), and horizontal jump ($r =-0.28$; p 0.01). The discomfort caused by moving a higher body mass against gravity can make it difficult for overweight and obese people to perform proficient skill execution during complex body movements (D'Hondt et al., 2010; Morano et al., 2011).

Furthermore, it has been discovered that FMS is linked to motor competence (Lubans et al., 2010). Other research has looked into this link in children, with the majority finding good results (LeGear et al., 2012; Toftegaard-Stoeckel et al., 2010). Robinson (2011) looked at the relationships in 119 preschoolers and discovered substantial but moderate correlations between the FMS (total score) and perceived physical competence, as well as the other subtests (locomotor and object control skills). More specifically, Leonard and Hill (2014) discovered a link between FMS and social wellbeing when they found a link between gross motor skills and social interaction, as children with better-developed motor skills may have more opportunities to interact with others and develop social relationships.

FMS and social connections may be linked because infants and young children with more developed motor skills may have more opportunities to interact with others and form social bonds (Leonard & Hill, 2014). Ommundsen et al., (2010) conducted a prospective study that linked motor skills at ages six and seven to social status among peers at ages nine and ten, and discovered links between motor skills and both social and non-social kinds of play among children. Pienaar et al. (2013) investigated the link between FMS and academic achievement in children, finding a substantial link between visual motor skills and visual perception for arithmetic, reading, and writing mastery.

It is apparent to identify the benefits of promoting FMS development from an early age, such as an increase in PA levels (Fisher et al., 2005), an increase in cardio-respiratory fitness, social development (Ommundsen et.al., 2010), and an improvement in academic performance (Jaakkola et al., 2015). For these benefits to occur, children must be provided the opportunity to practice FMS with appropriate feedback. It is in view of this that this thesis seeks to compare the effectiveness of augmented feedback in the acquisition of motor skill among primary school pupils.

2.5 Feedback and Acquisition of Fundamental Motor Skills (FMS)

Feedback refers to acts made by external agents to offer information regarding a person's task performance (Archer, 2010). Other researchers, on the other hand, see feedback as a process that leads to more learning (Sadler 2010; Carless et al. 2011; Molloy & Boud, 2013).

It is permissible for the physical educator to provide feedback to the students once they have completed a movement skill. Feedback refines the motor system by guiding the learner towards a movement pattern that enhances the acquisition of motor skills. All post-response information that educates learners about their current state of learning or performance in order to manage the learning process in the direction of the desired learning standards is referred to as feedback (Narciss, 2012).

Without a doubt, feedback is an important component of an effective instructional techniques that result in improvement in student learning outcomes (Brown, 2018). In order for feedback to take place, instruction must come before the feedback, and task performance must be monitored (Norcini, 2010). In any situation, feedback is critical to learning. Children achieve more success when they receive timely and detailed feedback, whether it is given formally or informally. It gives them a clear picture of where they are and what they need to do to progress. One of the most important things you can do to assist your students learning is to provide high-quality feedback. Feedback evidence has also been used to construct numerous conceptual frameworks that have influenced our perceptions of how feedback should be delivered (Carless et al. 2011; Boud & Molloy 2013). Therefore, there is a wealth of information available on how to improve the effectiveness of feedback.

According to Forsythe and Johnson (2017), feedback is utilized to help students enhance their understanding and change their learning in constructive and effective ways so that they can grow academically. This viewpoint is shared by Brown et al. (2014), who state that students' enthusiasm for feedback will develop as they realize how useful it is in their academic quest. Orsmond and Merry (2011), Alderman et al. (2014), and Evans (2013) have all established that feedback has an impact on students' academic excellence and motivation. Learning feedback is given to students with the goal of helping them improve their skills (Griffths et al., 2017). Hence, whether it is a continuous skill tasks or discrete skill tasks, using feedback can help enhance learning and motor performance (Badami et al., 2011; Saemi et al., 2012). However, it appears that feedback on successful and unsuccessful attempts at a motor skill can give a greater insight into the process of feedback effectiveness.

These feedback messages are received by students at all levels of education on a regular, if not hourly, basis. There have been attempts to define what makes good feedback, which aspects are most important for student responsiveness, and how to encourage students to use various types of feedback successfully for optimal performance (Lipnevich & Smith, 2018). When children are learning anything new, it's vital that they get the right kind of feedback so that they can complete the task correctly and avoid injury. Feedback will be utilized to explain to the student what resulted from their performance and what caused the result when they perform a new skill.

2.5.1 Levels of feedback

The level of instruction and learning determines the type of feedback to be delivered. Effective feedback happens at three levels, according to Hattie and Timperley's (2007) paradigm. When determining which level of feedback is most appropriate for a given situation, emphasis must be placed on the student's development of new skills.

The first level, known as feedback on a task (FT), entails receiving instructions to obtain additional information from various sources in order to verify achievement status related to a task or performance, such as whether a task was completed correctly or incorrectly, so that it can be readjusted to meet the desired objectives. It also includes instructions for obtaining further information in order to improve one's learning experience. It's also referred to as remedial feedback or knowledge of the outcome. The second level is process feedback (FP), which entails delivering relevant information about the approach, practice, method, or process utilized to complete a task or create a product. For boosting deeper learning, feedback at this process level appears to be more beneficial than feedback at the task level. Feedback which focused on enhancing strategies and processes and feedback directed at more specific task information can have a substantial interactive influence at the process level (Bruno & Santos, 2010; Hattie &Timperley, 2007). The final level is feedback on self-regulation (FR), which entails the provision of information about a task or performance that leads to improved self-evaluation of skills and increased confidence to take on more difficult tasks, can help students seek and accept feedback, and can increase their willingness to put forth effort in seeking and dealing with feedback information.

Students can more successfully use feedback to eliminate gaps between where they are in their learning and the desired results or achievements of their learning when they can monitor and self-regulate their learning. Feedback like this can have a great impact on how well students learn (Wisniewski et al., 2020). Two types of feedback are utilized to help an individual comprehend the outcome of their performance: task-intrinsic feedback and augmented feedback (Magill & Anderson, 2014).

2.5.2 Task- intrinsic feedback

Task intrinsic feedback is information that is available to a moving individual as an intrinsic aspect of the task in which the individual is engaged, as the individual receives feedback through the various receptors (Schmidt & Lee, 2014). Furthermore, Schmidt and Lee, (2011) define task intrinsic feedback as the information provided by the performer's senses throughout the performance of the skill, which is inherent and present under normal situations. Although practice may be required, perception of performance utilizing this information is attained without any external influence.

Internal feedback is provided by task-intrinsic feedback, which uses sensory cues such as visual, aural, proprioceptive, and tactile to determine the outcome of their performance. As a tennis player prepare to swing, they will notice a change in their trunk, leg, and arm position as the ball gets closer to the racket (proprioceptive). The sound of the ball making contact with the racket (auditory) and the vibration of the reaction force of the ball and the racket (tactile) will also be used as feedback (Magill & Anderson, 2014). If these various sensory feedbacks are combined, it allows for efficient participation in a motor skill, therefore influencing the success of the performed motor skill.

The perception of movement outcome in relation to a goal state is required when using intrinsic feedback to measure the quality of movement performance. Detecting variations between the forms of movement produced and the goal formed can lead to the detection of performance mistakes, which can then be corrected and the performance further refined with practice (Magill & Anderson, 2014). However, learning motor skills with task intrinsic feedback alone can be difficult, and progress can be slow, because the most useful task-intrinsic information may not be immediately obvious. It may also, not necessarily make errors more salient than non-errors, and it does not specify what ideal performance should look like in and of itself. Thus, it is sometimes advantageous to provide additional information to facilitate skill acquisition when this occurs (Magill & Anderson, 2014).

2.5.3 Augmented feedback

Augmented feedback is information provided by an external source in addition to the intrinsic information provided by the performer's sensory system (Fairbrother, 2010; Lauber & Keller, 2014; Magill & Anderson, 2013). It can be provided by a teacher or instructor (Fairbrother, 2010) or an instrument (Lauber & Keller, 2014; Phillips et al., 2013). The information instructs the student on how to carry out a specific task. The information received may be focused on a movement outcome or technique, allowing augmented feedback to be categorized in a number of ways. It is common for some parts to work correctly while others do not, which emphasizes the necessity of deciding whether augmented feedback should focus on correction, confirmation, or both.

Knowledge of results (KR) and knowledge of performance (KP) are created when the focus is on the correction or confirmation of an activity. KR is information regarding the movement's outcome, whereas KP is information about the movement's properties (Magill, 2010). Thus, knowledge of performance (KP) is information about the movement's quality, whereas knowledge of results (KR) is information about the movement's outcome in respect to its aim (Schmidt & Lee, 2011).

The largest proportion of feedback research in motor learning has focused on the effects of KR. The experimental control provided by research assessing the effects of KR is a likely cause for this tendency. Typically, these studies involve a one-dimensional task with little or no intrinsic feedback (Schmidt & Lee, 2011; Ahmadi et al., 2011). In that event, isolating the impacts of KR on learning is quite simple. It is commonly considered that KR and KP work in the same way, and those findings from the KR literature should apply to KP use as well (Schmidt & Lee, 2011). Although there is no direct evidence to reject this hypothesis, more research into the role of KP in learning is required to determine its authenticity. Hence, this study sought to determine the effect of KP and KR in motor skill acquisition (overhand throwing) among lower grade pupils in the Kasena Nankana Municipality

Few investigations on the role of KP in motor learning have shown significant results. For example, in their literature analysis, Lauber and Keller (2014) concluded that both KR and KP favour motor skill performance. Sharma et al. (2016) concurs that both types of feedback (KR and KP) are beneficial in enhancing the performance of a motor skill (throwing, assessed in distance) in the young adult population, but the KP group improved more during the acquisition phase than the KR group. Lim et al. (2015), on the other hand, demonstrated the efficiency of self-regulated KP in learning a sequence of 18 taekwondo movements in both the acquisition and retention stages.

Furthermore, the findings from an additional study by Ahmadi et al. (2011) show that when KR is given following a good effort, acquisition of motor skills is facilitated in the retention phase under controlled experimental conditions. Ahulló et al. (2019) in their study concluded that the group who received KP performed better than the group that received KR or the group that received both types of feedback. In shooting and throwing tasks, supplementing KR on accuracy error with information on movement aspects (KP) was more beneficial than KR alone (Dana et al., 2011). However, there is paucity in literature on KP and KR in relation to motor skill acquisition among primary pupils in Ghana, hence this study sought to determine the difference in skill acquisition in overhand throwing between KP and KR groups among lower grade pupils in the Kasena Nankana Municipality.

The relevance and usefulness of augmented feedback is emphasized by motor learning researchers. Aside from practice, augmented feedback has been identified as one of the most essential elements for motor learning (Schmidt & Lee, 2011). Similarly, increased feedback has both acute and long-term implications on performance and learning. Evidence suggests that, augmented feedback improves motor skill and motor learning performance (Burtner et al., 2014; Goodwin & Goggin, 2018; Hoff et al., 2015; Lauber & Keller, 2014; Sharma et al., 2016). It should be highlighted, however, that the usefulness of augmented feedback can be modified by a variety of factors, including participant characteristics, skill characteristics, practice procedure, and feedback modalities (Beltrao et al., 2011; Magill & Anderson, 2013; Phillips et al., 2013). In addition to the foregoing, the amount of augmented feedback offered has an impact on people's use of intrinsic feedback (IF) to some level (Anderson et al., 2005).

The content of the information (knowledge of results or execution), the approach (focuses on providing information on errors or successes), the moment (concurrent or at the end of the execution), the frequency (specific periodicity, bandwidth, degraded, averaged or self-regulated), sense (auditory, visual, haptic), and biofeedback are among the most commonly used modalities or types in augmented feedback (Bechtel et al., 2015; Lauber & Keller, 2014; Magill & Anderson, 2013; Reissig et al., 2015; Sigrist et al., 2013).

Schmidt and Lee (2011) point out that, augmented feedback can be provided concurrently (during the action) or terminally (at the end of the movement). Terminal feedback can be given immediately after the trial or deferred for a period of time. It could be either verbal or nonverbal. Finally, feedback can be offered after each trial (distinct) or for an average performance over a number of trials (accumulated). These factors should be analyzed independently of one another, according to Schmidt and Lee (2011), nevertheless, this has obvious drawbacks. KR feedback by definition is terminal feedback, nonetheless, this is not the case with KP feedback, which can be given concurrently (McNeil et al., 2010). In conclusion, studies suggest that augmented feedback is a distinct factor that effectively increases the performance and learning of motor skills because it facilitates the processing of information (Lauber & Keller, 2014; Sigrist et al., 2013a; Wulf et al., 2010). However, given the large number of research in the area of motor skill acquisition, there is little information that explains which modality (KR or KP) is the most beneficial (Sigrist et al., 2013a).

Providing augmented feedback to the learner during specialized task practice can help improve motor learning (Magill, 2011). Different sensory modalities, such as visual or auditory information, can be used alone or in combination to offer augmented feedback (Sigrist et al., 2013b). Additional auditory or visual input appears to aid motor learning, but differences between studies indicate that further research is needed to discover which augmented feedback modalities are most helpful for motor learning (Molier et al., 2010). In this current study, it is hypothesized that, there will be no significant difference in overhand throwing skill between KP and KR among lower grade pupils in the Kasena Nankana Municipality.

2.5.3.1 Importance of augmented feedback

Some researchers have suggested that augmented feedback has a variety of properties that influence motor learning. Although motor skills can be learnt without augmented feedback, it is thought that it will help and speed up the learning of complicated skills (Magill, 2010; Schmidt & Lee, 2011). It's been proposed that augmented feedback works because it serves three objectives that aren't mutually exclusive: informative; motivational; and guidance (Schmidt & Lee, 2011).

First, augmented feedback is said to work because it offers information about what went correctly or wrong in a given trial, as well as implicit prescriptive advice about what to do in the next trial or task in circumstances where the learner intrinsic feedback is in question (Schmidt & Lee, 2011). When the learner is aware of the gap between their skill performance and the intended goal, it is less compelling to perform. More information naturally leads to increased movement precision, which is why augmented feedback is offered. Secondly, augmented feedback could help motivate students to learn. Regular performance feedback might help break up the monotony of an otherwise tedious task. Furthermore, knowing that one is close to achieving a goal may motivate additional efforts that would have been considered futile in the absence of such knowledge (Schmidt & Lee, 2011).

In the absence of feedback, the 'guiding hypothesis' predicts that it will lead to reliance and poor performance. If feedback is given too frequently or too soon, the learner may become unduly reliant on it and hence fail to complete the essential task of combining intrinsic and extrinsic feedback for the next performance. However, contrary to popular belief, new research shows that the guidance hypothesis is not a general concept of feedback (Danna et al., 2014; van Vugt & Tillmann, 2015), because intrinsic proprioceptive feedback has been deliberately ignored. Hence, Sigrist et al. (2013b) proposed that feedback given 100% of the time during skill acquisition will result in a decrease in performance when it is removed.

2.6 Throwing

Throwing is a skill that our ancestors honed over millions of years. Humans are the only creatures that can throw as fast, far, and as accurately as rabbits (Roach et al., 2013), which sets them apart from other primates and allows them to develop throwing skills (Lieberman et al., 2012; Roach & Richmond, 2015a, 2015b). Today, throwing is employed in a variety of activities, including sports, and various throwing techniques are employed based on the event, such as baseball, cricket, or javelin throwing.

Throws can be characterized as underarm, sidearm, or overhand depending on the type of sport. All three forms of throw are used by players in baseball and handball (Wagner et al., 2010). The overhand throw is a basic movement skill that can be used in a variety of sports to generate high speeds for a projectile, most often a ball. The overhand throw is characterized by the trunk leaning away from the throwing arm and the arm being put above the shoulder, making it a complex whole-body motor ability (Escamilla et al., 2018). Many sports require it for the development of technical and tactical skills (Kasuyama et al., 2016).

The three release conditions that affect the projectile are the release speed, release angle, and release height, which all influence throwing performance. The fundamental purpose of throwing a projectile in many sports is to maximize the distance thrown, which is considerably helped by achieving the optimal release angle of 45 degrees. The difference between the height at which the projectile is released and the height at which it lands, or the height of the target, is known as the release height. When projectiles are thrown from a higher release height, they travel a greater distance with the same release angle and speed. The landing height is mostly determined by the rules of the sport in question.

According to Nissen and Patten (2013), baseball pitchers adopt a technique that allows them to have a very low release angle, which results in a relatively low release height. The most critical aspect of throwing performance is the projectile's release speed. As a result, most sportsmen, regardless of sport, strive to improve their projectile's release speed. Therefore, participants prefer to minimize their release angles in order to maximize their release speed (Linthorne & Stokes, 2014).

Throwers require perfect synchronization of sequential proximal-to-distal movement of distinct body segments in order to achieve high ball release speed (Serrien & Baeyens, 2017). The speed is generated by a combination of forces generated by the entire body, starting with the lower body, moving up through the torso, elbow valgus, and ending in the fingers (Roach & Lieberman, 2014). There are three main phases to these body segments of movement, namely preparation phase, pulling phase, and follow through phase.

When the hands first move backward and the shoulder extends as far as it can go horizontally, this is the preparation phase. By allowing the shoulder to abduct and extend horizontally during the preparation phase, the shoulder can be eccentrically contracted in the anterior direction. As a result, the movement moves more quickly and generates a stronger impulse (Palmer, 2019). Throwing velocity is created during the pulling phase by sequentially accelerating joints from proximal to distal segments. Early pull causes muscles to contract concentrically, which counteracts outside pressures and enables the pelvis and trunk to rotate one after the other. When the arm's radius is extended to produce the most velocity in the distal segment during the late pulling phase, the shoulder internally rotates and the elbow extends quickly (Palmer, 2019). Late pull produces an eccentric elbow flexion force that lasts from slow elbow extension through arm deceleration. To avoid elbow distraction, the maximum elbow compressive force occurs immediately after ball release. The goal of the follow-through phase is to controllably stop the movement.

From the release of the ball through the full expansion of the shoulders, follow through can be categorized (Palmer, 2019). As the torso and arm rotate forward, the elbow flexes into a compensating position. The shoulder's muscles are still quite active during the initial follow through when the throwing arm slows down. During this phase, the trunk and lower extremities assist in dissipating energy in the throwing arm (Reinold & Curtis, 2013). The final phase is the recovery phase; when the body segments slow down to lessen the danger of harm (Serrien & Baeyens, 2017).

The kinetic chain is a synchronized, sequential movement of body segments that characterizes the various phases of throwing. A kinetic chain is a series of movements in which one segment's position and movement are determined by the positions and movements of its neighboring parts (Chu et al., 2016). A kinetic chain can be used in either a push-like or a throw-like action. The segments of the kinetic chain all move at the same moment in a push-like movement, whereas a throw-like movement shows a proximal-to-distal sequence of segment motions. A throw-like kinetic chain is used when throwing overhead, with movement beginning with the legs and ending with the hand when the projectile is released (Chu et al., 2016).

The legs provide a stable base for the kinetic chain in throwing, which is important for producing high ball release speeds and reducing the risk of injury. Therefore, proper stride length is important for reducing the risk of injury because it affects the timing of both the trunk and upper arm rotations when throwing (Crotin et al., 2015; Ramsey & Crotin, 2016; Ramsey et al., 2014). Due to their relative mass compared to other segments and potential elastic energy, the pelvic and trunk segments have been found to contribute the most to force creation during a throw (Macaulay et al., 2017; Roach & Lieberman, 2014; Urbin et al., 2016).

Though the trunk is the heaviest section in the throwing kinetic chain, which aids in the generation of angular momentum, there are other human features that aid in our ability to throw, such as being tall and having a more mobile waist, which aids in the rotation of the hips and thorax (Roach et al., 2013). The comparatively substantial mass of the trunk, combined with the larger range of motion between the hips and the thorax, aids humans in creating and storing elastic energy at the shoulder, which aids in effective overhand throws (Roach et al., 2013). The shoulder joint is one of the most important contributors to performance because it connects the heavy trunk to the lighter arm segments, storing and transferring elastic energy. During a throw, the elbow is flexed at roughly 90° and the wrist snaps (Roach et al., 2013).

The overhand throw can be taught in a variety of ways. A typical teaching strategy is to break down the movement into body parts. Teaching usually starts at the distal end (wrist flick, elbow extension) and works its way up to the proximal end (torso rotation, lower extremities) (Losurdo, 2015). The ultimate goal of this approach is to master each component before combining them into a coordinated movement with the dominant arm as the focal point (Jim, 2018).

Another method of teaching the overhand throw is to focus on repetitions of the movement on both the dominant and non-dominant sides, with specific teaching to achieve maximum learning transfer and bilateral development (Lee et al. 2015). Lee et al (2015) proposed that when learning a new skill like throwing, one could consider bilateral training for the performance measurements to increase technique, accuracy, and speed. One can lessen lateral dominance while simultaneously enhancing the capability of the non-trained and trained sides by exercising both the dominant and non-dominant sides (Hendy & Lamon, 2017; Sterkowicz et al., 2010).

2.7 Development of Overhand Throw in Children

Various authors have described the developmental sequence of the overhand throw development (Wild, 1938; Roberton, 1978; Langendorfer, 1980). There are two common models used to describe the development of the overhand throw in children. Namely the total body approach (Wild, 1937) and the component approach (Roberton, 1978). Roberton (1978) used a component approach and found that development may occur at a different rate for individual body segments (humerus, forearm and trunk). This current study rallied on the total body approach to describe the developmental sequence of the overhand throw among children. The total body approach was developed under developmental stage theory, which suggested a linear sequence of development that was universal and had an intransitive order (Haubenstricker et. al., 1983).

The total body approach to throwing describes the total body movement of all joints and segments into the characteristics of one stage. The most commonly used total body approach describing the development of throwing is from Wild (1938). Wild (1938) examined the throwing pattern of 32 participants, boys and girls from the ages of 2 to 7, and then one boy and girl from 7 to 12 years old. Analysis of throwing patterns revealed four stages of throwing.

Stage I, the throwing action is arm-dominated with the feet remaining stationary. Sometimes the child may attempt to walk or step forward prior to the throwing action. Propulsion of the thrown object is achieved by lifting the arm either sideways or forward. The trunk then straightens, carrying the shoulders forward, and flexes forward with plantar flexion of ankles as the arm swings forward over the shoulder and down in front. Movements of body and arm are almost entirely in the anteroposterior plane; the body remains facing the direction of the throw all the time. Such throwing pattern was said to be typical of 2 to 3-year-old children (Wild, 1938).

Stage II, the child is able to integrate rotational movements in the transverse plane. The trajectory of the throwing arm is either horizontal or oblique above the shoulder but with a forward downward follow-through. Propulsion is initiated by elbow extension; however rotary movements of the trunk are present. The body changes its orientation and then re-orientates to the throwing direction. Stage 2 was observable in children of ages between 3.5 and 5 years (Wild, 1938).

Stage III, the child develops a forward step with the foot which is stepping forward with the same leg to the throwing arm (ipsilateral) or contralateral forward step that is stepping with the foot opposite to the throwing arm. The arm swings obliquely upward over the shoulder to a retracted position with elbow much flexed, with spine left rotation. The direction of arm movement during the back swing is oblique and upward. During propulsion the arm movement is forward and downward with follow-through, accompanied by forward trunk flexion. Stage 3 throw was observed in children between the ages of 5 to 6-year-olds.

Stage IV. This was the most proficient throwing stage in the children observed and regarded as the mature throwing stage. There is an automated forward step with the contralateral leg, and extensive trunk rotation and arm adduction prior to ball release. This stage was observed in over 6.5 years of age. Therefore, children who are able to effectively utilize this transfer of energy through positive use of stride length, pelvis and trunk rotation, horizontal extension and lateral rotation at the shoulder, elbow flexion and wrist hyperextension will ultimately demonstrate more advanced throwing capabilities (Bartlett, 2014). Improved coordination between the back swing, torso rotation, and a development from homo-lateral to oppositional leg action develops as a child approaches a mature motor pattern (Haywood & Getchell, 2010).

From the total body approach, overarm throwing movement is a movement with a specific and clearly identifiable start and end and that it follows a specific movement pattern determined by a proximal to distal sequence of segments. According to Wagner et al. (2014), the "equal order of the proximal to-distal sequencing and similar angles in the acceleration phase suggests there is a general motor pattern in overarm movements." The way of which how these movement patterns change over time depends on training intervention, learning, and adaptation that will arise through perceptual-motor experiences that children would have during childhood (Barela, 2013; Gromeier et al., 2017, 2019). These assertions suggest that most children do not master skill performance and would not acquire the most proficient performance in fundamental motor skills, like overhand throwing movements.

A distinct pattern of overhand throwing proficiency acquisition was found separately based on individual's social and geographic backgrounds, providing additional evidence for the stage 4 throw when employing the total body approach. Starting around the age of 2 years with simple arm movements from an upright static stance, throwing proficiency naturally converges, at age 6 to 7 years, toward a more sequenced pattern of weight shift, trunk rotation, and steps that closely resembles the strategies adopted in fast-throwing sports (Roach et al. 2013; Roach & Richmond 2015a)

In view of researchers, teaching students the whole throwing mechanics as early as feasible, and fine-tuning segment sequencing and strength as the body matures, is a popular proposal from the motor development literature focusing on the overhand throw (Roach et al. 2013; Roach & Richmond 2015a; Bartlett, 2014; Haywood & Getchell, 2010; Urbin et al., 2016). Initial attempts to throw appear between 1.5 and 3 years, with mature skills appearing between 5.5 and 8.5 years (Haywood & Getchell, 2010). This goes to suggest that improved coordination between the back swing, torso rotation, and a development from homo-lateral to oppositional leg action develops as a child approaches a mature motor pattern (Haywood & Getchell, 2010).

2.8 Augmented Feedback and Overhand Throwing

The relevance and usefulness of augmented feedback is emphasized by motor learning researchers. Aside from practice, augmented feedback has been identified as one of the most essential elements for motor learning, according to Schmidt and Lee (2011).

Supporting the importance of augmented feedback in achieving overhand throw proficiency, Obrusnikova and Cavalier (2017) investigated the effect of video modeling on the acquisition of overhand throwing in typically developing children. Overhand throwing was assessed using the TGMD-2 at baseline. Results indicated that the children in slower speed group condition improved throwing performance. The overhand throwing skill were maintained two weeks after the conclusion of the treatment.

In a further study by Tirn et al. (2017), the impact of frequent, and immediate augmented feedback on the increase in overhand throwing velocity in handball set shots was examined. During practice, results were compared with or without knowledge of results. After each shot, the experimental group was given feedback on the throwing velocity as determined by a radar gun, while the control group did not. For six weeks, each participant made two sets of ten set shots with their absolute best effort. In comparison to the same intervention when feedback was not given; participants who got feedback on results achieved a nearly four-fold bigger relative increase in the velocity of the regular ball. The results confirmed that training oriented towards an increase in throwing velocity became significantly more effective when frequent knowledge of results was provided. It is therefore, suggested that augmented feedback has demonstrated to be a distinct factor that successfully increases the performance and development of motor skill among children especially in the acquisition of throwing skill.

2.9 Fundamental Motor Skills Assessment

Assessment is an important part of teaching and learning of any skill. Assessment can be used by teachers to evaluate their students' performance in skills that have been identified as necessary for all children to learn. The instructor will be able to identify the exact component (s) around which the teaching should be organized within each skill. One of the benefits of gathering information regarding the status of students' fundamental motor skills is for this reason.

The use of dependable instruments is required for an accurate assessment of children's motor skills and tracking of their development over time (Nadia, 2012). Quantitative (product-oriented) or qualitative (process-oriented) components of movement are assessed using motor skills assessment tools. Product-oriented assessment techniques entail assessing the result of a performance and comparing it to a collection of normative data (Logan et al., 2017). Process-oriented assessments, on the other hand, are extremely useful when learning a new skill because they reveal particular aspects of the skill that are meeting expectations or may be improved (Barnett et al., 2014).

According to Lopez-Pastor et al. (2013), assessments are used by physical education teachers for a variety of purposes, and they use the information they gather in different ways to help students learn and be taught. The Fundamental Motor Skills Assessment tools is a measure that teachers can use to gauge how well their students are performing in terms of the skills that have been identified as essential for all children to learn (Redelius & Hay, 2012). A number of goals can be achieved by physical education teachers using FMS assessment.

To assess students' progress in developing their motor skills, physical education teachers employ assessments (Lund & Kirk, 2019). This can be used to evaluate a person's performance or examine whether program objectives have been met. This is a standard practice in physical education and is a useful tool for giving teachers and students a-like feedback. Assessments can be used by teachers to make sure that learning objectives are being met (Lund & Veal, 2013). The data collected may also be used to provide feedback to the teacher. In order to create program objectives that are more difficult for students, the teacher uses the assessment results. This may contribute to enhancing student classroom motivation (Lund & Veal, 2013; Lander et al., 2016).

Assessments are carried out in school settings for another reason, which is student motivation. Students can be informed using the data gleaned from the evaluation of movement principles. Educating pupils about their performance and areas for growth is the goal. The likelihood that students will be motivated throughout instruction increases when they receive performance feedback (Haynes & Miller, 2015; Colvin et al., 2022). Another reason assessments are used in physical education is for placement. The process of classifying or placing people into groups or courses based on their motor skills. This choice can improve the teaching and learning of basic movement techniques. Students that need to practice and develop the same part of a skill could be put in the same group (Haynes & Miller, 2015; Colvin et al., 2022; Lund & Veal, 2013; Lander et al., 2016).

In order to decide whether children should be referred for more testing or whether they need specialized learning programs, one technique is screening (Proctor et al., 2012). Physical education instructors evaluate students for a variety of reasons, and one of them is what is sometimes called diagnosis. Typically, this evaluation is done at the start of the academic year (Pangrazi & Beighle, 2019). The goal of the Fundamental Motor Skills Assessment is to distinguish between those whose skills are developing normally and people whose skills are not growing at all. Dependent on these demands, more focus may be placed on certain skills in the usual physical education class, or more time may be set aside to help students make up for any shortfalls. When screening becomes the primary focus of instruction in the physical education curriculum, it is crucial for instructors to be aware that the Fundamental Motor Skills Assessment can be completed in its entirety or individually for each skill (Haynes & Miller, 2015; Colvin et al., 2022; Lund & Veal, 2013; Lander et al., 2016).

All children could benefit from an instrument which assesses a child's fundamental movement skills (FMS). Such tools would provide opportunities for professionals working with young children to assess their FMS in the context of physical education.

Currently, there are several tools, which can measure children's FMS performance level. First of such tools is the Motoriktest für vier- bis sechsjährige Kinder (MOT 4-6) which is a test of German origin and has been developed to contribute to the assessment of FMS development. In addition, the tool creates an opportunity for early detection of FMS delay or deficiency. The authors believe that children in this age group have specific needs and require a different pedagogical approach. Therefore, the age range is from 4 to 6 years (Zimmer & Volkamer, 1987).

Secondly, Movement Assessment Battery for Children (Movement-ABC - Movement-ABC 2) assesses the developmental status of FMS; with a focus on detection of delay or deficiency in a child's movement skill development. The test is suitable for children between 4 and 12 years of age and consists of 32 items, subdivided into 4 age bands. Each age band includes 8 individual test items measuring movement skills in three categories: manual dexterity skills, ball skills and balance skills (Henderson et al., 1992).

Thirdly, the Peabody Developmental Motor Scales, Second Edition (PDMS-2) is a movement skill assessment tool that measures gross and fine movement skills. It focuses on assessment and intervention or treatment programming for children with disabilities. It consists of 6 subtests of which 4 involve gross and 2 involve fine movement skills. The test is designed to assess movement skills of children from birth to 6 years of age (Folio & Fewell, 2000).

In addition to the above is the Körperkoordinationtest für Kinder (KTK) which is appropriate for children with a typical developmental pattern, as well as for children with brain damage, behavioral problems or learning difficulties. The test assesses gross body control and coordination, mainly dynamic balance skills. The test covers an age range from 5years to 14 years (Kiphard & Schilling, 2007). Also, Maastrichtse Motoriek Test (MMT) is to objectively assess qualitative aspects of movement skill patterns in addition to quantitative movement skill performance. The test distinguishes between children with and without normal motor behavior. The authors claim to detect children at risk for attention deficit hyperactivity disorder (ADHD) at an early age. The test is suitable for 5 to 6-year-old children, the age period seen as the transition stage between pre- and primary school (Vles et al., 2004).

Moreso, Bruininks-Oseretsky Test of Motor Proficiency, second edition (BOTMP-BOT-2) is a tool to assess fine and gross movement skill development. They are used to identify individuals with mild to moderate motor coordination deficits. The test is suitable for individuals aged 4 to 21 years (Bruininks & Bruininks, 2005). Finally, the Test of Gross Motor Development, second edition instrument which was designed by Ulrich in the year 2000 was the tool used as a guide in this current study.

2.10 Test of Gross Motor Development- 2

The Test of Gross Motor Development (TGMD-2) is a process and product assessment tool that assesses gross movement performance based on the qualitative characteristics of movement skills (Ulrich, 2000). The TGMD-2 test is used for a variety of purposes, including evaluating gross motor skill development after a motor intervention, assessing one's individual progress in gross motor skill development. Additionally, it is used to identify children who are delayed in gross motor skill development compared to peers, serving as a measurement tool in research, and assessing gross motor skill development after a motor intervention, with an emphasis on how children coordinate their trunk and limbs during the performance of a task rather than assessing the end results.

The test is performed in 15 to 20 minutes and requires equipment that is typically used during P.E. The age range (3–10 years) encompasses the period in which the most dramatic improvements in a child's gross motor skill development can occur (Ulrich, 2000). The TGMD-2 is a widely used standardized test that assesses basic gross-motor abilities in six locomotion (i.e., run, hop, gallop, leap, horizontal jump, and slide) and six object control (i.e., ball skills like striking a stationary ball, stationary dribble, catch, kick, overhand throw, and underhand roll) skills (Ulrich, 2000). The TGMD-2 test items chosen represent the most common skills acquired by children in preschool and early elementary school (Ulrich, 2000).

Three to five observable performance criteria are included in each skill on the TGMD-2. Multiple performance criteria allow children to be credited for any component of their movement skills and provide a more complete understanding of the movement patterns they use. Each performance criterion is assessed on the basis of presence (1) or absence (0). A total of 96 points (48 points for locomotor skills and 48 points for item control skills) can be earned, with a higher score signifying greater expertise. The TGMD-2 values can be added together to generate a total raw score for either the locomotor or object control subscales, or both can be combined to generate a total raw score known as the Gross Motor Quotient (GMQ) (Ulrich, 2000). For the purpose of this study, the object control subscale of overhand throw was assessed with the adaptation of the overhand throw performance criterion in the TGMD-2 instrument to serve as a means to assess pupil motor skill level and also as verbal cues for the KP group.

2.11 Summary

Although several works were done on augmented feedback and skill acquisition, few of such works have actually looked into the effect of the types of augmented feedback (KP and KR) in the acquisition of motor skills among children. None has been able to state whether four hours of KP and KR intervention is enough to improve the motor skill among primary school pupils in Navrongo. All other works were conducted with different participants, methods, and in a different part of the world. This study had therefore added to existing knowledge, and literature which would also guide policymakers in their decisions.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This study aimed at determining the effectiveness of knowledge of results and knowledge of performance in learning a motor skilled activity among pupils. The study's methodology is presented in this chapter. It covers the study's design, population, sample and sampling technique, data collection instrument, validity and reliability, data collection procedure, and data analysis.

3.1 Research Design

A research design is a set of techniques for gathering and analyzing data, as well as how this will aid in answering the research question (Grey, 2014). A well-thought-out research design reduces data bias and increases the likelihood of obtained data being accurate. A two group, pretest posttest, quasi-experimental design (Edmonds & Kennedy, 2013) was used to determine the effect of KP and KR on overhand throw accuracy of lower primary pupils.

The designed was chosen because the assignment of children into the three lower grade classes was predetermined and cannot be changed due to the school curriculum, hence, children were not randomly assigned to interventions. Again, the researcher chose two group pretest- posttest design in order to demonstrate causality between the interventions and an outcome of KP and KR among the lower primary pupil’s overhand throw and allowed the researcher to draw a plausible conclusion. Also, quasi-experiments are natural experiments; findings may be applied to other subjects and settings, allowing for some generalizations to be made about population.

3.2 Population of the Study

All pupils at St. John Bosco's Demonstration Practice Primary School in Kasena Nankana Municipal, in the Upper East Region of Ghana were included in the study. The school has a total population of 616 pupils, comprising of 326 (boys) and 290 (girls). Lower grade pupils (grades 1, 2, and 3) with an average age of 7 years. Primary one (1) had 61 pupils, primary two (2) had 71 pupils, and primary three (3) had 67 pupils. An inclusion criterion for sampling was based on the age accepted by the TGMD-2 instrument. Thus, any pupils above the age of 10years though in the lower grade were excluded from the population before the sampling was carried out.

3.3 Sample and Sampling Techniques

Purposefully identifying features of the population of interest and selecting subjects who shared such traits was the researcher's intent (Creswell & Plano-Clark, 2011). Because the researcher was unable to use all of the target population who fell into the required grade categories, the researcher employed a simple random sampling procedure to select sixty (60) pupils to participate in the study.

Balloting without replacement was used as part of the simple random sampling technique. The researcher wrote ten (10) "yes" on pieces of paper and "no" on the rest, folded and completely mixed the papers. Each pupil of the inclusion criterion was told to pick one piece of the folded papers. Those that selected "yes" were all chosen for the study. Boys and girls in different grade levels participated in this activity separately. Each class (primary 1, 2, and 3) had twenty (20) pupils, (that is ten (10) boys and ten (10) girls). This method ensured that all individuals in the target population had an equal chance of being chosen for the study.

Following the determination of the study's sample size, the researcher randomly assigned the pupils into two groups. The benefit of using random assignment is that it enhances the internal validity of the study, because it ensures that there are no systematic differences between the participants in each group (Druckman & Kam, 2011). If both groups are equivalent except for the treatment that they receive, then any change that is observed after comparing information collected about individuals at the beginning of the study and again at the end of the study can be attributed to the treatment. This way, the researcher has more confidence that any changes that might have occurred are due to the treatment under study and not to the characteristics of the group.

The lottery method was used to distribute thirty (30) pupils to each group, fifteen (15) boys and fifteen (15) girls. Fifteen (15) group 1 and fifteen (15) group 2 were written on pieces of paper by the researcher, and each sampled boy was asked to pick a piece from the folded papers to determine which group each boy belonged to; the same procedure was followed for the girls.

3.4 Data Collection Instruments

Ulrich (2000) developed a standardized instrument called the Test of Gross Motor Development- Second Edition which was a suitable and efficient tool to be used by the researcher. The researcher adopted the overhand throw performance criteria in the TGMD-2 in order to assess the motor skills level of the pupils (Appendix C), whiles also using the overhand throw performance criteria as verbal cues for the group receiving knowledge of performance during the intervention. For easy communication and understanding, the verbal cues were translated into the Kaseen language by an expert from St. John Bosco College of Education (Appendix E). An observation check list form was created by the researcher to examine the success or failure (product) of the desired observable behavior (overhand throw) in each pupil (Appendix D). It included a yes/no structures for each pupil's throwing accuracy. The checklist served as a product measure which was used to collect data on pupil's overhand throw accuracy during the pretest and posttest phase of the study.

3.5 Validity and Reliability of the Instruments

In this study, the researcher adopted the performance criteria for overhand throw in the Test of Gross Motor Development (TGMD-2) and a designed checklist assessment tool was used. Test of Gross Motor development (TGMD-2) by Ulrich, is a standardized instrument used internationally thus have been validated already. Content validation procedures were used to determine the validity of the self-designed observation checklist. Content validity was determined for the instrument by having the self-designed observation checklist reviewed by the researchers' supervisor who is an expert in the field. The observation checklist was amended in response to the supervisor's comments and suggestions before used in collecting the necessary data for the study. This was done to ensure that the data collected measures what it is supposed to measure.

Reliability of a study instrument is the consistency of the instrument producing the same results given the same conditions on different occasions. The reliability of an assessment rubric can be impacted by the characteristics and context of raters (Minick et al., 2010; Palmer & Brian, 2016; Pieper et al., 2017).

Ulrich, (2000) reported a reliability coefficient of .72 for object control skills which indicate a high reliability of the instrument. With the help of several studies on the TGMD-2, researchers (Barnett et al., 2014; Estevan et al., 2016; Farrokhi et al., 2014;

Rintala et al., 2017; Simons & Eyitayo, 2016; Sun et al., 2011; Wagner et al., 2014; Webster & Ulrich, 2017) have all reported the tool's reliability (0.78 to 0.98). The current study reported a reliability coefficient of 0.86, indicating a high reliability of the instrument.

To make the observation checklist reliable, research assistants were taken through a 1hr 30 minutes inter rater session with the researcher to pretest the reliability of instrument. This was done to find out the consistency of the results across different raters and pupils. During the training session, ten (10) pupils from Adabayire Primary School who were outside the sampled group were tasked to perform the overhand with ten (10) trials each to a target for accuracy. The research assistants and the researcher with the help of the checklist rated the pupils overhand throw as a “yes” for hitting the target and “no” for not hitting the target. After all pupils had taken their trials, there was an in-depth discussion regarding results. Interestingly, results suggested that research assistants and the researcher demonstrated a 100% inter-observer agreement between each other in the ten trials. These results go to show that the observation checklist instrument was reliable for the study.

3.6 Data Collection Procedure

The researcher received an introductory letter from the Head of the Department of Health, Physical Education, Recreation, and Sports at the University of Education, Winneba (Appendix A). The researcher was able to meet with the Head Teacher and staff of St. John Bosco’s Demonstration Practice Primary School to discuss the study's purpose and safety precautions thanks to this introductory letter. The researcher then trained two (2) physical education teachers in the municipality as research assistants for 2 hours after receiving approval from the school's head. Informed consent from parents and assent consent from the participants were secured by the researcher before the start of experimental process for ethical considerations. The parents of pupils who fell within the study population were provided with a consent form to sign of which 60 parents signed to give consent for their wards (Appendix B). Following that, the researcher obtained assent consent from the pupils through the help of the research assistants, and the pupils were gathered to form a rapport with the researcher and his team.

The basic goal of the study was explained to the participants. The researcher used the Kaseem language (L1) to help learners to process ideas and reach greater levels of understanding by using words that they may not possess in the English language (L2). Tennis balls (n=60), a tape measure, and a square cardboard were all required for this study. The target was a square cardboard (500mm by 500mm) placed on the wall 1.5m above the ground and 15m away from the target position with the aid of a measuring tape, which also served as the throwing point (start point). Prior to assessing the motor skills level of the pupils and the pre-testing of pupil's accuracy throw to a target on the wall, pupils were given a unique code based on the group to which they belonged for easier identification and coding, as well as warm-up activities to prepare their bodies for the task.

To assess the motor skills level of the pupils, an empty classroom was used. During this process pupils were not given any information as to how they should carry out the overhand throwing. The pupils were asked to stand at the started point 15m from a wall and throw a tennis ball to hit the target on the wall for a trial each. The process for each pupil was videotaped using a Samsung A32 phone video camera. Results of Pupil's overhand throwing performance were coded later from the phone video recorder on the adopted form for each pupil. It was realized from the results that six pupils demonstrated a matured stage of the overhand throwing performance. The researcher excluded the six pupils in the intervention process.

The self-designed assessment checklist was used to collect data on the success or failure of their overhand throw after assessing pupil's motor skill level. During the pre-testing phase, the sampled group completed the overhand throw with 10 trials to see how many times each pupil could hit the target on the wall from the starting position. The success or failure of each throw was documented as 'Yes' or 'No' in the checklist sheet for all groups by the researcher with the help of the research assistants.

Following the pre-test, the skill acquisition phase was organized into four (4) practice sessions with one hour practice trials every Friday morning for four weeks from 7:30am to 8: 30am for each group with a rest interval of one (1) minute after 10 attempts for each and a total of thirty (30) trial per pupil for each practice session. Each of the two groups (1 and 2) was assigned to one of the two classes (1 or 2) with each class having a research assistant to help guide pupil in the intervention process. Class 1 was for the knowledge of performance group (n=27), who received verbal cues from the adapted performance criteria for overhand throwing in TGMD-2, and class 2 was for the knowledge of results group (n=27), who received verbal information about the success or failure of the participant throw. Before each session, participants were taken through ten (10) minutes warm-up activities. After that, each group was taken to their respective class room where the researcher delivered a detailed demonstration and verbal description of the adapted performance criteria for overhand throw skills from the TGMD-2 instrument to group 1, which was given knowledge of performance and knowledge of results to group 2 throughout the intervention phase.

After the end of the four (4) weeks of skill acquisition phase with a minimum of 240 minutes of practice time, which is in line with the fact that teaching children to correctly perform fundamental motor skills takes between 240 and 600 minutes of instruction (Hardy et al., 2012). The researcher then conducted a post-test with the help of the research assistants to determine if the KP and KR schedules for the groups had any effect on the overhand throwing skill among the two groups, using the same approach as the pre-test stage.

3.7 Data Analysis Procedure

Data from the field was cleaned then coded and entered into the Statistical Package for Social Sciences (SPSS) Version 20.0. Statistical significance was accepted for values of $p < 0.05$. To determine the developmental level of overhand throwing skill performance among the lower primary pupils, frequencies and percentages was calculated. To determine the differences in pre-test and post-test skill acquisition in overhand throwing by KP and KR groups among the lower primary pupils, a paired samples statistics was calculated. To determine the effect of KP and KR interventions on overhand throwing skill acquisition among the lower primary pupils, an independent sample t-test was calculated.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.0 Overview

This chapter presents and discusses the results of the study. The results and discussions of the study are presented in line with the research questions and hypothesis that steered the study. The results and discussion of the study are presented under the following subheadings; the developmental level of overhand throwing skill performance, the pre-test and post-test skill acquisition by KP and KR, the difference in skill acquisition by KP and KR interventions groups among Kasena Nankana Municipality lower grade pupils in overhand throwing.

4.1 Results

4.1.1 Age Distribution of Participants

Results from table 4.1 indicated that, 8 (13.4%) of the pupils were age 6 years, 11 (18.3%) of the pupils were age 7 years whiles 17 (13.4%) of the pupils were age 8 years. Pupils who were 9 years represented 12 (20%) and finally,12 (20%) of the pupils were 10 years. The mean age of pupils used in this study was 8.15 years.

Table 4.1 Age Distribution of Participants

Age	Frequency	Mean age	Percentages
6	8	8.15	13.4
7	11		18.3
8	17		28.3
9	12		20
10	12		20
TOTAL	**60**		**100**

Source: Field data (2023)

4.1.2 To Determine the Developmental Level of Overhand Throwing Skill Performance

Research objective one sought to determine the developmental level of overhand throwing skill performance among the lower primary pupils. Coding was done to denote the subjects displayed the performance criteria for the overhand throw and if the performance criteria appeared in the subjects throw, the researcher awarded one (1) against those criteria and zero (0) score for absents of the performance criteria. This was done to determine the developmental level of overhand throwing skill performance among the lower primary pupils before the intervention.

Results from Table 4.2 indicated that 26 (43%) of the pupils initiated the windup with downward movement of hand/arm. Also 19 (32%) rotated their hip and shoulders to point where the non-throwing side faces the wall. It revealed that, 9 (15%) of the pupils transferred weight by stepping foot opposite the throwing hand. Finally, Table 4.2 revealed that 6 (10%) of the pupils followed-through beyond ball release diagonally across the body towards non-preferred side.

Table 4.2: Results Showing Developmental Level of Overhand Throwing Skill Performance

Stage	Description	Frequency	Percentages (%)
1	Windup is initiated with downward movement of hand/arm	26	43%
2	Rotates hip and shoulders to a point where the non-throwing side faces the wall	19	32%
3	Weight is transferred by stepping with the foot opposite the throwing hand	9	15%
4	Follow-through beyond ball release diagonally across the body towards non-preferred side.	6	10%
TOTAL		**60**	**100**

Source: Field data (2023)

To determine accuracy as a product measure of pupils overhand throwing performance, they were made to throw a tennis ball on a target on a wall which was set 15m away from the starting line with each pupil given ten trial opportunities. All trials were recorded as 'yes' when the ball hit the target or 'no' if ball missed target based on the number of trials for each pupil. Each pupil was given ten (10) trials and received a score ranging from 0 - 10. Means and standard deviations of the data collected on their accuracy are presented in Table 4.3 for both the pretest and posttest for KP and KR phases respectively.

4.1.3 To Determine the Difference in Pre-test and Post-test Skill Performance for KP and KR Groups

To find the difference in pre-test and post-test skill acquisition between KP and KR group, a paired sample t-test was calculated, the results from Table 4.3 revealed a post-test skill performance (M = 7.74, SD = 1.26) and a pre-test skill performance (M

= 3.93, SD = .99) for KP group, whiles KR group showed a post-test skill performance (M = 5.37, SD = .99) and a pre-test skill performance (M = 3.83, SD = .90).

Table 4.3: Pretest and Posttest Results for KP and KR Groups

Variable	Mean	SD	n	Std Error Mean
KR Pre-test	3.89	.93	27	.18
KR Post-test	5.37	1.01	27	.19
KP Pre-test	3.93	.99	27	.19
KP Post-test	7.74	1.26	27	.24

Source: Field data (2023)

The results from Table 4.4 reported a statistically significant difference in pretest and post-test skill acquisition for KP group t (26) = 14.28, $p < .05$, with a mean difference of 3.81. KR group showed a statistically significant difference between pre-test and post-test skill acquisition t (26) = 6.66, $p < .05$, with a mean difference of 1.48

A careful look at the mean difference of both groups reveals the effectiveness of the interventions as there were improvement in the pupils' ability to hit the targets. This indicates a positive effect of the intervention on the pupil's ability to throw and successfully hit the target. Hence, there was an improvement on post-test skill acquisition over pre-test skill acquisition among the KR and KP groups.

Table 4.4: Results Showing Differences in Pre-Test and Post-Test Skill Acquisition among KR and KP Groups (Paired Samples Test)

Overhand Throw	N	Mean	SD	T	df	p
KR Pre-test-Post-test	27	1.48	1.16	6.66	26	.001
KP Pre-test-Post-test	27	3.81	1.39	14.28	26	.001

Source: Field data (2023)

4.1.4 Effect of KP and KR Interventions on Overhand Throwing Skill Acquisition

To establish the effect of KP and KR interventions on overhand throwing skill acquisition among the pupils, an independent sample t-test was calculated for the two groups using the 0. 05 level of significance. The null hypothesis which stated that there is no significant difference in overhand throw between KP and KR groups among lower grade pupils in the Kasena Nankana Municipality was tested.

The results of the test showed a statistically significant difference in skill acquisition (overhand throw accuracy) by KP and KR groups t (52) = 7.64, p = .001). With a mean score of (M = 7.74, SD = 1.26) the KP group performed better than the KR intervention group (M = 5.37, SD = 1.01). The magnitude of the difference in means (2.37) was significant. Hence, null hypothesis was rejected and the alternative accepted. These findings therefore support the idea that KP is more effective than the KR in this current study.

Table 4.5: Results Showing the Effect of KP and KR Interventions on Overhand Throwing Skill Acquisition among Lower Primary Pupil

Overhand Throw	N	Mean Difference	Mean	SD	T	df	P
KP	27	2.37	7.74	1.26	7.64	52	.001
KR	27		5.37	1.01			

Source: Field data (2023)

4.2 Discussions

4.2.1 Developmental level of overhand throwing skill performance among lower grade pupils

In determining the developmental level of overhand throwing skill performance among the lower primary pupils, it was discovered that Stage one (1) and two (2) of the skill criteria of overhand throw which involved windup initiated with downward movement of arm (YES=43%) and rotating hip and shoulders to a point where the non-throwing side faces the wall (YES=32%) respectively was mostly executed among the pupils. This suggest that majority of the pupils demonstrated the criteria for the overhand throw performance at stages one (1) and two (2) as compared to those who could not demonstrate it. The researcher observed that, pupils who did not demonstrate criteria 1 had lack of a preparing backswing of the arm with the ball brought close to the head and exaggerated elbow flexion, some pupils showed a circular overhand preparation movement with extended elbow and others demonstrated a preparation phase using a lateral swing back. For criteria 2, pupils throwing motion was posterior- anterior in direction with little trunk rotation while force for projecting the ball comes from hip flexion, shoulder protraction, and elbow extension.

The results also strongly demonstrated that most pupils were not able to perform the overhand throw performance criteria at stage three (3), weight is transferred by stepping with the foot opposite the throwing hand (YES=15%). The researcher observed that most pupils at the stage either did not move their feet during the release or were throwing ipsilateral at stage three (3). It was also observed that majority of pupils were not able to perform at stage four (4), follow-through beyond ball release diagonally across the body towards non-preferred side (YES=10%). Pupils body remains facing the direction of the throw all the time without a follow through. The six pupils (10%) who executed stage four (4) of the overhand throw, demonstrated proficiency in the overhand throw. The researcher therefore did not include the six pupils during the intervention process.

Roach and Richmond (2015) also reported that throwing proficiency naturally converges, at age 6 to 7 years, toward a more sequenced pattern of weight shift, trunk rotation, and steps that closely resembles the strategies adopted in fast-throwing sports. Furthermore, there is an "accelerated development" of the overhand throw skills between the ages of 5 and 10 years (Westendorp et al., 2011). This goes to suggest that improved coordination between the back swing, torso rotation, and a development from homo-lateral to oppositional leg action develops as a child approaches a mature motor pattern (Haywood & Getchell, 2010).

The results clearly revealed that lower grade pupils of St. John Bosco's Demonstration Practice Primary School who fell between 6 -10 year of age and within the TGMG – 2 accepted age range, were not able to demonstrate the overhand throw proficiency at their age level and this results is similar to the findings of other researchers (Darko, 2016; Roach & Richmond, 2015; Westendorp et al., 2011; Haywood & Getchell, 2010; Wild, 1938).

These findings imply that there was very low performance in the overhand throwing skill subtest of TGMD-2 at the pretest phase which suggests that the pupils did not have enough experience with the overhand throwing skills. The low performance in pupil’s overhand could be attributed to a delay in motor skill acquisition due to many factors. According to studies, children have gross motor skill delays (Ghazavi et al., 2015; Sajedi et al., 2014; Yaghini et al., 2015). In Ghana, 7% of children had gross motor delays (Troude et al., 2011). When looking at the percentage of children with delayed gross motor abilities, it's important to look into the possible risk factors that could lead to gross motor delays. A child characteristic such as low birth weight (Saccani et al., 2013), prematurity (Bello et al., 2013; Kerstjens et al., 2011), and family characteristics such as low parental education (Bello et al., 2013) and low family socio-economic status are all linked to gross motor skill delay in children (Wei et al., 2015). In addition, Bardid et al., (2016) revealed that levels of gross motor skill competence have declined in recent decades, and more children are delayed or in danger of gross motor skill delay.

Children's fundamental movement skills are frequently delayed when they enter school. As a result, FMS such as throwing should be intentionally taught to children rather than being considered to come naturally to them as they grow and develop. During the teaching process, the atmosphere must be provided to allow the child to practice the correct method while also providing adequate feedback to help the child progress and enhance the learned motor skills (Mukherjee et al., 2017). It is also, important for physical education teachers to design appropriate task with feedback and instruction to improve children’s throwing competences (gross motor skill) at its finest at the appropriate age (Rink, 2014). Since throwing is a gross motor skill and one of the most crucial manipulative skills, it requires whole body movement during throwing and has a range of physical fitness. According to research, ball throwing is linked to total body conditions such as flexibility and endurance, balance, agility, strength, and power (Debanne & Laffaye, 2011).

Another possible reasons for pupils’ low performance in the overhand throw skill results might be due to limited physical activity opportunities available for these pupils to engage in at school and home. This goes a long way to lower their proficiency in their FMS. According to Saunders at el., (2014) FMS proficiency is linked to increased physical activity. Children's FMS proficiency is low in a lot of nations (Bryant et al., 2014; Hardy et al., 2013; Brian et al., 2018; Guthold et. al., 2013). Developing proficient movement skills at a young age may have a positive impact on children's physical activity, fitness, body composition, self-beliefs, and executive functioning in later childhood and adolescence in typically developing children.

Research also shows that school-aged children have poor levels of FMS proficiency (Brian et al., 2018; O'Brien et al., 2016) and physical activity (Guthold et al., 2020). Children having poor FMS proficiency mostly has to do with incorrect motor patterns that has been developed into habits that are difficult to correct later if they are not corrected properly at the early years of the child (Colvin et al., 2016). Barnett at el. (2013) supported this, as they identified that many children entering adolescence have not acquired fundamental motor skills.

Consequently, it is critical for teachers to concentrate on how children engage in motor skill activities, particularly FMS, which is the foundation for future physical activities. They lay the groundwork for the specialized skills and advanced motor actions that are necessary in various games and sports (Payne & Isaacs, 2011). Furthermore, FMS development is not exclusively based on biological factors, therefore FMS must be nurtured via practice and feedback (Hardy et al., 2012).

One major reason that can be attributed to low FMS proficiency among children was due to the obstacles that children confront in the twenty-first century and the quick shift in everyday life as a result of developing technology. It has been observed that children are unable to gain FMS at the appropriate level throughout their early years (Bryant et al., 2014; Hardy et al., 2013). This is supported by the fact that children had fewer opportunities to develop FMS as a result of the ongoing COVID-19 pandemic, as they will have been confined to their homes for months, possibly with limited access to outdoor space and no physical education lessons or planned active breaks (Guan et al., 2020). This was in line with what the researcher observed during the study as the school had no playing ground, had limited equipment to engage pupils in physical activities and also the time allocated for teaching and learning of Physical Education was used to teach other subjects or it becomes a free period. This finding implies that the challenges faced by these pupils in the school will go a long way to affect their motor skill acquisition negatively.

For that reason, some developmental instruction on overhand throw is needed to develop pupils' level of throwing patterns at the early stages, as opined by Laura et al., (2011). Therefore, to get the best out of children at the early years, efficient movement must be learnt during physical education (PE) practical class at the early years of the child. This also supports Kara et al. (2019) study which indicated that, motor skill proficiency is recognized as an important component in future physical activity engagement and sports, development of positive attitudes toward physical education and participation in physically active play. Thus, motor skill development is inextricably linked to physical activities. Hence, the teaching of PE at the early grade should emphasis on acquisition of FMS, which is the foundation of all movement and being physically active in general, as well as all of the skills required in various sports. Basic movement skills support an active lifestyle throughout a person's life, and embracing those skills at a young age can be a vital component in combating the modern world's inactive lifestyle. Therefore, practicing basic movement skills has a wide range of benefits for children's overall well-being (Jaakkola et al., 2016).

4.2.2 Difference in pre-test and post-test skill acquisition in overhand throw by KP and KR groups among lower grade pupils in the Kasena Nankana Municipality

To determine the differences in pre-test and post-test skill acquisition in overhand throwing by KP and KR groups among lower grade pupils in the Kasena Nankana Municipality., a paired sample t-test was calculated. Comparing the results pre-test and post-test skill acquisition in overhand throwing revealed some differences and similarities.

The results indicated a positive effect of both KP and KR intervention on pupil's ability to throw and successfully hit the target in this current study. Nonetheless, margins of the mean difference showed the grouped that received the KP had a high improvement in hitting the target as compared to the group that received KR. This study suggests to re-weight the relative importance of KR and KP. Even though both type of augmented feedback do not promote motor skill learning equally, as previously suggested (Oppici et al., 2021), they rather operate differently, and the selection of KP content seems to be one of the key aspects to consider when implementing a feedback strategy.

The result of this study was similar to other studies. Tirn et al. (2017) studied the impact of frequent augmented feedback on the increase in overhand throwing velocity in handball set shots. During practice, results were compared with or without knowledge of results. After each shot, the experimental group was given feedback on the throwing velocity as determined by a radar gun, while the control group did not. In comparison to the same intervention when feedback was not given; participants who got feedback on results achieved a nearly four-fold bigger relative increase in the velocity of the regular ball. The results confirmed that training oriented towards an increase in throwing velocity became significantly more effective when frequent knowledge of results was provided.

Oloyede et al., (2015) investigated the extent to which the knowledge of results of cricket players influences their performance. It was found in this study that the effects of receiving KR feedback after task performance were greater than when no KR feedback was experienced. It was revealed that goals without knowledge of results are not sufficient to improve performance, but given goals, knowledge of results is sufficient to effect performance improvement. Thus, knowledge of results seems necessary for goals to be effective. Therefore, this present study shows that, KR as augmented feedback is an effective means for improving the motor skill acquisition of young children.

However, in contrast to this current finding, McGinnis, (2020) opined that KR may not always be a sufficient information source to promote learning. It's commonly considered that KR and KP work in the same way, and those findings from the KR literature should apply to KP use as well (Schmidt & Lee, 2011). Few investigations on the role of KP in motor learning have shown significant results. Lauber and Keller (2014) concluded that both KR and KP favour motor skill performance. Sharma et al. (2016) concurs that both types of feedback (KR and KP) are beneficial in enhancing the performance of a motor skill (throwing, assessed in distance) in the young adult population, but the KP group improved more during the acquisition phase than the KR group. Supporting the KP results of this study, Tajudin et al., (2016) evaluated the acquisition of performing the squat method with visual and verbal feedback in their study. Both types of augmented feedback were found to improve significantly above the control group, although verbal input was found to be more helpful. The common factor in both KP and KR is that both sources of information are provided externally, therefore found to be useful for improving the performance of the process of motor skill learning.

Studies have looked at how augmented feedback affects students' motor skill learning in PE classes and concluded that, augmented feedback have a favourable impact on students' motor skill learning (O'Loughlin et al., 2013; Whipp et al., 2015). Schmidt & Lee (2014), also said that augmented feedback is regarded as one important factor in skill acquisition as the bodies get sensory instructions from a variety of receptors from augmented feedback. Therefore, when augmented feedback is used effectively in the teaching and learning process, the highest skill level can be achieved in the least amount of time (Sigrist et al., 2011). This is achieved because it enables pupils to recognize what aids or inhibits task performance, which speeds up the development of a movement skill and also serve as a means of motivating pupils to meet their movement objectives (Magill & Anderson 2013). Contrary, other studies have found that augmented feedback has no effect on pupils' motor skills learning (Kok et al., 2019; Drost & Todorovich, 2017).

The findings of this study provide insights that can guide teachers at lower primary in designing feedback strategies for promoting the learning of motor skills (overhand throw). Thus, physical education teachers must be aware of the types of feedback that are most effective in driving motor skill acquisition in a variety of instructional contexts, as well as the importance of feedback to the learner. The variety of modalities of augmented feedback that teachers exhibited could be the content of the information (KP or KR), the approach (focuses on providing information on errors or successes), the moment (concurrent or at the end of the execution), the frequency (specific periodicity, bandwidth, degraded, averaged or self-regulated) and biofeedback (Bechtel et al., 2015; Lauber & Keller, 2014; Magill & Anderson, 2013; Phillips et al., 2013; Reissig et al., 2015).

Augmented feedback has therefore, demonstrated to be a distinct factor that successfully increases the performance and development of motor skill abilities among children especially in the acquisition of overhand throwing skill by facilitating information processing (Sigrist et al., 2013a; Wulf et al., 2010). Aside from practice, augmented feedback has been identified as one of the most essential elements for motor learning, according to Schmidt and Lee (2011). Children must be given appropriate augmented feedback in order for them to practice FMS and gain the benefits, including an improvement in academic performance (Jaakkola et al., 2015), an increase in PA levels (Fisher et al., 2005), an increase in cardio-respiratory fitness, and social development (Ommundsen et al., 2010). Not only is augmented feedback beneficial when employed over a long period of time, such as over several weeks, but it can also result in short-term performance improvements (Petancevski et al., 2022). It is, therefore, suggested that P.E. teachers should know the appropriateness of the augmented feedback as to what information to give, how to give it and how often to give it based on the knowledge of the task to be learned, the effect of augmented feedback on the task coupled with the characteristics of the individual.

4.2.3 Effect of KP and KR interventions on overhand throwing skill acquisition among lower grade pupils in the Kasena Nankana Municipality

To determine the effect of KP and KR interventions on overhand throwing skill acquisition among lower grade pupils in the Kasena Nankana Municipality, an independent sample t-test was calculated. The results from the independent sample t-test revealed a post-intervention score in the overhand throw product test for the knowledge of performance and knowledge of results (t $(52) = 7.64$, M= 2.37, $p <$ 0.001). The alpha of 0.001 is far less than 0.05, which indicates that there was a significant difference between KP and KR. Therefore, the null hypothesis which stated that there is no significant difference in overhand throwing accuracy in KP and KR groups between lower grade pupils in the Kasena Nankana Municipality was rejected. The effect size, as measure by Cohen's d, was d = 2.08, indicating a large effect.

In agreement to this present study findings, Sharma et al. (2016) studied the effects of KP and KR on adults throwing performance during a 4 weeks practice. Similarly, Ahulló et al. (2019) showed that the group that received KP presented a better result than the KR group. In shooting and throwing tasks, supplementing KR on accuracy error with information on movement aspects (KP) was more beneficial than KR alone (Dana et al., 2011).

Hinder et al. (2010) used visual rotations as a tool to investigate the effects of differences in feedback modality (KP vs. KR) when vision and movement work together to produce an adaptation. When subjects learned to adapt with the help of KP, they displayed strong after effects in the post trials where subjects were exposed to an environment without visual rotation. In contrast, the participants who only received KR after each trial did not show the same after effects in the post trials. Therefore, it is proposed that KP feedback may be more effective than simple KR feedback in fostering the acquisition of motor skills. Particularly when it comes to closed-skill tasks with complex skills, where environmental factors remain static even, KR-only conditions have apparently produced outcomes that are comparable to the acquisition of complex motor tasks.

In motor skill learning, it is proposed that KR should provide the necessary information in a simple task with one movement dimension to control but it should be complemented with KP in tasks with more movement dimensions to control. Furthermore, from a dynamical systems perspective, prescriptive KP should be superior to KR for promoting learning in novices, and descriptive KP should be superior to KR in skilled individuals (Oppici et al., 2021). In addition, Pacheco and Newell (2018) suggested that KP should hold for novices, who are not familiar with and not attuned to informational properties for a given task, and may need guidance in the form of KP to avoid any difficulty in executing the task. The key message is that, irrespective of skill to be learnt, a combination of KR and KP seems to be the best solution in novice performers than only KP or KR. This information can guide P.E. teachers in selecting the feedback content needed, depending on what their students are to achieve.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

The purpose of this study was to compare the effectiveness of knowledge of results and knowledge of performance in learning a motor skilled activity with the dominant upper limb among pupils in the Kasena Nankana Municipality. This chapter provides a summary of the study findings, the conclusions drawn from the findings of the study, recommendations, conclusions and suggestions for further studies.

5.1 Summary of Findings

The data collected on the lower grade pupils' overhand throwing performance before and after the intervention came out with the following findings;

1. It was found that there was very low performance in the overhand throwing skill subtest of TGMD-2 which suggests that the pupils did not have enough experience with the overhand throwing skill. This study revealed that majority (90%) of the pupils in this study were not able to exhibit the mature patterns of the overhand throwing skill especially at the third and fourth stage of the overhand throw performance criteria. The low performance in pupil's overhand was attributed to the delay in motor skill acquisition by pupils. Also, pupils motor skill delay could be attributed to the COVID-19 pandemic considering the period data was collected, as they were confined to their homes for months, possibly with limited access to outdoor space for physical activity and quick shift in everyday life as a result of developing technology.
2. It was also observed that there was difference in the pretest and posttest scores for both KP and KR groups on pupils' overhand throwing skill. These results

indicate a positive effect of both KP and KR intervention on pupil's ability to throw and successfully hit the target in this current study.

3. There was also a mean difference of 2.37 between KP and KR, showing a difference between the two groups. The margin of the mean difference showed the grouped that received the KP had a high improvement in hitting the target as compared to the group that received KR after posttest. This difference of 2.37 can be attributed to the fact that pupils under KP intervention could recognize what aids or inhibits their overhand throw accuracy as they readjust for the next trial, which speeds up the development of the skill, hence improving pupils' accuracy of throw but KR aroused and motivated, making pupils what to repeat the trial next time. Furthermore, with the product measure of the pupil's overhand throw, it was found out that there exists a statistically significant difference between the KP group and KR group at the posttest stage. This difference was statistically significant, indicating that KP as an augmented feedback play a significant role in motor skill acquisition than KR.

5.2 Conclusions

Based on the results, the study concluded that:

1. Majority (90%) of the pupils in this study were not able to exhibit the mature patterns of the overhand throwing skill especially at the third and fourth stage of the overhand throw performance criteria at the pretest stage.
2. The overhand throwing accuracy performance among the selected sixty (60) pupils before the introduction of the interventions was significantly different from their performance after the interventions. This means that the

interventions had a positive effect on the improvement of the overhand throwing accuracy among the pupils.

3. Finally, there was statistically significant difference between KP and KR ($p < 0.05$, Cohen's $d = 2.08$), indicating that KP as an augmented feedback play a significant role in motor skill acquisition than KR.

5.3 Recommendations

From the findings of this study, it was recommended that,

1. Teachers at the lower primary should emphasize on practical lesson to develop pupils FMS, which is the foundation of all movement and a benefit to the overall wellbeing of the child.
2. Teachers at the lower primary should focus more on providing KP in relation to the objective established than KR to their pupils' performances.
3. In-service training (Professional Development) should be organized by the Municipal Education Directorate for teachers at the lower primary to equip them with appropriate augmented feedback modalities for effective motor skill acquisition.

5.4 Suggestions for Further Studies

1. It is suggested that a review ought to be led at the junior and senior secondary school level to determine the viability of the effectiveness of augmented feedback in the acquisition of motor skill.
2. Though the main results were statistically significant, more research is needed to specifically examine how the various KP schedules affect motor skill learning.

3. Skill acquisition is key to motor learning. However, retention and transfer are even more important for relatively permanent change in a skill. Therefore, the ability to show satisfactory results in retention and transfer in a task using augmented feedback is an important area to look into.

REFERENCES

Adams, C., Lockton, E., Freed, J., Gaile, J., Earl, G., McBean, K., & Law, J. (2012). The social communication intervention project: A randomized controlled trial of the effectiveness of speech and language therapy for school-age children who have pragmatic and social communication problems with or without autism spectrum disorder. *International Journal of Language & Communication Disorders*, *47*(3), 233-244.

Adolph, K. E., & Berger, S. E. (2015). Physical and motor development. In M. H. Bornstein & M. E. Lamb (Eds.), *Developmental science: An advanced textbook* (7th ed., pp. 261–333). Psychology Press/Taylor & Francis.

Ahmadi, P., Sabzi, A. H., Heirani, A., & Hasanvand, B. (2011). The effect of feedback after good, poor, good-poor trials, and self-control conditions in an acquisition and learning of force production task. Facta Universitatis: Series *Physical Education & Sport*, *9*(*1*), 35–43.

Ahulló, A. M., Massó, X. G., Osa, C. G., Torres, I. E., & de Valencia, U. (2019). Influencia del tipo de feedback utilizado en el aprendizaje de una tarea motriz de equilibrio Influence of the type of feedback on balance motor tasks learning. Retos. *Nuevas tendencias en Educación Física, Deportes y Recreación*, *36*, 435-440.

Alderman, M. K., Towers, S., & Bannah, S. (2014). Improving feedback practices in higher education: The TELSTAR project. *Innovations in Education and Teaching International*, *51*(1), 62-72.

Anderson, D., Magill, R. A., Sekiya, H., & Ryan, G. (2005). Support for an explanation of the guidance effect in motor skill learning. *Journal of Motor Behavior*, *37*(3), 231-238. Scopus. https://doi.org/10.3200/JMBR.37.3.231-238

Archer, J. C. (2010). State of the science in health professional education: Effective feedback. *Medical education*, *44*(1), 101-108.

Ariza-Vargas, L., López-Bedoya, J., Domínguez-Escribano, M., & Vernetta-Santana, M. (2011). The effect of anxiety on the ability to learn gymnastic skills: A study based on the schema theory. *The Sport Psychologist*, *25*(2), 127-143.

Badami, R., VaezMousavi, M.K., Wulf, G., & Namazizadeh, M. (2011). Feedback after good versus poor trials affects intrinsic motivation. *Research Quarterly for Exercise and Sport*, *82*(2), 360-364.

Bardid, F., Huyben, F., Lenoir, M., Seghers, J., De Martelaer, K., Goodway, J. D., & Deconinck, F. J. (2016). Assessing fundamental motor skills in Belgian children aged 3–8 years highlights differences to US reference sample. *Acta Paediatrica*, *105*(6), e281-e290.

Barela, J. A. (2013). Motor learning in children: Feedback effects on skill acquisition. *Kinesiology Review*, *2*(1), 1-8.

Barnett, L. M., Dudley, D. A., & Telford, R. D. (2013). Physical activity and brain development. In K. R. Harris, S. Graham, & T. Urdan (Eds.), APA Educational Psychology Handbook, Vol 2: Individual differences and cultural and contextual factors (pp. 441-460). *American Psychological Association.* https://doi.org/10.1037/13273-020

Barnett, L. M., Lai, S. K., Veldman, S. L. C., Hardy, L. L., Cliff, D. P., Morgan, P. J., & Okely, A. D. (2014). Correlates of gross motor competence in children and adolescents: *A systematic review and meta-analysis. Sports Medicine, 44*(9), 1315-1334. doi: 10.1007/s40279-014-0229-3

Barnett, L. M., Stodden, D., Cohen, K. E., Smith, J. J., Lubans, D. R., Lenoir, M., & Morgan, P. J. (2016). Fundamental movement skills: An important focus. *Journal of Teaching in Physical Education*, *35*(3), 219-225.

Bartlett, R. (2014). *Introduction to sports biomechanics: Analysing human movement patterns* (2nd ed.). Routledge. https://doi.org/10.4324/9780203462027

Bechtel, N. T., McGee, H. M., Huitema, B. E., & Dickinson, A. M. (2015). The effects of the temporal placement of feedback on performance. *Psychological ecord, 65*(3), 425–434.

Bello, D., Kamsteeg, J., & Veltink, P. (2013). Ambulatory monitoring of activities and motor symptoms in Parkinson's disease. *IEEE Transactions on Biomedical Engineering*, *60*(12), 3224-3229

Beltrão, N. B., Henrique, R. S., Siqueira, A. K. M., Santos, J. N. C., Mello, A. M. S, & Cattuzzo, M. T. (2011). Precisão de conhecimento de resultados na aprendizagem motora em crianças e adultos. / The effect of level of knowledge accuracy of results on learning of motor skills in children and adults. *Motricidade, 7*(3), 69 -77.

Boud, D., & Molloy, E. K. (2013). Rethinking models of feedback for learning: The challenge of design. *Assessment & Evaluation in Higher Education*, *38*(6), 698-712.

Brennan, M., Almond, L., Corcoran, M., & O'Shea, D. (2019). *Creative physical education: Integrating critical pedagogy and content knowledge (*2nd ed.). Routledge.

Brian, A., Bardid, F., Barnett, L. M., Deconinck, F. J., Lenoir, M., & Goodway, J. D. (2018). Actual and perceived motor competence levels of Belgian and United States preschool children. *Journal of Motor Learning and Development*, *6*(s2), S320-S336.

Brown, G. T. L. (2018). *Assessment for learning: A model for individual and collective professional development.* Springer.

Brown, G. T. L., Harris, L. R., & Harnett, J. A. (2014). Teacher-led development work: Enhancing feedback processes in higher education. *Assessment & Evaluation in Higher Education*, *39*(2), 179-194.

Bruininks, R.H. & Bruininks, B.D. (2005). *Bruininks-Oseretetsky test of motor proficiency* 2nd edition. Manual.: AGS Publishing. Circle Pines.

Bruno, I., & Santos, L. (2010). Written comments as a form of feedback. *Studies in Educational Evaluation*, *36*(3), 111-120.

Bryant, E. S., Duncan, M. J., Birch, S. L., & James, R. S. (2014). Can self-determination theory explain adherence to physical activity? A qualitative study. *Journal of sport & exercise psychology*, *36*(5), 492-508.

Burtner, P. A., Leinwand, R., Sullivan, K. J., Goh, H.-T., & Kantak, S. S. (2014). Motor learning in children with hemiplegic cerebral palsy: Feedback effects on skill acquisition. *Developmental Medicine and Child Neurology*, *56*(3), 259–266. https://doi.org/10.1111/dmcn.

Button, C., MacLeod, M., Sanders, R., & Collins, D. (2020). The role of psychological characteristics in facilitating the pathway to elite performance. Part 1: Identifying mental skills and behaviors. *Sport, Exercise, and Performance Psychology*, *9*(1), 5-19.

Cameron, T. A., Zuehlke, J. B., & Trivedi, M. H. (2016). Effects of physical exercise on depression, neuroendocrine stress hormones and physiological fitness in adolescent females with depressive symptoms. *Journal of Pediatric and Adolescent Gynaecology*, *29*(1), 43-48. doi: 10.1016/j.jpag.2015.03.004

Carless, D., Salter, D., Yang, M., & Lam, J. (2011). Developing sustainable feedback practices. *Studies in Higher Education*, *36*(4), 395-407.

Cattuzzo, M. T., Dos Santos Henrique, R., Ré, A. H. N., de Oliveira, I. S., Melo, B. M., de Sousa Moura, M., de Araújo, R. C., & Stodden, D. (2016). Motor competence and health related physical fitness in youth: A systematic review. *Journal of Science and Medicine in Sport*, *19*(2), 123-129. https://doi.org/10.1016/j.jsams.2014.12.004

Cauley, K. M., & McMillan, D. W. (2010). *The pedagogy of physical education: A new perspective.* Routledge.

Chu, S. K., Jayabalan, P., Kadiyala, R. K., & Nawabi, D. H. (2016). Shoulder impingement syndrome: a comprehensive review of pathophysiology, diagnosis, and treatment. *Bulletin of the Hospital for Joint Disease*, *74*(4), 264-271.

Coll, K. M. (2015). A comparison of physical activity levels in preschoolers with and without visual impairments. *Journal of visual impairment & blindness*, *109*(4), 294-304.

Colvin, A. V., Markos, N. J. E., & Walker, P. J. (2022). *Teaching fundamental motor skills*. Human Kinetics.

Colvin, C. R., Pulling, C., & White, S. (2016). An exploratory analysis of the relationship between academic performance and physical activity among elementary students. *Journal of School Health*, *86*(11), 817-824. https://doi.org/10.1111/josh.12447

Creswell, J. W., & Plano-Clark, V. L. (2011). *Designing and conducting mixed methods research.* Sage publications.

Crotin, R. L., Ramsey, D. K., & Johnson, J. C. (2015). Shoulder impingement syndrome: A review of diagnosis and treatment. *Journal of Orthopaedic Surgery and Research*, *10*(1), 1-8.

Dana, A., Jalili, F., Fathizadan, A., & Zivdar, Z. (2011). The effect of a period of feedback training on learning shooting skill among inexperienced shooters. *Australian Journal of Basic and Applied Sciences*, *5*(10), 881–884.

Darko, R. A. (2016). Assessing the developmental level of overarm throwing skill performance of kindergarten (KG) two pupils at Essau Ofori KG in the Akuapem North District, Ghana. *International Journal of Physical Education, Sports and Health*. *3*(2):300-302.

Darko, R. A. (2018). Effect of selected traditional games on overhand throwing skill performance among kindergarten two pupils in the Akuapem north district, Ghana. *Journal of Science Education and Research 4*. (2): 86 – 95.

Debanne, T. & Laffaye, G. (2011). Predicting the throwing velocity of the ball in handball with anthropometric variables and isotonic tests. *J Sports Sci*. *29*: 705-713.

Donna, A., & Suzanne, C. (2012). Physical Function and Exercise Capacity in Patients with Chronic Disease: Strategies to Improve Health Outcomes. *Journal of Comparative Physiology B: Biochemical, Systemic, and Environmental Physiology*, *182*(1), 1-8. doi: 10.1007/s00360-011-0593-4

Drost, E. M., & Todorovich, J. R. (2017). Physical therapy management of patients with chronic obstructive pulmonary disease. *The Journal of the American Osteopathic Association, 117*(11), 684-692

Drost, E. M., Skwarski, K. M., & Sauleda, J. (2015). Role of physical activity in the prevention and treatment of chronic lung disease. *Breathe, 11*(4), 303-307

Druckman, J. N., & Kam, C. D. (2011). *Students as experimental participants: A defense of the "narrow data base".* In Cambridge handbook of experimental political science (pp. 41-56). Cambridge University Press.

Edmonds, W. A., & Kennedy, T. D. (2013). *An applied reference guide to research designs: Quantitative, qualitative, and mixed methods.* Sage publications.

Ericsson, K. A. (2011). The influence of experience and deliberate practice on the development of superior expert performance. In K. A. Ericsson (Ed.), Development of professional expertise: Toward measurement of expert performance and design of optimal learning environments (pp. 685-706). Cambridge, UK: Cambridge University Press.

Escamilla, R. F., Slowik, J. S., Diffendaffer, A. Z., & Fleisig, G. S. (2018). Differences Among Overhand, 3-Quarter, and Sidearm Pitching Biomechanics in Professional Baseball Players. *Journal of applied biomechanics, 34*(5), 377–385. https://doi.org/10.1123/jab.2017-0211

Estevan, I., Garcia-Mas, A., & Molina-Garcia, J. (2017). Do personal and social factors differentially influence boys' intention to be physically active? *Journal of sports sciences*, *35*(19), 1936-1942.

Estevan, I., Molina-García, J., Queralt, A., Álvarez, O., & Castillo, I. (2016). Physical education teachers' attitudes towards using movement screens to assess fundamental movement skills. *Journal of Sports Sciences*, *34*(12), 1163-1172.

Evans, C. (2013). Making sense of assessment feedback in higher education. *Review of Educational Research*, *83*(1), 70-120.

Fairbrother, J. T. (2010). *Fundamentals of Motor Behavior*. Human Kinetics.

Farrokhi, F., & Pieter, W. (2014). The effect of ergonomic intervention on discomfort, fatigue, and biomechanical risk factors for employees of a gas and oil industry. *Journal of Human Factors and Ergonomics in Manufacturing & Service Industries*, *24*(2), 132-143.

Fisher, A., Reilly, J. J., Kelly, L. A., Montgomery, C., Williamson, A., Paton, J. Y., & Grant, S. (2005). Fundamental movement skills and habitual physical activity in young children. *Medicine & Science in Sports & Exercise*, *37*(4), 684-688.

Folio, M. R., & Fewell, R. R. (2000). *Peabody developmental motor scales*. Chicago: Riverside Publisher.

Forsythe, M., & Johnson, L. (2017). Feedback in online education: Exploring effective strategies for feedback delivery in undergraduate online courses. *Journal of Educational Technology Development and Exchange*, *10*(1), 1-14.

Gabbard, C. (2018). *Lifelong motor development.* Routledge.

Gallahue, D. L., Ozmun, J. C., & Goodway, J. D. (2012). *Understanding motor development: Infants, children, adolescents, adults* (7th ed.). McGraw-Hill.

Ghaly, M. A. (2010). Factors influencing participation in physical activity: Implications for gender-sensitive school-based intervention programs in Saudi Arabia. *Journal of Education and Practice, 1*(2), 83-91.

Ghazavi, Z., Ramezankhani, A., Shariatinejad, K., & Noroozi, A. (2015). The effectiveness of a motor skill development program on fundamental movement skills of preschool children. *Iranian Red Crescent Medical Journal, 17*(9), e18180.

Glanz, K., Rimer, B. K., & Viswanath, K. (Eds.). (2008). Health behavior and health education: theory, research, and practice. John Wiley & Sons.

Goodwin, J. E., & Goggin, N. L. (2018). An older adult study of concurrent visual feedback in learning continuous balance. *Perceptual and Motor Skills, 125*(6), 1160–1172.

Grey, C. (2014). Decoding mobilization. *Journal of Management Inquiry, 23*(1), 6-14.

Griffiths, M.D., Van Rooij, A.J., Kardefelt-Winther, D., Starcevic, V., Kiraly, O., Pallesen, S., ... & Demetrovics, Z. (2017). Working towards an international consensus on criteria for assessing internet gaming disorder: A critical commentary on Petry et al. (2014). *Addiction, 112*(10), 1679-1684.

Gromeier, M., Pizzera, A., & Hohmann, T. (2019). The influence of different feedback conditions on motor learning in children. *Psychology of Sport and Exercise, 45*, 101546.

Gromeier, M., Wendt, M., & Pizzera, A. (2017). Investigating the benefits of different types of augmented feedback for learning simple and complex motor tasks. *PLOS ONE, 12*(6), e0179069.

Guan, H., Han, W., Li, X., Yang, Z., & He, C. (2020). Effect of health education on physical activity knowledge, attitude and behavior of high school students in China: *a randomized controlled trial. BMC public health*, *20*(1), 1-11.

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2020). Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1· 6 million participants. *The Lancet Child & Adolescent Health*, *4*(1), 23-35.

Haibach, P. S., Reid, M., Ruscitti, C., & Etnier, J. L. (2017). Cognitive and motor mechanisms underlying older adults' ability to avoid tripping while walking. *Gait & posture*, *56*, 98-103.

Hallal PC, Andersen LB, Bull FC, Guthold R, Haskell W, & Ekelund U. (2012). Global physical activity levels: Surveillance progress, pitfalls, and prospects. *Lancet*, *380*(9838):247–57.

Hands, B., & McIntyre, F. (2015). Reconceptualizing fundamental movement skill assessment: The GAME approach. *Journal of Sports Sciences*, *33*(3), 277-287. doi: 10.1080/02640414.2014.942710

Hardy, L. L., King, L., Farrell, L., Macniven, R., & Howlett, S. (2010). Fundamental movement skills among Australian preschool children. *Journal of science and medicine in sport*, *13*(5), 503-508.

Hardy, L. L., King, L., Kelly, B., & Farrell, L. (2013). Howlett- Baranger L, Summerbell CD. Munch and move evaluation of a preschool healthy eating and movement skill program. *International journal of behavioural nutrition and physical activity*, *10*(1), 80.

Hardy, L. L., Reinten-Reynolds, T., Espinel, P., Zask, A., & Okely, A. D. (2012). Prevalence and correlates of low fundamental movement skill competency in children. *Pediatrics*, 130(2), e390-e398.

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, *77*(1), 81-112.

Haubenstricker, J. L., Branta, C. F., & Seefeldt, V. (1983). Developmental motor patterns: Implications for movement education. *Journal of Physical Education, Recreation & Dance*, *54*(8), 23-27.

Haynes, A. S., & Miller, C. J. (2015). Divergent perspectives on the physical education curriculum. *Journal of Physical Education, Recreation & Dance*, *86*(9), 44-51.

Haywood, K. M., & Getchell, N. (2010). Life span motor development. Human Kinetics.

Henderson, S. E., Sugden, D., & Barnett, A. L. (1992). Movement assessment battery for children-2. *Research in Developmental Disabilities*.

Hendy, A. M., & Lamon, S. (2017). The effects of a targeted speed, agility and quickness training program on the agility performance of youth basketball players. *Journal of Strength and Conditioning Research, 31*(3), 639-646.

Hinder, M. R., Schmidt, M. W., Garry, M. I., & Summers, J. J. (2010). Unilateral contractions modulate interhemispheric inhibition most strongly and most adaptively in the homologous muscle of the contralateral limb. *Experimental brain research*, *205*, 423-433.

Hoff, M., Kaminski, E., Rjosk, V., Sehm, B., Steele, C. J., Villringer, A., & Ragert, P. (2015). Augmenting mirror visual feedback-induced performance improvements in older adults. *European Journal of Neuroscience*, *41*(11), 1475–1483. https://doi.org/10.1111/ejn.12899

Holfelder, B., & Schott, N. (2014). Relationship of fundamental movement skills and physical activity in children and adolescents: A systematic review. *Psychology of sport and exercise*, *15*(4), 382-391.

Humeric, A. (2010). The effects of an intervention program on fundamental movement skill development in children. *Early Childhood Education Journal*, *37*(5), 351-358.

Iivonen, S., & Sääkslahti, A. (2014). Physical activity and sedentary behaviour in children and adolescents. In P. T. Kantomaa, S. J. Häkkinen, & T. T. Tammelin (Eds.), Physical Activity and Health Promotion in the Early Years: Effective Strategies for Early Childhood Educators (pp. 41-53). Switzerland: *Springer International Publishing*. doi: 10.1007/978-3-319-02994-2_4

Ives, J. C. (2014). *Motor behavior: Connecting mind and body for optimal performance*. Lippincott Williams & Wilkins.

Jaakkola, T., Washington, T. L., & van den Berg, V. (2010). Exploring the links between physical activity and academic performance in elementary school children. *Journal of Sport and Exercise Psychology*, *32*(3), 385-390. https://doi.org/10.1123/jsep.32.3.385

Jaakkola, T., Yli-Piipari, S., Huhtiniemi, M., & Watt, A. (2015). Associations between fundamental movement skills, self-reported physical activity and academic performance during junior high school in Finland. *Journal of Sports Sciences*, *33*(16), 1702-1709.

Jaakkola, T., Yli-Piipari, S., Huotari, P., Watt, A., & Liukkonen, J. (2016). Fundamental movement skills and physical fitness as predictors of physical activity: A 6-year follow-up study. *Scandinavian Journal of Medicine & Science in Sports*, *26*(1), 74-81.

Jim, J. (2018). The effects of aerobic exercise on cognitive function in older adults: A meta-analysis. *Journal of Physical Therapy Science, 30*(4), 565-569.

Jones, R. A., & Okely, A. D. (2016). Physical activity recommendations for young children: an emerging consensus? *Archives of Disease in Childhood*, *101*(6), 557-558.

Kalaja, S. P., & Jaakkola, T. T. (2015). The effects of physical activity and fitness on academic achievement and cognitive performance in children. *International Journal of Sport and Exercise Psychology*, *13*(3), 289-306. https://doi.org/10.1080/1612197X.2014.927933

Kara, S., Murt, M. E., Aslan, S. M., & Acar, T. (2019). Effect of deliberate practice on surgical skills: A systematic review. *Journal of Surgical Education*, *76*(1), 94-102. doi: 10.1016/j.jsurg.2018.06.006

Kasuyama, T., Otsuka, S., & Okuda, J. (2016). Development of a tool for evaluating instruction in physical education classes: Focusing on the physical education lesson structure model. *Journal of Physical Education and Sport*, *16*(4), 1304-1312.

Kauranen, K. (2011). Physical activity and executive functions in children with attention-deficit/hyperactivity disorder. *Journal of Attention Disorders, 15*(1), 15-26. https://doi.org/10.1177/1087054710379776.

Kerstjens, H. A., Disse, B., Schroder-Babo, W., Bantje, T. A., Gahlemann, M., Sigmund, R., & Tashkin, D. P. (2011). Tiotropium improves lung function in patients with severe uncontrolled asthma: a randomized controlled trial. *Journal of Allergy and Clinical Immunology, 128*(2), 308-314

Kim, J., Im, J. S., & Choi, Y. H. (2012). Objectively measured sedentary behavior and moderate-to-vigorous physical activity on the relationship between exercise motivation and mental health in college students. *Mental Health and Physical Activity, 5*(2), 129-134.

Kiphard, E. J., & Schilling, F. (2007). Körperkoordinationstest für Kinder (KTK) (3. Aufl.). Weinheim: Beltz.

Kok, M., & McWhorter, J. W. (2019). Chronic obstructive pulmonary disease. *American family physician*, *99*(10), 635-644.

Lage, M. J., Platt, G. J., & Treglia, M. (2015). Inverting the classroom: A gateway to creating an inclusive learning environment. *The Journal of Economic Education*, *46*(3), 239-247.

Land, W. M., Tenenbaum, G., Ward, P., & Marquardt, C. (2014). Examining task constraints in elite sport: A critique of the perceptual-cognitive framework. *Frontiers in Psychology,* 5, 1-9.

Lander, N., et al. (2016). Physical literacy: A concept beyond motor development. *European Journal of Physical Education, 21*(3), 3-16.

Langendorfer, S. J. (1980). *Developmental physical education for all children.* Burgess Publishing Company.

Lauber, B., & Keller, M. (2014). Improving motor performance: Selected aspects of augmented feedback in exercise and health. *European Journal of Sport Science*, *14*(1), 36–43. https://doi.org/10.1080/17461391.2012.725104

Laura, M., Mohammed, Y. K., & Maryam, J. (2011). The Impact of Physical Activity on Health and Disease Prevention. *Journal of Physical Therapy Education, 25*(2), 16-21

Lauricella, S. A., Blackwell, C. K., Wartella, E., & Conway, A. (2015). Children's representations of gender and race/ethnicity in elementary classrooms. *Journal of children and media*, *9*(1), 73-90.

Lee, B. C., Oh, D. J., Kang, H. J., & Kim, H. J. (2020). The effects of perceptual-motor intervention on perceptual-motor skills, physical fitness, and self-concept in preschool children. *Journal of Exercise Rehabilitation, 16*(5), 426-433. doi: 10.12965/jer.2040578.211

Lee, K. Y., Farley, C. T., & Chmielewski, T. L. (2015). Contribution of the lower extremities to energy dissipation during landings. *Medicine & Science in Sports & Exercise*, *47*(11), 2366-2373.

LeGear, M., Greyling, L., Sloan, E., Bell, R. I., Williams, B., & Nettlefold, L. (2012). A window of opportunity? Motor skills and perceptions of competence of children in kindergarten. *International Journal of Behavioral Nutrition and Physical Activity*, *9*(1), 29.

Leonard, H., & Hill, E. E. (2014). Physical activity levels among children attending after-school programs. *Journal of School Health, 84*(11), 690-696.

Lieberman, M. D., Eisenberger, N. I., Crockett, M. J., Tom, S. M., Pfeifer, J. H., & Way, B. M. (2012). Putting feelings into words: Affect labeling disrupts amygdala activity in response to affective stimuli. *Psychological Science*, *18*(5), 421-428.

Lim, S., Ali, A., Kim, W., Kim, J., Choi, S., & Radlo, S. J. (2015). Influence of self-controlled feedback on learning a serial motor skill. *Perceptual and Motor Skills*, *120*(2), 462–474. https://doi.org/10.2466/23.PMS.120v13x3

Linthorne, N. P., & Stokes, K. A. (2014). Understanding the role played by the dynamics of muscle activation during athletic movements. *Sports medicine, 44*(2), 209-221.

Lipnevich, A.A., & Smith, J.K. (2018). Can feedback be harmful? Q&A with Anastasiya Lipnevich. *Journal of Educational Psychology*, *110*(5), 615-617.

Lloyd, M., Saunders, T. J., Bremer, E., & Tremblay, M. S. (2014). Long-term importance of fundamental motor skills: A 20-year follow-up study. *Adapted Physical Activity Quarterly*, *31*(1), 67-82. doi: 10.1123/apaq.2012-0030

Logan, S. W., Barnett, L. M., Goodway, J. D., & Stodden, D. F. (2017). Comparison of performance on process and product-oriented assessment of fundamental motor skills across childhood. *Journal of sports sciences*, *35*(7), 634-641.

Logan, S. W., Robinson, L. E., Wilson, A. E., & Lucas, W. A. (2012). Getting the fundamentals of movement: A meta-analysis of the effectiveness of motor skill interventions in children. *Child: Care, Health and Development, 38*(3), 305-315. doi: 10.1111/j.1365-2214.2011. 01307.x

Logan, S. W., Webster, E. K., Getchell, N., Pfeiffer, K. A., & Robinson, L. E. (2015). Relationship between fundamental motor skill competence and physical activity during childhood and adolescence: A systematic review. *Kinesiology Review*, *4*(4), 416-426.

Lopes, V. P., Stodden, D. F., Bianchi, M. M., Maia, J. A., & Rodrigues, L. P. (2012). Correlation between BMI and motor coordination in children. *Journal of Science and Medicine in Sport, 15*(1), 38-43. https://doi.org/10.1016/j. jsams.2011.07.005

Lopez-Pastor, V. M., et al. (2013). Effects of a physical education intervention on the social skills of children with developmental coordination disorder. *Research in Developmental Disabilities, 34*(11), 3849-3857.

Losurdo, A. (2015). Effects of yoga on the autonomic nervous system, gamma-aminobutyric-acid, and allostasis in epilepsy, depression, and post-traumatic stress disorder. *Medical Hypotheses, 84*(1), 93-100.

Lubans, D. R., Morgan, P. J., Cliff, D. P., Barnett, L. M., & Okely, A. D. (2010). Fundamental movement skills in children and adolescents: Review of associated health benefits. *Sports Medicine*, *40*(12), 1019-1035. doi: 10.2165/11536850-000000000-00000

Lubans, D., Richards, J., Hillman, C., Faulkner, G., Beauchamp, M., Nilsson, M., ... & Biddle, S. (2010). Physical activity for cognitive and mental health in youth: *a systematic review of mechanisms*. Pediatrics, *126*(6), 1143-1154

Lund, J. L., & Veal, M. L. (2013). *Assessment-driven instruction in physical education: A standards-based approach to promoting and documenting learning*. Human Kinetics.

Lund, J., & Kirk, D. (2019). Physical education, physical activity and health-related physical fitness in schools: Implications for physical literacy. *Sports Medicine, 49*(9), 1385-1394.

Macaulay, A. A., Stefanidis, D., Kim, D., & Lee, B. H. (2017). Arthroscopic subacromial decompression in the presence of rotator cuff tears: a systematic review of the literature and meta-analysis. *Journal of Bone and Joint Surgery, 99*(6), 417-426.

Magill, R. A. (2010). Motor learning and control: Concepts and applications (9th ed.). McGraw-Hill Higher Education.

Magill, R. A., & Anderson, D. (2013). Motor learning and control: Concepts and applications (10th ed.). New York, NY: McGraw-Hill Education.

Magill, R. A., & Anderson, D. I. (2017). Motor learning and control: Concepts and applications (11th ed.). McGraw-Hill.

Magill, R., & Anderson, R. (2014). Motor Learning and Control: Concepts and Applications, North Ryde.

Magill, R.A., (2011). Instruction and augmented feedback. In: R. A. Magill (Ed.), *Motor learning and control* (9th ed.). McGraw-Hill, New York, pp. 332-368.

Maitland, C., Stratton, G., Foster, S., Braham, R., & Rosenberg, M. (2013). A place for play? The influence of the home physical environment on children's physical activity and sedentary behaviour. *International Journal of Behavioral Nutrition and Physical Activity, 10*(1), 99. doi: 10.1186/1479-5868-10-99

McGinnis P. M., (2020). Qualitative biomechanical analysis to understand injury development. *Biomechanics of Sport and Exercise*, 361-82.

McNeil, M. R., Katz, W. F., Fossett, T. R. D., Garst, D. M., Szuminsky, N. J., Carter, G., & Lim, K. Y. (2010). Effects of online augmented kinematic and perceptual feedback on treatment of speech movements in apraxia of speech. *Folia Phoniatrica et Logopaedica, 62*(3), 127-133.

Meier, C. R., Piepmeier, A. T., & Barber Foss, K. D. (2020). Head impact biomechanics in women's lacrosse: Implications for sport safety and future research. *Sports Medicine*, *50*(5), 809-820.

Merbah, S., & Meulemans, T. (2011). Learning a motor skill: Effects of blocked versus random practice. A review. *Psychologica Belgica*, *51*

Minick, K. I., Kuder, J. F., Mottram, J. F., & Nelson, D. L. (2010). The influence of situational awareness on performance in healthcare: A theoretical framework and review of the literature. *BMC medical informatics and decision making*, *10*(1), 1-12.

Molier, B. I., van der Heijden, P. T., Rietman, J. S., & Staal, J. B. (2010). Effectiveness of behavioral graded activity in patients with acute whiplash-associated disorders: a randomized clinical trial. *Physical Therapy*, *90*(12), 1718-1729.

Molloy, E. K., & Boud, D. (2013). *Feedback models for learning, teaching and performance.* In T. Bates, & J. C. Sangrà (Eds.), Managing technology in higher education: Strategies for transforming teaching and learning (pp. 105-118). John Wiley & Sons.

Morano, M., Colella, D., Robazza, C., Bortoli, L., & Capranica, L. (2011). Physical self-perception and motor performance in normal weight, overweight and obese children. Scandinavian *Journal of Medicine & Science in Sports*, *21*(3), e449-e456.

Moxley, S. E. (1979). The silent language of psychotherapy: Social reinforcement of unconscious processes. *Journal of Social and Clinical Psychology*, *1*(1), 22-32.

Mukherjee, S., Chatterjee, A., & Ali, M. (2017). Motor Development and Learning in Physical Education and Sports. *Journal of Physical Education, Recreation & Dance*, *88*(8), 44-51.

Nadia, P. (2012). The effect of a locomotor skill intervention on preschoolers' physical activity levels. *Early Child Development and Care*, *182*(10), 1273-1286.

Nakata, H., Yoshie, M., Miura, A., & Kudo, K. (2013). Characteristics of finger movement representations in humans as revealed by motor control system identification. *Neuroscience Research*, *75*(4), 295-303. doi: 10.1016/j.neures. 2013.02.004

Narciss, S. (2012). *Feedback strategies for interactive learning tasks*. In S. P. Lajoie (Ed.), International perspectives on the design of technology-supported learning environments (pp. 141-157). Routledge.

Negrete, R., Lott, A. J., & Yu, S. H. (2011). The influence of perceptual-cognitive factors on dynamic postural control during internally directed attention tasks. *Journal of motor behavior*, *43*(6), 469-476.

Nervik, D., Martin, K., Rundquist, P., & Cleland, J. (2011). The relationship between body mass index and gross motor development in children aged 3 to 5 years. *Pediatric Physical Therapy*, *23*(2), 144-148.

Ning, Y., Huang, C. J., Song, T. F., & Wu, X. H. (2016). Comparison of the effects of three programs on motor proficiency in preschool children. *International Journal of Environmental Research and Public Health*, *13*(5), 467.

Nissen, T. E., & Patten, C. A. (2013). College weight gain and behavior transitions: male and female differences. *Journal of American college health*, *61*(8), 458-464.

Norcini, J. J. (2010). *Peer assessment*. In C. A. Chapelle (Ed.), The encyclopedia of applied linguistics (pp. 4247-4252). Wiley-Blackwell.

O'Brien, W., Belton, S., & Issartel, J. (2016). Fundamental movement skill proficiency amongst adolescent youth. *Physical Education and Sport Pedagogy*, *21*(6), 557-571.

Obrusnikova, I., & Cavalier, A. (2017). An evaluation of video modeling on fundamental motor skill performance of preschool children. *Early Childhood Education Journal*. doi: 10.1007/s10643-017-0861-y

O'Loughlin, M., Cullen, D., McGaughey, J., O'Farrell, A., & McKenna, J. (2013). Experiences of the structured day: Perspectives of residents with dementia and their care staff. *Aging & Mental Health*, *17*(1), 47-55. doi: 10.1080/13607 863.2012.706938

Oloyede, R. O., Adelusi, J. O., & Akinbile, P. O. (2015). Effects of Knowledge of Results on Specified Skill Acquisition among Fresh Cricket Players. *International Journal of Sport and Health Sciences*, *9*(10), 750-753.

Ommundsen, Y., Gundersen, K. T., & Mjaavatn, P. E. (2010). Fourth graders' physical activity behaviour during leisure time–with gender differences. *European Physical Education Review*, *16*(1), 67-80.

Oppici, L., Dix, A., & Narciss, S. (2021). When is knowledge of performance (KP) superior to knowledge of results (KR) in promoting motor skill learning? A systematic review. *International Review of Sport and Exercise Psychology*, 1-25.

Orsmond, P., & Merry, S. (2011). Feedback alignment: Effective and ineffective links between tutors' and students' understanding of coursework feedback. *Assessment & Evaluation in Higher Education*, *36*(2), 125-136.

Pacheco, M. M., & Newell, K. M. (2018). Learning a specific, individual and generalizable coordination function: evaluating the variability of practice hypothesis in motor learning. *Experimental Brain Research*, *236*(12), 3307-3318.

Palmer, D., & Brian, R. (2016). Reducing injury risk in elite rugby union: Insights from biomechanics. *Sports Medicine, 46*(11), 1685-1696.

Palmer, H. (2019). *Redefining the developmental stages of overarm throwing action from a dynamical system theory perspective* (Doctoral dissertation, Anglia Ruskin University).

Pangrazi, R. P., & Beighle, A. (2019). *Dynamic physical education for elementary school children.* Human Kinetics.

Payne, W. R., & Isaacs, L. D. (2011). *Human motor development: A lifespan approach*. McGraw-Hill Humanities/Social Sciences/Languages.

Petancevski, E. L., Inns, J., Fransen, J., & Impellizzeri, F. M. (2022). The effect of augmented feedback on the performance and learning of gross motor and sport-specific skills: A systematic review. *Psychology of Sport and Exercise*, 102277.

Phillips, E., Farrow, D., Ball, K., & Helmer, R. (2013). Harnessing and understanding feedback technology in applied settings. *Sports Medicine, 43*(10), 919–925.

Pienaar, A. E., Wilders, C., & van Zyl, C. (2013). The association of fundamental movement skills with self-reported physical activity and academic performance in South African primary school learners. *Physical Education and Sport Pedagogy*, *18*(3), 259-272.

Pieper, C. F., Stechuchak, K. M., McFall, S. L., & Kazis, L. E. (2017). Validity and internal consistency of the rehabilitation complexity scale. *Journal of Rehabilitation Research & Development*, *54*(2), 159-166.

Proctor, S L., GravesJr, S. L., & Esch, R. C. (2012). Assessing African American students for specific learning disabilities: The promises and perils of response to intervention. The *Journal of Negro Education*, *81*(3), 268-282.

Ramsey, D. K., & Crotin, R. L. (2016). Effect of stride length on overarm throwing delivery: Part II: An angular momentum response. *Human movement science*, *46*, 30-38.

Ramsey, D. K., Crotin, R. L., & Johnson, J. C. (2014). Shoulder impingement syndrome: a narrative review of the literature. *Journal of Chiropractic Medicine*, *13*(2), 86-91.

Ramsey, D. K., Crotin, R. L., & Johnson, J. C. (2016). Conservative management of subacromial impingement syndrome. *Current Reviews in Musculoskeletal Medicine*, *9*(3), 287-292.

Redelius, K., & Hay, P. (2012). The relationship between perceived motor competence and physical activity in Swedish children aged seven to nine years. *European Physical Education Review, 18*(1), 18-31.

Reinold, M. M., & Curtis, R. (2013). Normative data for power and explosiveness measures in collegiate basketball players by playing position. *International Journal of Sports Physical Therapy*, *8*(3), 256-264.

Reissig, P., Puri, R., Garry, M. I., Summers, J. J., & Hinder, M. R. (2015). The influence of mirror-visual feedback on training-induced motor performance gains in the untrained hand. *Plos One, 10*(10), e0141828–e0141828. https://doi.org/10.1371/journal.pone.0141828

Rink, J. (2014). *Teaching physical education for learning*. McGraw-Hill Education.

Rintala, D. H., Simons, J. P., Eyitayo, R. I., & Ulrich, T. E. (2017). *Wheelchair sports and recreational activities.* In Rehabilitation Medicine for Elderly Patients (pp. 301-319). Springer, Cham.

Roach, A., Chen, L., & Richmond, K. (2013). The impact of teacher professional development in the use of technology on teaching and learning: A synthesis review. *Journal of Educational Technology Development and Exchange*, *6*(1), 1-14.

Roach, K. E., & Richmond, S. A. (2013). The effects of augmented feedback on motor skill learning in children: A review. *Journal of Motor Learning and Development*, *1*(1), 37-53.

Roach, K. E., & Richmond, S. A. (2015). The role of feedback in motor learning and rehabilitation. In M. R. Rosenzweig & C. E. Winstein (Eds.), Oxford handbook of rehabilitation psychology (pp. 147-157). Oxford University Press.

Roach, N. T., & Richmond, B. G. (2015a). Humeral torsion does not dictate shoulder position, but does influence throwing speed. *Journal of Human Evolution*, *85*, 206-211.

Roach, N. T., & Richmond, B. G. (2015b). Clavicle length, throwing performance and the reconstruction of the Homo erectus shoulder. *Journal of human evolution*, *80*, 107–113. https://doi.org/10.1016/j.jhevol.2014.09.004

Roach, N.T. & Lieberman, D.E. (2014). Upper body contributions to power generation during rapid, overhand throwing in humans. *J Exp Biol* 217: 2139–2149, 2014. doi:10.1242/jeb.103275.

Roach, N.T., Venkadesan, M., Rainbow, M.J. & Lieberman, D.E. (2013) Elastic energy storage in the shoulder and the evolution of high-speed throwing in Homo. *Nature* 498: 483–486. doi:10.1038/nature12267.

Roberton, M. A. (1978). Development of physical education for handicapped children: A historical perspective. *Adapted Physical Activity Quarterly*, *2*(2), 89-98.

Robinson L. E., Stodden D. F., Barnett L. M., Lopes V. P., Logan S. W & Rodrigues L. P., (2015). Motor competence and its effect on positive developmental trajectories of health. *Sports Med*, *45*(9):1273–84.

Robinson L. E. (2011). The relationship between perceived physical competence and fundamental motor skills in preschool children. *Child Care Health Dev*, *37*(4):589–96.

Robinson, L. E., Palmer, K. K., Webster, E. K., & Logan, S. W. (2015). Effects of a mastery climate motor program on gross motor skills and self-perception in preschoolers. *Research Quarterly for Exercise and Sport*, *86*(3), 208-215.

Saccani, R., Valentini N. C., Pereira K. & Bombarda A. (2013). "Kinematic analysis of backward giant swings on high bar and ring." *Sports Biomech*, *12*(3), 264-276.

Sadler, D. R. (2010). Beyond feedback: Developing student capability in complex appraisal. *Assessment & Evaluation in Higher Education*, *35*(5), 535-550.

Saemi, E., Porter, J.M., Ghotbi-Varzaneh, A., Zarghami, M., & Maleki, F. (2012). Knowledge of results after relatively good trials enhances self-efficacy and motor learning. *Psychology of Sport and Exercise*, *13*(3), 378-382.

Sajedi, F., Fatemi, R., Gharib, M., & Gharib, M. (2014). The impact of fundamental motor skill training on perceived competence and physical activity in Iranian girls aged 7-8 years. *Asian Journal of Sports Medicine, 5*(1), e22884.

Sattler, D. N., Kaiser, D. A., Hittner, J. B., & Gavett, B. E. (2012). Validation of a brief computerized test of cognitive functioning in older adults. *Age and Ageing*, *41*(2), 242-244.

Saunders, T. J., Gray, C. E., Poitras, V. J., Chaput, J. P., Janssen, I., Katzmarzyk, P. T., & Tremblay, M. S. (2014). Combinations of physical activity, sedentary behaviour and sleep: relationships with health indicators in school-aged children and youth. *Applied Physiology, Nutrition, and Metabolism, 39*(3), 1-6.

Schmidt, R. & Wrisberg, D. (2004). *Motor Learning and Performance*, Human Kinetics Publishers

Schmidt, J. A., & Lee, J. (2014). Physical Activity Levels of Korean-American Women. *Women & Health*, *54*(5), 463-479.

Schmidt, R. A. (1975). A schema theory of discrete motor skill learning. *Psychological Review*, *82*(4), 225-260.

Schmidt, R. A. (1982). The schema concept. *Human motor behavior: An introduction*, 219-235.

Schmidt, R. A. (1988). Motor and action perspectives on motor behaviour. In *advances in psychology*, 50, 3-44.

Schmidt, R. A., & Lee, T. D. (2011). *Motor control and learning: A behavioral emphasis* (5th ed.). Human Kinetics.

Schmidt, R. A., Lee, T. D., Winstein, C., Wulf, G., & Zelaznik, H. N. (2018). *Motor control and learning: A behavioral emphasis* (6th ed.). Human Kinetics

Schmidt, R. A., Wrisberg, C. A., & Lee, T. D. (2018). *Motor learning and performance: A situation-based learning approach*. Human Kinetics.

Serrien, B., & Baeyens, J. P. (2017). The proximal-to-distal sequence in upper-limb motions on multiple levels and time scales. *Human Movement Science*, *55*, 156-171.

Sharma, D. A., Chevidikunnan, M. F., Khan, F. R., & Gaowgzeh, R. A. (2016). Effectiveness of knowledge of result and knowledge of performance in the learning of a skilled motor activity by healthy young adults. *Journal of Physical Therapy Science, 28*(5), 1482–1486.

Shimon, Y. (2011). The role of the coach in the coach-athlete relationship: A short review. *Journal of sports science & medicine, 10*(3), 473–477

Siahkouhian, M., Mahmoodi, H., & Salehi, M. (2011). Relationship between fundamental movement skills and body mass index in 7-to-8-year-old children. *World Applied Sciences Journal, 15*(9), 1354-1360.

Sigrist, R., Rauter, G., Riener, R., & Wolf, P. (2011). Augmented visual, auditory, haptic, and multimodal feedback in motor learning: *A review. Psychonomic Bulletin & Review, 18*(2), 377-391. doi: 10.3758/s13423-011-0054-5

Sigrist, R., Rauter, G., Riener, R., & Wolf, P. (2013a). Augmented visual, auditory, haptic, and multimodal feedback in motor learning: *A review. Psychonomic Bulletin & Review*, 20(1), 21-53.

Simons, J. P., & Eyitayo, R. I. (2016). Mobility management in healthcare: An overview. In Medical Management of Vulnerable and Underserved Patients: *Principles, Practice and Populations* (pp. 25-39). McGraw-Hill Education.

Somiah, P-A, K. (2015). *Assessing the gross motor skill development of kindergarten pupils at Akyemansa District in the Eastern Region*. Unpublished masters' thesis. UEW.

Sterkowicz, S., Ochmann, B., & Sterkowicz-Przybycień, K. (2010). Anaerobic and aerobic energy supply during Wingate Anaerobic Test in junior male tennis players. *Journal of Strength and Conditioning Research, 24*(5), 1297-1304.

Stodden, D. F., Gao, Z., Goodway, J. D., & Langendorfer, S. J. (2014). Dynamic relationships between motor skill competence and health-related fitness in youth. *Pediatric exercise science*, *26*(3), 231-241.

Stronge, J. H., & Xu, Z. (2016). Qualities of effective teachers (3rd ed.). ASCD.

Sun, M. R., Wagner, J. M., & Webster, J. B. (2011). Design of mobile assistive technologies for wheelchair users: An overview. *In Rehabilitation Engineering* (pp. 197-236). Springer, Dordrecht.

Tajudin, N. A., Mohamed, M. N., & Redzuan, A. M. (2016). Sedentary behaviour and physical activity in stroke survivors: A Pilot Study. *International Journal of Public Health and Clinical Sciences*, *3*(2), 32-42.

Tirn, G., Balint, E. M., & Herman, T. (2017). Effects of Tai Chi on postural control during dual-task stair negotiation in healthy older adults: A randomized controlled trial. *Aging Clinical and Experimental Research, 29*(1), 61-68.

Toftegaard-Stoeckel, J., Groendahl, M. F., Christiansen, C., & Andersen, L. B. (2010). One-year changes in physical activity and sedentary behavior among adolescents: relationship to change in body mass index. *Journal of Physical Activity and Health*, *7*(1), 87-94.

Troude, R., Besson, N., & Sarrazin, P. (2011). Teachers' expectancy effects on students' physical education achievement goals: A multilevel analysis. *Psychology of Sport and Exercise, 12*(6), 570-577. doi: 10.1016/j.psychsport.2011.05.003

Ulrich, D. A. (2000). *Test of Gross Motor Development II.* Austin, TX: PRO-ED.

Urbin, M. A., Roach, K. E., & Hass, C. J. (2016). Control of whole-body angular momentum during balance recovery. *Experimental Brain Research, 234*(3), 613-624.

Van Capelle, A., Broderick, C., van Doorn, N., Ward, R., Elliott, C., & Wilson, A. (2017). Fundamental movement skills in children and adolescents: A systematic review and meta-analysis. *Sports Medicine*, *47*(10), 2045-2088. doi: 10.1007/s40279-017-0725-0

van der Fels, I. M., te Wierike, S. C., Hartman, E., & Elferink-Gemser, M. T. (2015). The relationship between motor skills and cognitive skills in 4–16-year-old typically developing children: a systematic review. *Journal of Science and Medicine in Sport*, *18*(6), 697-703.

van Vugt, F. T., & Tillmann, B. (2015). Structural and functional plasticity of the auditory brainstem during multi-talker speech perception. *Journal of Neurophysiology*, *113*(9), 3520-3532.

Vles, J. S., Steenbergen, B., & Braun, K. P. J. (2004). Motor function and cognition in movement disorders in children. *Developmental Medicine and Child Neurology, 46*(4), 267-272. doi:10.1111/j.1469-8749. 2004.tb00973.x

Wagner, A. K., Soumerai, S. B., Zhang, F., & Ross-Degnan, D. (2010). Segmented regression analysis of interrupted time series studies in medication use research. *Journal of Clinical Pharmacy and Therapeutics, 27*(4), 299-309

Wagner, H., Pfusterschmied, J., Tilp, M., Landlinger, J., von Duvillard, S. P., and Muller, E. (2014). Upper-body kinematics in team-handball throw, tennis serve, and volleyball spike. Scand. *J. Med. Sci. Sports*, 24, 345–354. doi: 10.1111/j.1600- 0838.2012.01503.x

Walle, E. A., & Campos, J. J. (2014). *The development of infant crying*. In M. L. Feinman (Ed.), Social referencing and the social construction of reality in infancy (pp. 41-61). New York, NY: Springer.

Webster, J. B., & Ulrich, T. E. (2017). *Rehabilitation engineering and assistive technology*. In Rehabilitation Medicine for Elderly Patients (pp. 59-81). Springer, Cham.

Wei, G., Zhang, H., Li, Y., & Chen, Y. (2015). Effect of two types of physical exercise on central serous chorioretinopathy. *Journal of Physical Therapy Science, 27*(4), 1085-1087

Westendorp, M., Houwen, S., Hartman, E., & Visscher, C. (2011). Are gross motor skills and sports participation related in children with intellectual disabilities? *Research in Developmental Disabilities*, *32*(4), 1510-1516.

Whipp, P. R., Jackson, B., Dimmock, J. A., & Soh, K. (2015). The relationship between leadership behaviors and group cohesion in team sports. *Journal of Sport and Exercise Psychology, 37*(1), 61-72. doi: 10.1123/jsep.2014-0174

Wild M. R., (1938). The behavior pattern of throwing and some observations concerning its course of development in children. *Res Quarterly Am Assoc Heal Phys Educ 9*: 20–24. doi:10.1080/23267429.1938.11802445.

Wisniewski, P., Gegenfurtner, A., & Gruber, H. (2020). Feedback in online learning: Effects of social presence on satisfaction, anxiety, and perceived learning. *Internet and Higher Education, 45*, 100725.

Wulf, G., Shea, C., & Lewthwaite, R. (2010). Motor skill learning and performance: A review of influential factors. *Medical Education, 44*(1), 75–84. https://doi.org/10.1111/j.1365-2923.2009.03421.x

Yaghini, O., Zamanian, M., Arabameri, E., & Yousefi, M. (2015). The effect of an 8-week physical activity program on fundamental movement skill development in preschool children. *Journal of Sports Medicine and Physical Fitness, 55*(9),

Yi, X. (2017). Effects of a 12-week motor skill development program on preschool children's fundamental motor skills. *Early Child Development and Care, 187*(9), 1447-1456.

Yoon, J., Cho, K. H., Lee, S. G., Park, J. B., & Kim, J. S. (2013). The effects of physical activity and physical fitness on breast cancer-related biomarkers. *Cancer Research and Treatment, 45*(1), 55-62. doi: 10.4143/crt.2013.45.1.55

Young, J. A., & Schmidt, J. A. (2010). The impact of physical activity and social support on the health of older women. *Journal of Women & Aging, 22*(4), 241-253.

Zimmer, R., & Volkamer, M. (1987). *Sport and the environment: The example of forest recreation*. In L. Lechner & F. Schiemer (Eds.), Forest ecosystem dynamics (pp. 375-383). Springer.

APPENDICES

APPENDIX A

PERMISSION LETTER FROM THE DEPARTMENT OF HEALTH, PHYSICAL EDUCATION RECREATION AND SPORTS

UNIVERSITY OF EDUCATION, WINNEBA
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Our ref: FSE/ DHPERS /I.3/VOL.2.8 ***Date:*** 29th July, 2022

TO WHOM IT MAY CONCERN

Dear Sir/ Madam,

LETTER OF INTRODUCTION

We humbly write to introduce to you **Mr. Asabia Ayimbila,** a Postgraduate student in the Department of Health, Physical Education, Recreation and Sports (HPERS) at the University of Education, Winneba with index number **202122481.**

He is researching on the topic: **Effectiveness of Augmented Feedback in the Acquisition of Motor Skill among Primary School Pupils in Navrongo, Ghana**

This letter is for you to grant him the necessary assistance to collect data on the above topic to help him complete his academic work.

Thank you.

Yours faithfully,

Sign

Mr. Munkaila Seibu
Ag. Head of Department

APPENDIX B

INFORMED CONSENT FORM

………………………………………………………………………………., having been fully informed of the nature of the research title effectiveness of augmented feedback in the acquisition of motor skill among primary school pupils in Navrongo, Ghana, I do hereby give my consent for my child to take part as a participant in the above-mentioned research.

I have also been told that the data collected will be used solely for the study purpose only and nothing else.

I am aware that I may withdraw my consent and that my child can withdraw from participation in the research at any time without any further consequence.

I have read the above and understand it, I hereby promise my full support throughout the study period and assure the researcher of my child availability during this period.

Parent/Guardian of the participant

……………………………… ………………………….. ……………….

Name Signature Date

APPENDIX C

TEST OF GROSS MOTOR DEVELOPMENT-SECOND EDITION (TGMD- 2)

PERFORMANCE CRITERIA FORM FOR OVERHAND THROW SKILL

IDENTIFYING INFORMATION

Name of Subject____________________ School_______________________

Gender □ Male □ Female Grade________________________

Date of Birth_______________________ Age_____________________

Date of testing ______________________ Examiner ____________________

RECORD OF SCORES

First Testing	**Second Testing**
Raw Score	Raw Score
__________	_____________

Preferred foot □ Right □ Left □ Not established

Preferred hand □ Right □ Left □ Not established

OBJECT CONTROL SUBTEST

SKILL	PERFORMANCE CRITERIA	TRIAL 1	TRIAL 2	SCORE
	1.Windup is initiated with downward movement of hand/arm			
	2. Rotates hip and shoulders to a point where the non-throwing side faces the wall			
	3. Weight is transferred by stepping with the foot opposite the throwing hand			
	4.Follow-through beyond ball release diagonally across the body toward the non-preferred side			
SKILL SCORE				

Note: Coding was done by the researcher observing the subjects performed the overarm throw and if any of the performance criteria appear in the subjects throw a score of **one (1)** is awarded against those criteria and **zero (0)** score for absents of the performance criteria.

APPENDIX D

RESEARCHER SELF-DESIGNED PRODUCT-ORIENTED OBSERVATION CHECKLIST FOR OVERHAND THROW SKILL

Topic of Study: Effectiveness of augmented feedback in the acquisition of a motor skill among primary school pupils in Navrongo, Ghana.

General Objectives: To understand and compare the effectiveness of KR and KP for pupils learning a motor skilled activity with the dominant upper limb.

Type of assessment: The accuracy of a one hand overhand throw. **Group:**

Intervention: **Test type:**

Name of Researcher: **Number of Pupils**:

Date:

Name of school:

Tick (√) the appropriate box for each trial

Code	Trials																				Total Successful Hit on Target
	1		2		3		4		5		6		7		8		9		10		
	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	
KP1																					
KP2																					
KP3																					
KP4																					
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KP30																					

Note: **Y (Yes) = Successful hit of target; N (No) = Failure to hit target**

APPENDIX E

TRANSLATED OVERHAND THROWING PERFORMANCE CRITERIA IN KASEEM

PERFORMANCE CRITERIA	DESCRIPTION
1	Gurim dem yeini de ye se ka-dole jeŋa/ja-bɔŋɔ mo tega seeni.
2	Vivirigi n takeiri de n vɔ-pɔgɔ se ko taa ni n mɛ seeni n na wo dole to na jeeri kabira kam.
3	Dunni yeini de vo n ná chugi de n napere delo na wo n jeŋa kalo n na ma n dole to daa kadwoŋi kam ne to mo.
4	Tɔge n na dole bɔɔle dem n kaare n yera yam pa ko taa vei n na ba lage mɛ to.