UNIVERSITY OF EDUCATION, WINNEBA

AN ASSESSMENT OF RANDOM PRACTICE AND BLOCKED PRACTICE APPROACHES IN SKILLS ACQUISITION, RETENTION AND TRANSFER IN TEACHING BASKETBALL SKILLS TO BEGINNERS IN SENIOR HIGH SCHOOLS

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Submitted to the School of Graduate Studies, University of Education, Winneba in Partial Fulfilment of the Requirements for Award of the Master of Philosophy (Physical Education) Degree.

OCTOBER, 2015

DECLARATION

STUDENTS DECLARATION

I, Srem-Sai Medina, 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.

Candidate's signature: ……………………

Date: ……………………

SUPERVISOR'S DECLARATION

I, Dr. J. A. Baba, certify that the preparation and presentation of this thesis was supervised in accordance with the guidelines and supervision of the project report laid down rules and regulations by the School of Graduate Studies of the University of Education, Winneba.

Supervisor's signature: …………………..

Date: …………………...

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DEDICATION

I dedicate this work to my dear husband, Mr. Marsell Avadu

and our lovely children, Stanley and Audrey.

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Abstract

The purpose of this study was to assess the involvement of blocked and random practices in acquisition, retention and transfer in teaching basketball skills in Senior High Schools. A quasi-experimental design was used for this study. 60 participants were selected from Presbyterian Senior High School, Accra using simple random and purposive sampling techniques. Participants were assigned (n = 30) to Blocked Practice Group (BPG) and Random Practice Group (RPG) respectively. The study involved teaching and learning of 3 basketball skills in 9 training sessions. The reliability coefficient yielded $\alpha = .78$ using KR21. Four research questions were answered while 2 hypotheses were tested. Descriptive analysis of means and standard deviations was used to answer the research questions while inferential statistics of ANOVA and T-test was used to test the two hypotheses at 0.05 significant level. Results for acquisition indicated the BPG scored higher means than the RPG in all three skills. Results for retention showed much improved performance by the RPG than the BPG in all 3 skills. For transfer, similar results were obtained. ANOVA test for retention produced the following F-values at $p<.05$: chest pass 86.01; sidearm pass 44.82; and overhead pass 63.58. For transfer, the F-values at $p<.05$ were 232.54, 102.84 & 102.01 for chest, sidearm and overhead passes respectively, revealing significant mean differences among the three skills but with the RPG recording more superior values within and between group analyses than the BPG. Independent samples t-test revealed the existence of significant difference between random and blocked practices ($t_{(58)} = 17.61$, $p<.05$, 2-tailed) in terms of overall learned skills. It was recommended, that physical educators should adopt BPG when the learning objective is isolated skill learning. RPG should be used when the main objective is based on retention and transfer of knowledge to the competitive milieu or to other related activities.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The learning and training conditions in motor skills learning is one of the most important issues that physical educators and coaches must consider well in order to improve and promote learning. The organization of practice and the number of different skills included in a practice session are the core factors that influence skill learning during practice. Research has shown that interventions that enhance performance during training may have a detrimental effect on retention and transfer performance and conversely, instructional manipulations that influence performance during skill acquisition may support the long-term goals of training. An example of the latter is by providing a practice schedule where different variations of the learning tasks are sequenced randomly as opposed to sequenced in separate blocks (Shea & Morgan, 1979).

Magill & Hall (1990) have also suggested that learning without variability leads to good performance and poor retention and variable learning conditions can lead to poor performance but more effective learning. One way to create variability in practice, according to Magill and Hall (1990), is contextual interference which refers to a learning benefit observed when the skills to be learned are randomly intermixed across training blocks rather than repeated in blocks. Therefore, a high contextual interference (random practice) results in better learning of tasks variation than low contextual interference which inhibits performance in novel performance contexts. Teachers and coaches have often been challenged with how to help learners to learn new skills, relearn and refine already learned skills, retain what they have learned for a long time and transfer their learned skills into real game situations. The ability to learn, relearn or transfer motor skills is sometimes very frustrating and poses several challenges to teachers and coaches and even the learners themselves.

However, the strategy or process teachers and coaches' use in approaching their practice sessions during skill learning can make each learning opportunity one of the most effective practices or it can also make learning a practice that can be forgotten easily. The short-term improvement that students make during a particular drill or a specific day of practice is known as practice performance while real learning refers to the improvements that students make during the real world situation. Motor learning scientists therefore use the terms retention and skill transfer to describe this relearn process. It simply shows the amount of improvement that has taken place or occurred during practice and the amount of improvement that show up days or weeks after practice or during game play. According to scientists, the concern is not about looking at practice but about how the students perform after the practice either by the next day, week, month or most significantly, in more complex situations.

It is therefore, the duty of every teacher or coach to find ways and means to maximize this retention and transfer so that the improvement that is seen during practice will manifest during complex tasks execution. In order to help learners acquire these motor skills and have good retention and transfer in most sports disciplines, physical educators have structured their teaching around specific drills that are technique-focused. This strategy of teaching, otherwise called blocked practice is a traditional teaching approach that focuses on practising the same drill until the movement becomes automatic. It involves learners practicing a single skill over and over until some proficiency is achieved before moving on to another skill. In this case, variety in training is limited or is non-existent.

For instance, when a Volleyball instructor decides to teach his or her students serving, digging and volleying in a practice session, what the instructor does is to teach the three skills independent of each other. By this, the instructor first of all, demonstrates serving to students and focuses on them to practice serving over and over again until they are proficient enough in serving before they move to digging. They then shift from serving to practice digging only after acquiring mastery of serving. Learners then continue to practice the digging and volleying skills independently until proficiency is reached. This approach of teaching skills may be referred to as 'Do only' approach. Even though there is an old adage that states that 'practice makes perfect', research has shown that blocked practice (Low Contextual Interference) produces levels of 'cognitive interference' leading to a kind of rote learning that allows learners to perform better during training sessions but achieve less skill retention and transfer to competitive games over time. An explanation for the above is that there are limited or no demands on learners to actively solve problems and think or rethink during blocked practice.

In addition, although blocked practice is useful in the fundamental development of some skills, yet it produces an artificially high level of performance that gives coaches and players a false sense of accomplishment. There seems to be something about the way learners practice skills that matters when it comes to skill transfer and long-term retention. However, there are several other approaches that can be adopted by physical educators in teaching game skills to beginners. Some of these approaches include Teaching Games for Understanding (TGfU) approach, Tactical Games Model or Random practice. All these teaching strategies have a similar aim of adding critical thinking (reading and planning) and problem-solving skills to technique development.

Teaching Games for Understanding (TGfU) is a games-centred teaching model that was initially intended to address limitations in traditional games teachings, especially with respect to such things as techniques-based instruction and sustaining learners'games interest (Bunker & Thorpe, 1986). Manifestations of these limitations, as suggested by Bunker and Thorpe (1986), can be observed through various happenings, including learners' limited psychomotor success, inadequate games understanding, poor decision-making capabilities, and overdependence on teachers' guidance.

Unlike traditional games teaching, in which learners are often taught a prescribed skill with limited understanding of rationale or significance (Bunker & Thorpe, 1986), TGfU's focus is on teaching the "why" before the "how" of a game. Such a paradigmatic shift, Bunker and Thorpe (1986) suggest, leads to learners‟ increased games interest, enjoyment, and decision-making abilities". The TGFU was suggested as a better model of teaching games compared to a technical model. The technical model lessons are considered too structured, with warming up activities and skill drills as the main components and students lack of chances to participate in game play. The emphasis of this technical model is on acquiring technical skills for game play, while the cognitive skills, essential for effective participation in games, are often undermined (Tuner & Martinek, 1999). As a result, it has been suggested that students fail to transfer the skill and knowledge, tactical decision-making elements of game performance to game play. Proponents of the TGFU model suggest that exposing students to game like experiences early in the teaching-learning process helps them acquire substantive declarative and procedural knowledge, thereby facilitating tactical decision-making during game play (Mitchell, Griffin & Oslin, 1994).

The Tactical Games Model (TGM) by Griffin et al (1997), based on the TGfU framework, has been widely accepted in school physical education. This model has been viewed as a modified version of the TGFU (Griffin et al., 1997). The proponents of the TGM agree that the primary objectives to teaching sports in physical education are importing knowledge of the rules of the game, demonstrating tactics of the sport, and training students to make appropriate decisions. Instruction must emphasize tactical awareness so that players are able to understand "what to play" and "how to play" in game situation. Except for the similarity on the emphasis of tactical learning, the TGM is also a student-centered approach of teaching sport games because the instruction model begins and ends with the learners (Griffin et al., 1997). During teaching the teacher's role is more of a facilitator. For example, the TGM requires that teachers must question students after the first part of the teaching and foster students to be aware of the tactical problem.

In both instructional approaches, learners always study in a problem-solving context. Random practice however is a process of learning in which motor learners work on a number of different skills in combination with each other, randomly working trials and patterns with each trial interleaved on the previous one. The random element means the learner is forced to be on his or her toes, not falling into a repetitive routine (Belger, 2013).

This current study takes a critical look at the random practice approach as opposed to the blocked practice approach of skill teaching. In random practice, motor learners perform a lot of different skills in combination with each other, randomly working patterns and trials of one and then the next and the next and the next. This practice helps the learner to be on his or her toes, not falling into a repetitive routine. During random practice, learners are forced to use their cognitive system to adapt, rethink and solve the problem of choosing and executing appropriate motor patterns upon demand. From previous research, this strategy of teaching is exciting and fun for both teachers and coaches and athletes as it forces them to think and react in practice settings. This way, learners do not practice technique repetitively but also do a lot of reading and planning during training sessions.

Literature abounds from several studies conducted on both block practice and random practice. One of the most renowned studies on these two approaches was done by Shea and Morgan (1979). They had two groups of samples in which one group performed their movements using a blocked practice approach while the other group performed similar skills using the random practice approach. Each group's performance was tracked in the practice and acquisition stages. The results showed that both groups improved during the practice and acquisition stage but the blocked practice group outperformed the randompractice group. However, when research participants were tested on skill transfer to measure their real learning, it was discovered that the former lost all the group games and improvement they made during practice while the latter retained all the improvements they had made. Cuddy and Jacoby (1982) also conducted a study using the blocked practice and random practice approaches and their results were similar to that of Shea and Morgan (1979).

1.2 Statement of the Problem

Observations of the mode of teaching games skills at the Presbyterian Boys' Senior High School in Legon, Accra, has revealed that the Blocked Practice approach or the traditional approach which is the main method applied by physical education teachers in the teaching of games has produced students who have inflexible techniques and poor decision-making capacities during real world settings (game situations and assessment periods). Meanwhile, as most teachers continue to depend on the Blocked Practice approach as their only methodological approach in teaching, there seems to beanother competing methodological approach that could be employed in the teaching of games skills.

This study was therefore designed to comparethe blocked practice approach and the random practiceapproach in teaching selected Basketball skills to beginners in Senior High Schools in Accra and to introduce teachers to another alternative approach to motor skills teaching.

1.3 Purpose of the Study

The purpose of this study is to assess the random practice approach with the blocked practice approach to determine their involvement in acquisition, retention and transfer of Basketball skills. As a study focusing on teaching or coaching methodology, the study intends to provide information to teachers about efficient motor skill teaching methodologiesthat maximize retention and transfer of acquired skills. It is believed that there is lack of sufficient data to assist teachers in constructing good practice training sessions andto promote an effective understanding of transfer of motor skills to complex situations. This study will make an attempt to provide evidence that can make a significant impact in improving coaching or teaching efficiency for motor skill development of beginner learners in complex fundamental sports skills.

1.4 Objectives of the Study

The objectives of this study were:

a) To examine the blocked and random practice approaches in skill acquisition in Basketball.

b) To find out which of the two methodological approaches to teaching motor skills (Random Practice & Blocked Practice) produces better retention.

c) To find out how students with high level of technical skills learnt can efficiently transferthem into more complex performance settings.

d) To make recommendations to Physical Educators to use other skill teaching approaches like the random practice approach if their intent is to promote healthy competitive athletes.

1.5 Research Questions

1. What is the performance level of participants in the random practice approach group and blocked practice approach groupin skill acquisition?
2. What is the performance level of participants in the random practice group and blocked practicegroups'in skill retention?
3. What is the performance level of participants in the random practice group and blocked practicegroups'in skill transfer?
4. Which of the two methodological approaches (random practice and blocked Practice)producesbetter retention and transfer in skill learning?

1.6 Hypotheses

The following hypotheses were tested in this study:

1.6.1Hypothesis 1

a) H_O : There will be no significant difference in the skills performance (chest pass, overhead pass and sidearm pass) of participants between the Random Practice and Blocked Practice groups' on retention and transfer of skills learnt.

1.6.2 Hypothesis 2

b) H_O : There will be no significant mean difference in performance between the Random Practice group and Blocked Practice groups' in the two measurement occasions (retention and transfer).

1.7 Significance of the Study

The study would inform physical educators by unveiling the strengths and weaknesses of the blocked practice and random practice methods of teachingwith intent to provide them with suggestions to maximize long-term retention of acquired skills.

This study would also serve as a guide and reference material for teachers to use in achieving specific teaching and learning objectives to improve on student's learning of motor skills.The study would add to existing literature on these two methodological approaches to motor skills teaching or coaching and also form the basis for further studies into this complex phenomenon of human learning.

1.8 Limitations of the Study

Due to the large size of the population and the limited time available for the testing procedures, a smaller sample size was used for the current study. Conducted in a gymnasium with limited space and equipment, the collection of data took rather too long to execute. This does not in any way compromise the data collection process as well as the data collected for the study.

1.9Delimitations of the Study

The study was delimited to first year male students of Presbyterian Senior High School (PRESEC), Legon in Accra. It was further delimited to two teaching methodologies (random practice and blocked practice) and three basketball passing skills (chest pass, overhead pass and sidearm pass).

1.10 Definition of Terms

Functional task difficulty takes into account the skill level of the subject and the conditions under which the task is being performed.

Nominal difficulty refers to a constant level of task difficulty, without taking into consideration who is performing the task or under what conditions.

Retroactive interferenceis a phenomenon where later experiences affect memory for earlier learned associations.

Skill Acquisition: The performance of a learner during or immediately after skills practice.

Skill Retention: Skill retention is the improvement that learners show days, weeks, months or years after skill practice.

Skill Transfer: Skill transfer is the influence of a previous experience on performing a skill in a new context or on learning a new skill.

1.11Organization of the Study

This study consists of five main chapters. The first chapter includes the background of the study, statement of the problem, purpose of the study, objectives, research questions, hypotheses, and significance of the study, limitations, delimitations and definition of terms. The chapter two focuses on the review of related theoretical and empirical literature while chapter three describes comprehensively the methodological procedures of the study. These include the research design, population, sample size and sampling techniques utilized in the study process, instrumentation, data collection and data analysis procedures. Chapter four focuses on the presentation and discussion of findings while chapter five dealt with the summary of findings, conclusions and recommendations.

CHAPTER TWO

REVIEW OF LITERATURE

The aim of this study was to assess the effects of high and low contextual Interference on learningthree Basketball passes to beginners in Senior High Schools. Some literature suggests that students taught using the random practice method are able to think critically and solve problems and are able to retain and transfer what they learn into more complex situations. Others also suggest that teaching motor skills the blocked way promotes rote learning and does not challenge students to learn. Another school of thought also argues that for effective learning of motor skills, the two methods must be combined and used together. In order to find out how each of the practice methods affect students learning, it is important to define the two teaching methodologies and how teachers perceive them. This chapter also brings together various fields of concepts, thoughts and studies that have informed the notion of random practice and blocked practice teaching approaches.

2.1 Overview of Motor Skills Teaching

There are a number of teaching methods that teachers apply in teaching motor skills. One of the most vital issues in learning motor skills is how the learning and training conditions are applied. Most programmes in education aim to achieve the goals of enhancing adequate post training performance (retention) and transfer to related tasks and situations. However, very often, these goals are confused with enhancing performance and speed of skill acquisition during training. An example of the latter is by providing a practice schedule where different variations of the learning tasks are sequenced randomly as opposed to sequenced in separate blocks (Shea & Morgan, 1979). Research has shown that interventions that enhance performance during training may have detrimental effects on learning, and conversely, instructional manipulations that degrade performance during skill acquisition may support the long-term goals of training (Schmidt & Bjork, 1992).

According to Magill and Hall (1990), learning without variability leads to good performance and poor retention, and learning that involve variability can lead to poor performance but more effective learning. According to them, one way to create variability in practice is by contextual interference which they introduced and Coker, (2003) applied to motor skill learning as a driving factor in performance and learning of motor skills. According to the free encyclopedia, varied practice (also known as random practice or mixed practice) refers to the use of a training schedule that includes frequent changes of task so that the performer is constantly confronting novel instantiations of the to-be-learned information.

“The varied practice approach focuses on the distribution of practice in time, the organization of activities to be practiced (blocked practice vs. random practice), and the interleaving of information or content to highlight distinctions that facilitate learning. For example, a varied practice approach to learning to shoot a basketball might involve a sequence of ten mid-range jump shots, followed by ten lay-ups, followed by ten free-throws, followed by ten three-pointers, with the entire cycle repeating ten times. This contrasts with traditional approaches in which the learner is encouraged to focus on mastering a particular aspect or subset of the relevant information before moving on to new problems (focusing on free-throws before moving to three pointers). With varied practice, the learner is exposed to multiple versions of the problem even early in training.”

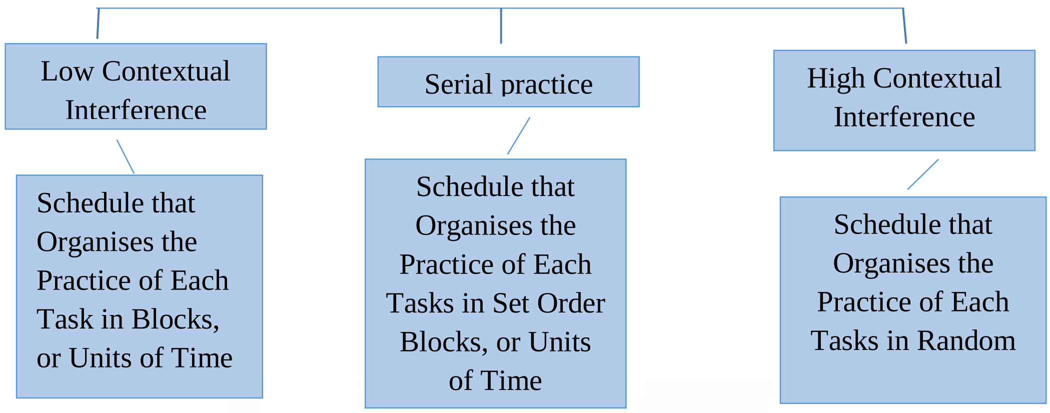
"In many learning domains, varied practice has been shown to enhance the retention, generalization and application of acquired skills. There are many potential sources of the observed advantages. First, greater diversity of the tasks may also allow learners to extract the most relevant, task-invariant information. Any given practice trial contains both task-relevant and task-irrelevant information. By mixing up the trials, task-irrelevant information will be less consistent, allowing the learner to strip away the spurious associations. Task-relevant information should be constant regardless of the particulars of individual trial. Second, varied practice creates conditions that are likely to encourage elaborative rehearsal. Elaborative rehearsal is a means by which the learner forms multiple associations with the to-be-learned material, so that it can be recalled using a variety of cues".

Cognitive psychologists generally regard elaborative rehearsal as one of the most effective means of acquiring new information, and it is basic logic to study the material from a range of perspectives in order to form richer links with preexisting knowledge. Finally, because learners are frequently changing tasks, practice may seem less repetitive, potentially minimizing boredom and increasing the level of engagement during practice.

2.2 Theoretical Framework of Random and Blocked Practices

The theoretical explanations of random and blocked practices are primarily stemmed from a behavioral phenomenon discussed in the skill acquisition literature called contextual interference (Shea & Morgan, 1979).

Continuum of Contextual Interference Effect



2.3 What is Contextual Interference Effect in Motor Skills Learning?

Contextual interference (CI) refers to a learning benefit observed when the items to be learned are randomly intermixed across training blocks rather than repeated in blocks (Magill and Hall, 1990). That is, when identical items are blocked together during training, post-training performance is worse than when different items are intermixed. On the other hand, it involves the presentation of different tasks in one training session. According to Magill and Hall (1990), contextual interference (CI) depends on the order of tasks or the manner of presenting the tasks. Thus, blocked practice and random practice can all create different levels of Contextual Interference effect and can be located along the CI continuum.

However, lowest levels of CI at one end of the continuum are created by blocked practice. At the other end of the continuum, there are high levels of CI created by varied practice with random, unpredictable order (random practice). Some studies have revealed that higher CI (random practice) increases the learning of tasks which are similar rather than distinct. It has been reported that a training programme with medium and high CI has not been effective in learning of three different volleyball skills. In addition, Gelber (2005) in a meta-analytic research suggested the little difference between blocked practice and random practice. He further supports the effect of contextual interference in applied settings and believes that the CI effect in these conditions is created regardless of the properties or the nature of tasks.Magill and Hall, (1990) explained further that high contextual interference (random practice) requires more attention to acquiring skills and employing problem solving techniques, thereby improving learning.

This action disturbs performance but improves retention and transfer, while low contextual interference (blocked practice) has inconsistent effects. Guadagnoli et al. (1999) and Hebert et al. (1996) argued that high contextual interference may be overwhelming at early stages of learning and may lead to degraded performance on retention test. Their result suggest that when a learner is presented with a challenging task the inefficiency of the information processing system may not interpret needed information which can hinder learning. The stages of learning model proposed by Gentile (1972) suggests that learners need initial repeated trials for movement pattern exploration, trial-and-error correction, and the development of a basic movement pattern to achieve the action goal of the task being learned. Magill and Hall (1990) also provided evidence that explained the poor results of CI effect in some studies. They considered the complexity of tasks for a beginner as the reason for inefficiency of CI. They suggested that beginners learn more effectively if they begin with blocked practice and continue with random practice.

Aloupis et al. (1995) proposed a theory that suggests that one's information processing ability is limited, and the amount of information that one is able to process at any given time cannot be increased, the efficiency of processing information can be improved. Shea et al., (1990) argued that inconsistency in findings can be attributed to characteristics of the subjects and that contextual interference is less effective in early stages of skill acquisition, while higher levels of CI are very effective at higher skill levels. The motivation caused by success at early blocked practice can increase self-efficacy of the individual in practice. The principle that a learner is inefficient at processing relevant environmental information early in the learning process is supported in the motor learning literature. This inefficiency may be compounded when the tasks are practiced in a high CI (random practice) schedule.

Lately, several attempts have been made to provide an appropriate practice method and to limit the negative effects of blocked and random practices. One of such methods is systematically increasing CI which is a combination of blocked and random practices. In this practice method, the amount of CI gradually increases across training sessions. Guadagnoli and Lee (2004) suggested that gradual increase in CI leads to increased amount and speed of learning and then proposed the "challenge-point hypothesis"as an important consideration for designing effective practice conditions.

Challenge Point hypothesis suggest that consistently challenging learners at the appropriate level during practice creates an optimal learning environment. Thus, the practice environment should become progressively more difficult as the learner becomes more skilled. Offering gradual increases in CI is one way to progressively increase the difficulty of the practice environment which is needed to appropriately challenge the learner as their skill level is developed. Jefferys (2006) claimed that gradual increase in CI during practice enhances the subjects' ability to process information. Magill and Hall (1990) also argued that learning tasks controlled by the same or different generalized motor program influences the CI effect. They suggested that CI effect can be observed when the generalized motor program changes.

On the contrary, Battig (1979) proposed that similarity of tasks increases the CI effect. There are also researchers who have shown that the CI effect can be observed when the parameters of the motor program changes. Studies carried out on CI in children and adolescents have led to different results. Some studies have reported the CI effect in 8-9 years old participant (Bortoli et al., 2001), while other studies found no such effect in 5, 7, and 11 year old children. Brady's review (1998) of the research on the CI effect showed that a low-CI training program leads to greater learning in children. Some studies, however, have reported contradictory results. For instance, Jarus (2001) and Smith (1997) in the review by Merbah and Meulemans (2011) studied the effect of cognitive process (CI effect) and skill difficulty on the acquisition, retention, and transfer of motor skills. 96 children (7.5-9.5 years old) participated in a task of throwing beanbags under high, low, and medium contextual interference in either a complex or simple task. The results indicated that the children in the random practice group completing the simple task outperformed the blocked practice group. However, in the complex task, no difference was found between the two practice groups during both the retention and transfer phases.

Also Zetou et al. (2007) considered the CI effect in both blockedand random practices as beneficial for learning volleyball skills. "There is little evidence regarding the effect of CI on explosive tasks such as throwing or striking an object". The positive effect of contextual interference has not been observed by Magill (2006) in badminton serve while similar results have been reported in volleyball skills. In some studies, a combination of the blocked and random practices have proven to be beneficial. Herbert (1996) in tennis skills showed different effects in the dominant and non-dominant hands.

Sarah Merbah and Thierry Meulemans (2011) in their study review, focused specifically on the importance of the organisation of training in the acquisition of new skills. They opined that when learning a new perceptuo-motor skill, is it preferable to practise the skill in a repetitive and structured way, or would the skill acquisition be more rapid and/or generalizable (transferable to new situations when the learning conditions are more variable and randomly organised). Different studies have explored the effects of the organisation of practice on the acquisition of a new motor skill. Generally, two learning conditions are contrasted: a high-variability condition, in which the training trials are arranged randomly, and a low-variability condition, in which the training trials are organised in a more constant (blocked) way.

More specifically, low variability is produced when subjects complete all the trials corresponding to one variation of a movement before performing another variation (AAA, BBB, CCC etc.) which is typical of blocked practice. On the other hand, high variability is produced when the variations are presented in an unpredictable order (ACB, BCA, CAB etc.), as is typical in random practice. The studies that have explored this contrast generally show that, while the random practice condition leads to poorer performance during acquisition than the blocked practice condition, it yields superior performance on a retention test, a phenomenon that is commonly called the contextual interference effect (CIE).

According to Merbah and Meulemans (2011), there are four main theoretical perspectives that attempt to account for the CIE. They are the elaboration hypothesis (Shea & Zimny, 1983), the action-plan reconstruction hypothesis (Lee & Magill, 1983), the Retroactive Inhibition Explanation (Magill, 1991), and Schmidt's schema theory (Schmidt, 1988).

2.3.1 TheElaboration Hypothesis

According to this theory, new skill learning can be sustained by two different kinds of processes: intra-task and inter-task. Intra-task processing involves the analysis of an individual task, without reference to any information directly related either to another task being acquired (which could be a variant of the task in hand) or to other extant knowledge. In contrast, inter-task processing aims to highlight, through between-task analysis, the similarities and differences between the tasks being acquired. Regarding the CIE, the idea is that a blocked practice requires only intra-task processing, whereas a random practice calls for both intra-task and inter-task processing. In the blocked practice, only one task resides in working memory at a time, which explains the requirement for intra-task processing. On the other hand, in the random practice, several tasks are present simultaneously in working memory. Several empirical observations support this theory.

Other experiments were carried out to support the elaboration hypothesis. They manipulated the type of processing by supplementing the blocked practice with additional inter-task or intra-task processing. Concretely, they managed to increase the level of inter-task processing by asking subjects, after each trial, to look at a figure with the movement pattern of one of the other two movement patterns (belonging to different blocks) and to identify the similarities between them. Intra-task processing was increased by asking subjects to verbalise the pattern of movement they had just performed. The results showed that the blocked practice group with additional inter-task processing was able to perform as well as the typical random practice group. This confirms that inter-task processing is essential, or at least important, for skill learning.

2.3.2The Action-Plan Reconstruction Hypothesis

The main idea of this theory in the review stated above is that random practice requires more effortful processing on each trial because the information related to the action plan for the current trial has been forgotten as a result of practising the intervening movements. So, for each trial, the participant must reconstruct a new action plan before executing the next movement. For the blocked practice, on the other hand, an action plan that is appropriate for an upcoming trial is still active in working memory from the preceding trial. Thus, reconstructive activity in blocked practice may be minimised relative to random practice. According to the action-plan reconstruction hypothesis, reconstructing the action plan at each trial generates a better ability to create appropriate responses when the learner is confronted with a new transfer task results support the action-plan reconstruction hypothesis. Three practice groups were compared in their study: random practice, blocked practice, and a random practice group for which a model was provided prior to each trial.

Lee et al., (1997) predicted that providing a template of the next trial should prevent the forgetting and the consequent need for action-plan reconstruction processing. Their results support this view since participants in the random practice condition with modelled information performed similarly to the blocked practice group on both the acquisition and retention tests. According to Wright (2000), if the basic principle underlying the reconstruction view is correct, one can expect that random practice subjects may need more time to complete their preparation of upcoming movements than their blocked practice counterparts.

2.3.3 Retroactive Inhibition Hypothesis

The theories described above generally explain the CIE as resulting from the benefits of random practice over blocked practice for retention and transfer. However, the retroactive inhibition hypothesis, focuses on the detrimental effects of a blocked practice. Specifically, Poto (1988) proposed that a blocked practice is disadvantageous because of a retroactive interference effect. Considering that performance on any retention test might be influenced by some combination of retroactive and proactive interference, Poto administered a task in which subjects went through a blocked schedule consisting of a block of task A, then a block of task B, and finally a block of task C. They were tested later on all three tasks. In this task, retroactive interference may influence the performance of tasks A and B, while proactive interference may influence the performance of tasks B and C. The results showed that the farther from the retention test a task was practised, the poorer the retention performance was. Thus, retroactive interference appeared to be the primary source of poor retention test performance.

However, on the basis of this information, we cannot rule out a simple effect of lapsed memory (an effect that is more marked for old knowledge and less so for recent knowledge). In his review, Brady (1998) cites a series of experiments that support the retroactive inhibition hypothesis. For example, Brady (1998) observed that a blocked practice group given a retention test after each trial block (and thereby eliminating retroactive inhibition) presented better results than a typical blocked practice group. He concluded that the worse performance after blocked practice, compared to random practice, might result from retroactive inhibition.

Shea and Titzer (1993) examined the influence of reminder trials on contextual interference. Three motor tasks were performed under a random or blocked schedule, with either one reminder trial or none for each task at the end of the practice session. They found no significant differences between the random practice group and the blocked practice group that received a reminder trial, but they observed a CIE between the typical blocked practice group (without a reminder trial) and the random practice group. This observation also supports the retroactive inhibition hypothesis as that of Shewokis et al., (1998).

2.3.4 Schmidt's Schema Theory

This theory, explains the effect of the organisation of practice on the learning and retention of new skills. It is also based on two elements: a Generalised Motor Programme (GMP) and rules of parameterisation. A GMP is not a specific movement but a class of movements. Thus, the parameterisation rules allow the GMP to be adapted to the specific nature of the task. This theory is organised around three elements that are specifically relevant to new motor skill learning. In the first place, GMPs control movement production (tossing movement). Specifically, a particular GMP governs the movements which belong to the same class because they share certain invariant features such as timing or sequencing.

Secondly, schemata provide scaling characteristics (parameters) to the GMP, allowing subjects to perform specific movements within the given class (long-distance toss vs. short-distance toss). For example, if the tossing has to be performed over a short distance, the invariant features of the GMP controlling the tossing movements remain unchanged, but the force parameter decreases. In other words, the strength of the schema is a function of practice variability. In comparison, constant practice does not support schema formation. More specifically, it is suggested that practice variability forces individuals to continuously (at each trial) parameterise the motor programme and allows the building of effective parameterisation rules. On the other hand, repetition of the same movement only allows reinforcement of a specific motor programme; in this context, the subject cannot learn to adapt to changing conditions.

Shea and Morgan (1979) therefore, proposed a link between Schmidt's schema theory and CIE theories (the elaboration hypothesis and the action-plan reconstruction hypothesis) because both address the idea that practice variability leads to improved learning. However, Newell (2003) highlights the fact that Schmidt's schema theory makes no prediction about the structure of the practice variability. Indeed, only the amount of variable practice is manipulated, with little attention to the practice schedule. In the CIE theories, on the contrary, the amount of variable practice is held constant while the practice sequence changes. In spite of this difference, the two kinds of theories provide complementary reasons for the advantages of random practice over other forms of training: random practice strengthens schemas in Schmidt's schema theory while, in the CIE theories, random practice enhances retention and transfer through elaborative encoding and or repeated reconstruction of the action plan during acquisition.

Several researchers have argued that these rival theories may not be mutually exclusive and that they share a common denominator which according to them might be the enhanced cognitive activity or the more effortful processing engendered by random practice schedules and the poor or decreased processing resulting from a blocked practice. In other words, practice manipulations that require more cognitive effort (random schedule) are predicted to be more effective for skill learning than practice manipulations that require less cognitive effort (Sherwood & Lee, 2003).

"Thus, according to both the elaboration and reconstruction hypotheses, a random schedule requires more cognitive activity. But the first hypothesis explains this increase by the participants' engagement in inter-task elaborative processing, whereas the second relies on the assumption that subjects have to reconstruct an action plan after each trial".

2.4 Theoretical Rationales of CIE on Learning

According to the review by Merbah and Meulemans (2011), several theories have been generated by researchers to adequately explain the apparent paradox of contextual interference. These following paragraphs examine these theories and indicate their supporting evidences. "It should be understood that these hypotheses are not competitive, but rather, complimentary to each other".

2.4.1 Elaborative and Distinctive Hypothesis

Some studies reveal that in blocked practice, only one task is needed to be kept in working memory, and interference would be low. However, in a random format, in which multiple tasks were kept in working memory, interference would be high. Secondly, in motor skills, for instance, if the tasks performed were similar, interference would be high, as the learner would have to work harder to distinguish between the two tasks. Conversely, two tasks which were entirely different would take little effort to distinguish from, and therefore would produce less contextual interference. However, there are conflicting results on this and that the learner would respond to high or low levels of contextual interference with correspondingly high or low levels of elaborative and distinctive processing (Merbah & Meulemans, 2011).

The elaborative and distinctive hypothesis suggests that contextual interference, facilitated by random practice, prompts the learner to compare and contrast between the tasks and this results in a more memorable and meaningful experience. Incidentally, evidence strongly suggests that the more meaning that is set to a task, the more the learner will retain (Hergenhahn & Olson, 2001).

"There are several lines of evidence supporting this hypothesis. For instance, post interviews of participants have found that participants performing random practice understand the task in a different manner than participants performing blocked practice. For example, participants in random practice group give much more elaborate descriptions of the tasks performed, noting that one pattern was very similar to another, or that one was the same, with the exception of a reversal in direction (comparing and contrasting). However, participants performing blocked practice reported very little thought processing, and instead suggested that they ran the tasks off practically automatically". Shea & Zimny (1988) reported that participants performing random practice reported comments about and between tasks twice as much as participants performing blocked practice such as reports were also found in the study of Del Rey and Shewokis (1993).

2.4.2 Forgetting and Reconstruction Hypothesis

Larry Jacoby (1982) proposed that in order to retain information, the learner must go through the entire learning process. Thus, if the information was stored in working memory after the first trial, during the second trial the information would not have to be fully processed, impeding learning. He further suggested that this could be induced by the spacing effect, which suggests that performing skills that have been repeated with long spaces between trials is more beneficial to learning than performing skills with little or no spacing between trials.

Findings of some studies suggested that the forgetting and Reconstruction Hypothesis which is also known as action-plan reconstruction hypothesis, suggest that in order to learn one must forget. They suggested that during random practice the constructed plan had to be abandoned and reconstructed to perform a different skill. In this context, the effectiveness of practice for learning is dependent on the reconstruction processing taking place. Another line of evidence used for this hypothesis is theories on schema learning. In this context, if the skills practiced in a random format are too similar, a generalized motor program (GMP) may be used to simply scale the parameters to the new environment, eliminating the need for reconstruction.

To elaborate, when features such as relative timing and relative force remain invariant, movements are considered to be in the same class and governed by the same GMP. Features that are free to vary from one performance to another, such as overall movement duration and overall force, are viewed as parameters of the GMP. Under this conceptualization, task variations that have different relative timing or relative force structures are controlled by different GMPs. Task variations, on the other hand, that share the same invariant features but vary in terms of parameters, are controlled by the same GMP. For example, performing a bench press but varying the speed of the repetition, such as varying the time under tension from 1 second compared to 5 (relative duration) or varying the weight from 315 pounds to 350 on each set (relative force), would use the same GMP but have varying parameters. Such a task is thought to cause little contextual interference, negating the effects of random practice. However, the results are rather inconsistent in this field of work (Magill, & Anderson, 1996).

2.4.3The Guiding Hypothesis

The guidance hypothesis suggests that a high relative frequency of augmented feedback during practice is detrimental to motor learning (Winstein, 1994). This is consistent with studies on the effect of feedback on retention (Sawyer, 2005). To elaborate, there are two types of feedback: intrinsic feedback and augmented feedback (Schmidt and Lee, 1999). Intrinsic feedback is inherent to the execution of movement and provided through various sensory channels. Augmented feedback is supplemental to intrinsic feedback. In this context, Knowledge of Results (KR), supplies augmented feedback about movement outcome. For instance, if a coach tells a basketball player who made a free throw shot, 'well done', this would be a form of KR. Evidence suggests that too much feedback appears to degrade learning.

For instance, several studies show that reduced relative frequency (the percent of KR trials given) produces more learning (Lee et al., 1990). Salmoni, Schmidt, and Walker (1984) propose that when KR is given on every trial, participants become reliant on the feedback and fail to process the information required to learn the task. Participants with less KR, however, must attempt to detect their own errors, increase cognitive effort, and go through the full learning process. In this context, in the aforementioned modeling study, the model may have given the participants a reference of correctness, which they become dependent on, resulting in a failure to process the information necessary for learning.

In this context, Sawyer (2005) suggests that in order to learn, the learner must make mistakes. This may be another mechanism by which random practice facilitates retention. Winstein et al., (1994) revealed that guided (errorless) practice was detrimental to retention and transfer, especially if presented on every acquisition trial. Four mechanisms may facilitate this process. The first two being that errors may increase cognitive effort and elaborative processing, enhancing learning (Sherwood &Lee, 2003). Third, it may help develop a schema, as evidence suggests that there are positive benefits from correct and incorrect movements for schema learning, which is based on a relationship among all stored elements (Schmidt and Lee, 1999). And fourth, 100% relative feedback impedes the intrinsic processes, such as problem solving, in the inter-trial interval, known to be important for learning (Sawyer, 2005). To elaborate, the inter-trial interval is the sum of KR delay (the delay from movement one completion and delivery of KR) and post KR delay (the delay from KR until the next movement; here it is presumed the person is processing the KR and deciding on the next movement).

2.4.4 Retroactive Inhibition Hypothesis

“Recent studies have popularized a third major alternative to the Forgetting and Reconstruction Hypothesis and the Elaborative and Distinctive Hypothesis to explain the benefits of contextual interference. This alternative has been termed retroactive inhibition, and can be defined as the retention deficit due to intervening activities between the practice of a task and the retention test of that task and the poor retention of an activity as a result of another activity interpolated between the original learning and the retention test. To elaborate, if an athlete performs 5 sets of squats, leg extensions, and leg curls, respectively, in a blocked fashion, and then a retention test one day later, there would be 10 sets between the last set of squats in acquisition and the first set of squats on the retention trial. On the other hand, if this was performed in a randomized fashion, there would be at most only 2 sets between the last set of squats in acquisition and the first set of squats in retention”.

Shewokis et al. (1998) examined the influence of retroactive inhibition on blocked practice performers' retention performances. Participants were instructed to perform coincidence anticipation timing, with three speeds presented to them: slow, moderate, and fast, for a total of 90 trials (30 each). Participants were divided into blocked practice and random practice conditions. Participants in the blocked practice conditions were randomly assigned to three retention tasks to assess the effect of retroactive inhibition on learning. Participants in the first blocked practice retention condition performed the slow task first, which resulted in 60 trials of retroactive inhibition, because the slow task was practiced first in acquisition. Participants in condition two performed the moderate speed task, which resulted in 30 trials of retroactive inhibition. Participants in condition three performed the fast speed task, which resulted in 0 trials of retroactive inhibition, as the fast speed task was practiced last during acquisition trials. Results showed that there was not a significant difference between random practice and blocked practice with 30 or 0 retroactive inhibition trials; however, the 60 retroactive inhibition blocked trial decreased learning. These results were also in line with the findings of Shea and Titzer (1993).

Del Rey et al., (1994) examined the effect of retroactive inhibition on contextual interference on 75 female participants. Participants performed blocked practice trials without retroactive inhibition, blocked practice with moderate retroactive inhibition (18), blocked practice with high retroactive inhibition (36), and random practice. Results demonstrated that reaction time was faster during retention trials for the random practice condition than all blocked practice conditions; however, the blocked practice conditions without retroactive inhibition had faster reaction times than the moderate and high retroactive inhibition conditions. Also in accord with past studies, random practice conditions had slower reaction times during acquisition than blocked practice conditions. These results are in accord with the findings of Meeuwsen and Magill (1991).

2.4.5 Cognitive Effort Hypothesis

Lee, Swinnen, & Serrien (1994) proposed the Cognitive Effort Theory of motor learning. Cognitive effort is defined as the mental work involved in making decisions. Sherwood and Lee (2003) defined it as those decisions that result in perceptual and motor processes involved in movement control. For example, an ice hockey goalie needs to learn how to anticipate where a shot will go to by using perceptual and decision-making processes. Because motor learning requires both cognitive and motor processes (Sawyer, 2005), Lee suggests that practice must encourage both the execution of skill as well as the underlying cognitive processes which also underlie the task. The evidence used to support both the Forgetting and Reconstruction Hypothesis and the Elaborative and Distinctive Hypothesis can be explained from the Cognitive Effort Hypothesis. It is suggested that random practice increases cognitive effort through mechanisms such as increased errors, thereby facilitating learning.

In a study, Blandin et al. (1994) examined the effects of physically practicing or observing a model practice three variations of a timing task in a random or blocked schedule. Results from the retention data revealed that timing error for the models and observers was similar; as in other experiments, random practice enhanced learning for both physical practice and observation. Building on the findings of Blandin et al. (1994), Wright et al. (1997) replicated the aforementioned study. For every pair of participants one was assigned to be a model and the other was instructed to observe the model practice either a random or blocked schedule. Results were consistent with the findings of Blandin et al. (1994), in that observation of a random practice model enhanced subsequent efforts to enact physically the observed responses beyond the level achieved via observation of a blocked practice model. These studies suggested that the benefit of contextual interference may be from cognitive standpoint as well as a motor standpoint. This would seemingly support the cognitive effort theory.

2.5 CIE of Practice on Acquisition, Retention and Transfer of Sports Skills

The following are different studies that have used sports situations to test the CIE as reported in the review by Merbah and Meulemans (2011). Hall, Domingues, and Cavazos (1994) trained their subjects on baseball batting. They practised with three kinds of pitches: change-up pitches, fastballs, and curveballs. No significant difference was found between blocked practice and random practice during the acquisition phase, but the random practice group outperformed the blocked practice group during the retention and transfer test. Memmert (2006), who used a basketball skill, also obtained results supporting the CIE. In the study, two groups were compared: the constant (blocked) practice group made shots from the same position, while the shooting position of the random practice group changed at each trial. A typical CIE was found. The constant (blocked) practice group outperformed the random practice group during acquisition, while the random practice group was more efficient in both the retention and transfer tests.

On the other hand, several studies have failed to demonstrate the CIE. For example, in a first series of studies on basketball skill acquisition, no benefit was observed for the random practice groups in comparison with the blocked practice groups: Crumpton et al., (1990) found no effect of the contextual variability of practice on the acquisition of a throwing skill (free throw, jump shot, and lay-up) while Snyder et al., (2002) did not observe the CIE for a shooting skill in a situation in which the distance between the shooting position and the target varied. The CIE was only partially present in a study by Goode and Magill (1986), who compared different serves (long, short, and drive serves) and revealed the CIE in both the retention and transfer tests only in the short serve condition.

In a similar study, Wrisberg and Liu (1991) introduced two contextual interference levels on long and short serves. Again, there were no differences in acquisition, whereas the random group had significantly higher retention scores on the short serve. However, in transfer, both kinds of serves showed evidence of the CIE. Another basketball study by Landin & Hebert, (1997) compared traditional schedules (blocked practice and random practice) with a blocked-serial schedule, which involves a more moderate level of contextual interference (CI). Participants assigned to the constant (blocked) practice condition performed six successive trials from each position. Those practising under the moderate CI schedule performed three successive trials at each location and repeated the sequence twice. The random practice condition involved performing one trial per position in a serial arrangement and repeating the sequence six times. The results indicated that a moderate level is more efficient than either the blocked or random practice schedules.

Proteau et al., (1994) attributed this superiority to the notion that the moderate schedule combined the best of the high-CI (random) schedule and low-CI (blocked) schedules. That is, it allowed repeated trials under one condition, which facilitated error correction, but also provided the interference of changing tasks. Other negative results were obtained in studies exploring volleyball serving skills (Zetou et al., 2007) but Bortoli, (1992) had contradictory results on volleyball serves and golf-related skills. In these latter studies, the variability manipulation concerned either the type of task (drive, pitch, and chip shot) or the distance of the target. Soccer and darts-related skills were also studied and did not show any CIE (Reina et al., 2003).

In another study, Sabbaghian et al (2012) conducted a research to compare blocked and random practices on acquisition of swimming skills. The purpose of their study was to study the effect of contextual interference on the acquisition of complexand continuous swimming skills. 20 girls with an age of 8-10 participated in the research and successfully performed the basic swimming skills. The participants were randomly divided into two practice groups: blocked practice and random practice. Each group participated in 36 exercise sessions and an acquisition test was administered on the 7th, 15th, 24th, and 32nd sessions. The results suggested the effectiveness of both blocked and random practices on the acquisition of the skills. In general, the results indicated that contextual interference can have apositive effect on the performance of swimming skills. According to the results of mixed analysis of variance, there was no significant difference between the effects of blocked practice and random practice on acquisition of swimming skills in effectiveness of both approaches. The acquisition scores of the participants indicated that both blocked practice and random practice can be effective for learning swimming skills, although the blocked practice group had a better performance than the random practice group. This was consistent with the findings of French et al. (1990) and Bortoli et al. (1992) for overhead pass, forearm pass skills respectively, and with the results of Jarus (1997), Smith (2006), Zetou et al. (2007). However, the results of their research were inconsistent with the findings of Herbert et al. (1996) and Coker (2003), for these studies have reported the advantage of high contextual interference (random practice) over low CI (blocked practice).

One of the possible reasons for lack of any significant CI effect in their research as compared to the contradictory studies was the differences in the tasks (Magill, 1990) for it appearred that applied settings are less affected by contextual interference

(Bortoli, 1991). Also the differences in the characteristics of the tasks and the participants cannot be overlooked. The participants used for their research were novice children and had less physical strength; therefore, it was difficult for them to properly execute the movements and based on cognitive effort, fatigue led to reduced mental work that was required for decision making and reduced the cognitive and motor processing involved in controlling the movements.

Moreover, most researchers in the area of contextual interference believe that there is a positive relationship between the period of exercises and the CI effect. Perhaps if the training sessions continued for a longer period, the difference between the two approaches would have become clearer (Gelber, 2005). They finally argued that, the difference in the practice environment and the higher resistance of aquatic settings could be considered as other factors that affected the CI effect by increasing cognitive load as well as the required processing activities.However, considering the results of their study, both blocked and random practice methods are recommended for better swimming performance in children. Given the lack of a significant difference between the two groups in acquisition scores, it seems that factors such as training volume, environment, etc. can affect swimming performance.

Pollatou et al., (1997) investigated the learning of two skills: throwing and kicking a ball. Significant improvements in performance were found in all groups for both tasks. However, the authors showed that random practice provided better retention, but only for the throwing task and not for the kicking. Wegman (1999) examined the CIE through three different skills: ball rolling, racket striking, and ball kicking. The blocked practice conditions gave better results at the end of the training, and the random practice group got a better result in the retention test but only for the racket striking skill. The author concluded that these results could be linked to the fact that the subjects were already familiar with that sport.

2.6Basketball Passing Skills

There are many types of passes used in playing the game of basketball. Krause, (1991) defines passing in basketball as a process of transferring a ball from one player to another or a target. He further suggested that the type of pass used depends on the distance the ball must travel and the location of the target. Moreover, the manner in which the ball is caught depends on the location of the passed ball in terms of height and trajectory. These passes are described in the following paragraphs;

Chest pass - It is the most frequently used form of passing in basketball, which is effective for short passes and is used when an opposing player is not in the intended path of the ball.

Two-Handed Overhead pass - It is similar to the chest pass and used to pass over short distances especially when a player wants to pass to a target above the reach of an opponent.

Sidearm pass - The sidearm pass is recommended when an offensive player is closely guarded and has to pass the ball around a defender. Except for theposition of the ball in the preparation phase, execution of the sidearm pass is similar to the overhead pass.

Bounce pass - The bounce pass is often as accurate as chest pass and harder to defend. The ball is held at chest level and bounced off half way between the player and his or her teammate. The defence may be anticipating a chest pass and often might not be ready for a ball that bounces hard and comes in from a low angle.

Baseball pass - This type of pass is used when the player has the ball in the back court often after a steal and his or her teammate is breaking to the basket. The ball is taken and brought overhead and thrown hard and direct to teammate. The pass should lead the teammate and give him or her a chance to catch the ball at full speed and then accelerate towards the basket.

Outlet pass – This pass is used mostly by rebounders. After getting a rebound off the defensive boards, a power forward or the center will take one step away from the basket and throw the ball toward the side line, where a guard catches it and starts the attack. This pass is often a two-handed overhead pass or as a bounce pass.

2.7Factors that Influence Motor Learning and Skills Transfer

The factors below seem to influence the probability that the CIE will appear.

2.7.1 Simpleversus Complex Task

According to Wulf and Shea (2002), a task is simple if it has only one degree of freedom, which can be mastered in a single practice session, and if the task appears to be artificial. On the other hand, a complex task cannot generally be mastered in a single session, has several degrees of freedom and tends to be ecologically valid. For instance, barrier knock- down tasks, simple aiming tasks, anticipation-timing tasks, and tracking tasks are considered to be simple tasks and all of them have demonstrated the CIE. On the other hand, complex tasks, for which the CIE is less frequently observed than for simple tasks, include, for example, badminton, volleyball and basketball.

As already mentioned in the review above, some theories claim that random practice requires the subjects to engage in deeper cognitive processing (Brady, 1998) so they can create a more distinctive and complete mnesic representation of the task. Albaret and Thon (1998) claimed that, if the movement to be learned is complex, participants may also have recourse to deeper cognitive processing even if they learn through blocked practice. These authors suggest that the complexity of a task could interfere with the practice schedule and thus could mask the benefits of a random practice. In their study, participants practised a drawing task in which the patterns to be learned differed in terms of the number of segments. Six groups practised three variations of the task: two groups (random practice and blocked practice) practised a pattern involving only two segments; two groups (random practice and blocked practice) practised three-segment patterns; and the remaining two groups (random practice and blocked practice) practised four-segment patterns. The results showed that the random-practice groups got better results than the blocked practice groups in the transfer tests but only for the two simplest tasks (involving two and three segments). No CIE was found in the transfer task for blocked practice and random practice groups on the most complex task.

However, Magill and Hall (1990) noted that the CIE was much more robust when the tasks were governed by different motor programmes rather than by the same one. The concept of a motor programme is a mnesic representation for a particular class of actions that share certain common or invariant motor control features, such as relativeforce and timing. Thus, movement production requires selecting the appropriate motor programme and then adding parameters, such as absolute force and duration.

2.7.2 Quantity and Duration of Practice Trials

The amount of training also seems to have an impact on the CIE. According to Shea et al. (1990), the CIE might be negatively influenced by an extended practice session in simple tasks or in blocked practice because subjects may become less attentive and lose their interest. Lee and White (1990) suggest that the CIE might be obtained more easily because most laboratory tasks pose minimal demands on subjects' attention. By contrast, the sports skills used in experiments complicate the production of the CIE. But a random practice schedule could delay inattention and loss of interest and therefore enhance learning; this means that the amount of practice in complex tasks improves the efficacy of the CIE.

Shea et al. (1990) worked on a blocked practice or a random practice order where learners received 50, 200, or 400 practice trials on a force production task. After completing 50 trials, the blocked practice group outperformed the random practice group but the largest number of trials generated better results for the random practice group. Thus, this experiment confirmed that a complex task or random practice needs more trials to be learned, whereas a simple task or blocked practice requires fewer trials to be mastered. However, Goodwin et al. (1998), who used a darts task, did not reach the same conclusion: a high number of trials (up to 75) did not improve retention. But one could ask whether that type of task should be considered to be complex or simple.

Other authors emphasise the importance of the duration of the task. In the first place, the fact that some experiments have generally used tasks of relatively short duration such as force production tasks, button-barrier tasks, base-ball hitting, or golf must be highlighted. Both the elaboration and reconstruction hypotheses suggest some reasons why shorter trials lead more systematically to the CIE. According to the elaboration hypothesis, a longer practice session reduces inter-task processing, which is progressively replaced by intra-task processing along trials; therefore, the learning advantage related to inter-task processing progressively disappears (Wright, 1991).

The reconstruction hypothesis proposes that the reconstruction process diminishes as task duration lengthens. In fact, the action plan would only influence performance directly during the first few seconds of each random trial, after which performance would be based more on ongoing attention to perceptual information.

2.7.3 Characteristics of Subjects

Magill and Hall (1990) considered a possible interaction between subjects' level of expertise and the CIE. This link seems logical, as the level of expertise could be correlated with the amount of practice: the more we practise, the more expert we become. Several studies indicate that skill acquisition in novice subjects tends to be higher in low-interference (blocked practice) conditions; on the other hand, highly skilled subjects can take advantage of high-interference (random practice) conditions in both retention and transfer (Merbah & Meulemans, 2011).

In a review of current coaching practice in tennis, Guadagnoli (2004) proposed a framework for conceptualising the effects of different practice conditions in motor learning and suggest, purely hypothetically, that performance level is linked to task difficulty for subjects with different levels of expertise. He defines difficulty along two dimensions: nominal task difficulty and functional task difficulty. Nominal difficulty refers to a constant level of task difficulty, without taking into consideration who is performing the task or under what conditions; functional task difficulty takes into account the skill level of the subject and the conditions under which the task is being performed. Guadagnoli (2004) suggests that, with a task of a given level of nominal difficulty, an individual at any skill level is likely to perform at a predictable level. For a beginner, performance outcome is expected to be high only under conditions of very low nominal task difficulty. As the task becomes more difficult, the expected level of performance for the beginner drops rapidly; it reaches a floor level of performance at a relatively low level of task difficulty. Expected performance for intermediate and skilled individuals would drop off at moderate rates as a function of increased nominal task difficulty. For the expert, only the most nominally difficult tasks would be expected to pose a problem. In conclusion, if the nominal difficulty increases, performance will decrease and the rate of decline in performance will be more rapid for the lower-skilled performer. Overall, according to this point of view, both the complexity of the task and the experience of the learner determine the presence of the CIE. When the task is complex (with high attention, memory, and/or motor demands) or when the learner is relatively inexperienced, random practice may overload the system and its potential benefits could be disrupted.

2.7.4Skill Learning Style

Studies have found that an individual's propensity for impulsiveness or reflectivity might influence the CIE. Reflectivity is associated with a tendency to take the time to choose the appropriate solution, while impulsivity refers to the tendency to favour speed instead of accuracy. Some authors suggest two ideas. First, a random practice condition generates more controlled processing than a blocked practice condition. This requirement allows a more adequate memory representation for retrieval. Secondly, if several possible solutions are present and if it is difficult to determine with certainty which one is the most appropriate, reflective individuals systematically tend to gather information, deploy more attention and make better use of feedback information. In this context, it is expected that reflective subjects would make more intensive use of controlled processing than impulsive ones. Moreover, even under the blocked condition, reflective subjects tend to generate their own contextual interference and then use controlled processing of their own.

2.7.5 Anxiety and Self-Efficacy

Brady (1998) suggested that anxiety reduces the benefits of a random practice schedule because stressed subjects are uncomfortable with variability and unpredicted contexts. However, this hypothesis has not yet been fully supported by empirical data. According to Bandura (1997), the notion of self-efficacy namely, the belief that an individual is capable of executing a certain course of action in order to obtain a specific outcome could also play a role in the type of practice effect. Highly efficacious individuals adapt more readily to a random practice schedule, while learning in low-self-efficacy individuals is often accelerated under blocked practice conditions because the acquisition is quicker and thus is reassuring from the beginning of the task.

Holladay and Quinones (2003) examined the role of 'self-efficacy generality' in the relationship between practice variability and transfer performance. They defined self-efficacy generality as the generalisation of the efficacy beliefs associated with one activity to similar ones within the same activity domain or across a range of activities. They concluded that higher practice variability leads to higher self-efficacy generality, demonstrating that performing variations of a task leads individuals to have more similar efficacy beliefs across a wider range of tasks. The improvement in self-efficacy generality produces a higher transfer performance for variations of the task that had not been previously trained.

2.8 TheConcept and Meaning of Blocked Practice and Random Practice

Blocked practice is defined by Bret Otte and Van Zanic, (2008) as the process of practising the same skill or drill until the movement becomes automatic. Gary Crossley (2012) also refers to block practice as a practice in which one skill is worked on at a time and the skill is worked on until a predetermined level of competence is acquired, and then the teacher/coach and learners/athletes move on to the next skill. One skill may be worked on for several practices before moving on. For example, a curler may work on out-turn line of delivery with draw weight for three consecutive practices before the skill reaches the desired level of proficiency. The decision is then made to move on to the next skill, which might be in-turn line of delivery with draw weight.

Furthermore, an instructional director of the McCleery Golf Academy explains that block practice in relation to golf as a commonly used form of practice that has the golfer hitting many shots with club attempting to achieve a consistent and particular outcome. The golfer may hit many shots straying from the particular desired achievement outcome and process. Random practice on the other hand is a form of practice by which the golfer changes the club for each shot as well as the desired ball flight outcome or target. The golfer will never hit more than one shot with a particular club to the same target consecutively.

In addition, Allison (2013) refers to blocked practice as a process of learning in which the learner performs a single skill over and over with repetition being the key. He opines that variance in training is minimized or non-existent. The learner then moves on to practice another discrete skill in the same way. By contrast, in random practice, motor learners work on a number of different skills in combination with each other, randomly working trials and patterns of one and then the next and the next, with each trial interleaved on the previous one. The random element means the learner is forced to be on his or her toes, not falling into a repetitive routine. Random Practice refers to practice sessions where multiple skills are incorporated into the same practice session. A predetermined level of competence is not required before moving on to the next skill. In soccer, for example, a random practice might involve time dedicated to individual ball handling skills, followed by passing skills, then heading the ball, and finally specific plays. These multi-tasking types of practices seem to be the most common in the curling environment as in any given practice it is not unusual to see a variety of drills, emphasizing different turns and weights amongst other training variables, incorporated into a single training session.

The random practice design does not follow the order of the movement. Drills for the skill are mixed up throughout the practice and, within extreme examples of random practices, the same drill or movement is not repeated throughout the session. In both controlled experiments and within the practical setting of a practice session, random practices are proven to be superior to blocked practices with regard to retention of learning and better performance over time. However, the random practice design does not lend itself to better performance compared to the blocked practice design on the day of practice. In other words, the athlete and coach will notice poorer initial practice performance within the practice setting. However, the athlete will perform the skills more effectively in the next practice session compared to the blocked practice design. So the adage "Short term pain for long term gain" seems to hold true for the random practice design, while "Short term gain for long term pain" seems to be true for the blocked practice design (Otte & Zanic, 2008).

Studies show that blocked practice is marked by low levels of what is called cognitive interference, while random practice is marked by high levels of cognitive interference. In simple terms, this means that random practice setups challenge the learner's cognitive and motor systems to deal with the interference of each task on the next, an element that keeps him/her on his/her toes and allows for greater retention and skill transfer.In a nutshell, it seems that repetitive blocked practice leads to a kind of rote learning that allows for better performance during training sessions but less skill transfer to competitions and novel situations, as well as lower retention levels over time. One explanation for this is that there are lower demands on active problem-solving and engagement during blocked practice than during random practice. During random practice, when one is forced to work through various skills in a single session that are presented randomly, one's cognitive system must adapt, rethink, and solve the problem of choosing and executing appropriate motor patterns, upon demand. This means determining similarities and differences among tasks before designating which motor pattern applies.

In contrast, during blocked practice with repetitive motor patterning, one can effortlessly rely on memory and automaticity of movement. Because blocked practice leads to better performance during training sessions, athletes and coaches are often led to a false sense of confidence that is shattered during competitions, when predictability and rote learning are no longer guaranteed (Allison, 2013). Simon and Bjork (2001) stated that subjects who were trained using blocked practice were more likely to predict higher levels of future task performance than those who were trained using random practice designs. They stated further that "It's natural to think that when progress is being made, learning is taking place, and when errors and strugglings' are also being made, learning does not take place as well. So people who are responsible for training can often be pushed toward training conditions that are far from optimal. The problem is that if people confuse the current sense of ease with learning, they'll tend to prefer training conditions where things are kept constant and predictable conditions that act as crutches to prop up performance without fostering learning".

Richard Schmidt (2011) addressed the applications of random and blocked practices to all kinds of sports and learning situations. Quoted in a 2011 article on golfdigest.com, Schmidt told attendees at the World Gold Fitness Summit that year "In blocked practice, because the task and goal are exactly the same on each attempt, the learner simply uses the solution generated on early trials in performing the next shot. Hence, blocked practice eliminates the learner's need to 'solve' the problem on every trial and the need to practice the decision-making required during a typical round of golf." This can apply to any number of athletic endeavours; the idea is that forcing athletes to come up with the best motor patterns given the nuances of the specific task at hand is imperative for long-term skill development that allows for flexible and adaptable motor recruitment in the heat of the moment, when competition and other variables are introduced.

The literature on this topic is deep and consistent: blocked practice is best for beginners learning new motor patterns and basic skills. Once a certain level of mastery is involved, random practice seems to be the way to go. Zanic (2008) performed a study on blocked practice and random practice with Drills for hurdlers and suggested that blocked practice sessions concentrate on one aspect of technique, practicing it over and over again until the skill is gotten right while random practices employ several aspects of technique within a session. Though they direct the article toward hurdlers, and provide dozens of hurdle drills, the blocked vs. random concepts apply to all events.

2.9Constructing Practice in order to Maximize Motor Skills Learning

Otte and Zanic (2008) suggests that learning and relearning skills can be frustrating, challenging and fun to teachers, coaches and athletes hence, how athletes and coaches construct and approach the practice can make each learning opportunity one of the best practices of the season, or a practice to forget quickly. So how can a good training session be constructed, considering the blocked and random practices? According to Abernethy, (1991) on the acquisition of motor skills suggests the following concepts; teachers and coaches should provide the opportunity for the greatest number of practice-trials-with-feedback possible.

Moreover, massed practices that lead to high levels of fatigue and performance deterioration, in the long-run, seem to be just as effective for developing skills as well-spaced practice sessions which allow recovery and the maintenance of good practice standards. However, too much excessively massed practice can be detrimental to learning and other factors associated with performance. It would be prudent to err on the side of beneficially spaced practice and recovery opportunities rather than excessive overloading. According to him varried practice activities contribute to developing a capacity for adaptation to varying competitive demands and conditions. Even in seemingly constant-performance sports (running, rowing, kayaking) some digression in practice demands are necessary to accommodate the within-competition skill variations (practicing within the range of paces likely to be experienced, adapting to various competitive conditions such as weather, water conditions). However, the development of adaptability and response flexibility should not go outside of the activity itself. It would be incorrect to assume that improvements in cycling will somehow transfer to kayaking speed. Even within a sport, it would be incorrect to assume that movement patterns which would never arise in a competitive performance, such as those developed by "drills," contribute to performance improvements.

The purpose of varied practice activities and drills should be to allow the athlete to adapt to all conditions and performance variations which could arise in a competitive experience. "The more specific the practice or training drills can be to the sport, the more effective they will be in enhancing competitive performances. Thus, if retention and transfer of learning from the practice session to complex or game situations is to be maximized, the demands of the practice session should mimic as closely as possible the demands of the sport itself (not only in terms of the movement execution requirements but also in terms of the perceptual and decision-making aspects of the performance). In general, motor skills are highly specific and transfer of learning between different motor skills is quite small. The best means of enhancing retention and transfer is to maximize the similarity between the practice and competition ('practice as you play'). When practice drills that differ from competition are used the purpose of the drills in terms of improved competitive performance should be clearly explained. When teaching new skills or altering established skills it is common practice to break skills into component parts and "build" the movement patterns. This "part-whole" approach is most effective when the skill to be learned is complex and has clearly defined natural breaks or components (a gymnastics routine). Such an approach to learning or (modification) however, may be of little to no value when the skill is essentially continuous with no natural breaks (such as in running, swimming).

Mental practice, when interspersed with physical practice, under some circumstances assists in both immediate and long-term sports performance improvements. The implication is that the experiences and dynamics of skill practice differ between sports. The nature of the competitive situation will usually dictate the scope and variations of activities that have to be learned and trained. However, in all sports there is a limitation on the extent of beneficial activities which will affect competitive performances positively. Practice activities would seem to be of questionable value if they cannot be justified on the grounds of direct relevance and transfer potential to competitive tasks and conditions (Abernethy, 1991).

Gary Crossley (2012) in his study on blocked practice and random practice in Curling observed that an important question that borders the minds of teachers, coaches and even athletes in sports is what practice structure yields the best results in relation to effective acquisition of game skills? The answer to this question is critical to all teachers, coaches, as they need to structure practices appropriately by selecting technical development drills that are appropriate given the bio-motor capabilities of the athletes they are working with, as well as considering such mitigating factors as experience and degree of neuromuscular development. These elements, as well as others, all must be woven into the appropriate tapestry that will lay the foundation for beginner learners and elite athlete development.

Schmidt and Lee (2013) as well as Otte and Zanic (2008) suggests that early in the learning stages, it is best to use the blocked practice plan so that the learners will have a psychological feeling of some accomplishments when they leave practice. According to them a random practice can be confusing and frustrating to a person new to an event or the sport of track and field without making practices harder through randomizing movements and drills. Thus, when the learner has hit the more automatic stages of learning the random practice is a valuable tool. Practice is not the same old thing done day after day. Each day is new and challenging; in fact, each minute of each practice is new and challenging.

The random practice is used extensively within each practice. They state that this can be more effective when trying to break bad habits that have crept in due to previous coaching or inattentive learners rehearsing something wrong over and over again and athletes get excited about the changes each day and must focus more in order to learn. They also begin to see long-term results and improved performances, which in turn enhances intrinsic motivation. Below is an example of a constructed random practice programme for athlete hurdlers by (Otte & Zanic, 2008). According to the researchers, it is best to use a few variations of the random practice design as shown in the sample below;

Variation #1---Use a number of drills to rehearse the same movement or skill within the event and then change to a different movement and different drills. The drills are not done in the skill sequence of performance.

Example: Lead Leg of Hurdling-" A" drill, "B" drill, Marching Lead-Leg Drill, Calvesi Drill, Skipping Lead-Leg drill, Skipping Lead-Leg drill with 5-stride pattern. Do each drill once per set and randomize the order within the set or incorporate new drills as practice moves along.

Variation #2---Pick three movements or skills and randomly practice each skill with different drills. The drills are not done in the skill sequence of performance.

Example: Skipping over side of the hurdle with trail leg, Skipping over side of hurdle with 3-skip rhythm using only trail leg, One-stride hurdling with trail only, Calvesi drill, Sprint in three-stride pattern through hoops or over cones.

Variation #3---Mix up the movements and skills of the entire event, never repeating a drill throughout the entire practice.

Example: The sky is the limit for this variation. You can use any drill at any time. Keep moving from drill to drill in rapid fashion. This variation should be used only for athletes who are fairly advanced in their learning of the event.

Example: Skipping over hurdles in a 3-stride pattern, Sprint over 11 hurdles at full or discounted (in from competition marks and down from full height), Sprint in 3-stride rhythm over 30 cm (cones at 3.5-4 meters apart), Wall Attacks (place hurdle along a wall and perform high" A" drill and hand attack). They agree that this form of practice is fun and exciting for both coaches and athletes as it pushes both parties to think and react in a practice setting. Random practice will mean no more redundant practice plans or dull repetition of drills in a sequence. Variety is the spice of life and random practice is like hot curry compared to the vanilla of blocked practice that was recycled from last year at about the same point in the season for the same event for the same athlete (Otte & Zanic, 2008).

Shaygoulding (2013) in his article; competitive practices for starting and finishing games (Volleyball) shared some thoughts on practice and how it should be implemented no matter the level of players involved. According to him, competitive game-like practices ensure that matches are not new or unfamiliar situations to the six players working together on the Volleyball court. Therefore, teachers have the responsibility to create game-like environments in practice that promote the transfer of skills to the desired outcome. Drills and games in practice should reflect the same high level of competition, along with the myriad stressful situations of a live match, because, the more transfer,the more a practice reflects a game-like situation. He further suggested that ultimately, a team is better prepared when it is familiar with a particular situation because the players have been exposed to it in practice. Because Volleyball is such a reactionary sport, skills manifest themselves best as a complex series of acquired habits. Teachers and coaches must ensure the habits gained in practice are actually ones that will assist players in the game itself and not prove to be a hindrance (Shaygoulding, 2013).

2.10Which is more Effective - Blocked Practice or Random Practice?

Gary Crossley (2012) states that what coaches need to know is which of these practice formats has been proven through research to be the most effective way for athletes to acquire skills? Are there differences related to age, and therefore the bio-motor development levels, of the athlete? What consideration should be given to the experience level of the athlete?

Historically, the random practice format would appear to be the most common practice format as it addresses the immediate concern of repetitive boredom in a practice session, thereby making it easier to keep athletes motivated. In some sports blocked practice sessions are quite common. The long jumper in track and field, for example, might be working only on approaches to the take-off board for several sessions in a row before moving on to take-off mechanics, then flight mechanics, and finally the mechanics associated with effective landings. This would represent an example of blocked practices being used to develop the entire serial sequence of skills required for high level performance. Each part of the skill is developed in the sequence of occurrence until the entire skill is complete. Coaches feel that by dedicating an entire practice to one skill, total focus and therefore deeper and more effective skill acquisition occurs. The desired neuromuscular patterns more commonly called muscle memory patterns become entrenched. These types of historical practice patterns alone, however, when supported only by anecdotal evidence do not confirm that random or blocked practices is the right choice. This can be determined only by empirical evidence that is supported by appropriate and well-structured research.

Not surprisingly, there is not one clear answer but rather the answer is dependent on a variety of factors. In the short term, research has supported that blocked practices are the most effective. Blocked practices also seem to have increased relevance when the performance skill in a competitive situation is always consistent, as the critical motor unit pathways are not dependent on an unpredictable environment. Research, however, does not support this practice structure for longer-term development, or for those sporting situations that have more fluid and unpredictable environments. In these situations research favours random practice as the most effective for skill acquisition.

Both of these practice formats will allow for an athlete to make the more rapid shifts that are common in game situations, meaning skills are more easily transferable from the practice session to the game situation. A variety of skills in an unpredictable order are the real demands of many sports, so practices that can mimic this reality are more effective as the skills become increasingly transferable to the game situation and, as a result, the skills learned tend to be ingrained not only at a more permanent level but more importantly a more flexible level as well, making the skill set a more readily available tool in the athlete's war chest. This falls in line with the Law of Specificity of Training.

Coaches must be cautious when using blocked practice sessions as too great an emphasis on isolated skill development can easily develop a false sense of confidence in one's ability level. Consistent success in a specific area with only a few blocked drills may lead the athlete to think that this alone will lead to success in a game situation. However, when other factors come into play in the game environment that are not present in the blocked practice structure, these compounding factors can become confusing since that athlete has not been exposed to them in the practice environment, therefore resulting in compromised performance.

Crossley (2012) further explained that with developmentally young athletes who have little or no skill, then it would seem reasonable that blocked practices would play a more significant role in the skill acquisition process. They may also serve a role at the very beginning of a season in an effort to reset the athlete’s skills after a long period of transition over the summer months. As athletes become more and more competent, then the practice structure should become increasingly distributed and random in nature with a growing emphasis on sessions that mimic game conditions as closely as possible. An examination of the related skills by Crossley placed curling in a somewhat unique situation, caught somewhere between a traditional individual sport and a traditional team sport. According to him, curling represents a rare team sport where the opposition is relegated to the sidelines to observe and plot potential responses while the other team executes the next play. This is unlike other common team sports where play is influenced by having both teams involved simultaneously in the action, therefore making for more rapid and fluid decision making and skill execution requirements. Basketball or hockey games are excellent examples of team sports where rapidly shifting skills are required to be successful.

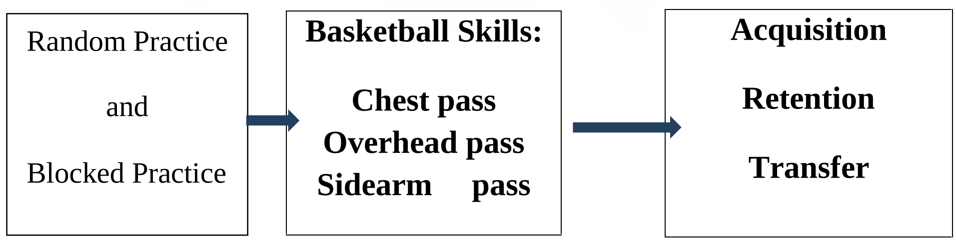
Many individual sports, on the other hand, require a very limited number of related skills to be linked together seamlessly to create winning conditions. In these cases the skill set required is, by and large, the same for every competitive situation. An obvious example would be any track and field event.Curling requires a larger set of skills, such as varied turns, grips and releases and weights as well as sweeping than is commonly found in most individual sports, suggesting that skill acquisition might best be in line with practice patterns suited for team sports. However, unlike team sports these skills are carried in an environment that is to a greater degree fixed and stable as the skill is being applied therefore resembling the conditions that most individual sports are accustomed to. These conditions remove, to a large degree, the need for rapid decision making and skill execution that is common in traditional team sports and suggest that skill acquisition might best be addressed using practice formats that are consistent with patterns used in individual sports (Crossley, 2012).

In reflecting upon his own practice with golfers, Mike Vanderwolf (2000) observed that many golfers believe that blocked practice, through it is repetitive nature will lead to a grooved and trusted action and the best results on course. Unfortunately the truth is that blocked practice, though generally leading to improved performance in practice, does not transfer well to the golf course very well. This is because in golf, one never gets a second chance, or a third to hit a particular shot. The challenge in golf is to be prepared to hit the shot that is in front of you and that means a 'd'- shot every time. Golfers that practice in blocked practice style never practice the skill of planning and executing under real conditions and are thus less prepared for real conditions.

He further suggested on the contrary that, random practisers are constantly challenged with having to go through a problem solving process that includes visualization of the shot, anticipation of the result both desirable and undesirable and to plan accordingly. Thus instead of hoping they will execute, they are practicing to a much higher standard, more likely to trust in their execution because they have already figured out what to do before they hit the shot. Random practisers do not practice "beating their head against a wall though this varied form of practice seems to exhibit lesser proficiencies in practice, those skills are better transferred into play on the course because they more accurately relate to the actual challenges presented on course. Thus offering a more realistic measure of ones skill level. That said, there is a time and a place for making use of blocked practice. Early on in the acquisition of a new skill, blocked practice may well be required for the golfer to gain an initial sense of accomplishment. Once the new skill has been performed and is understood, it is recommended that the student move to a random practice mode and diminish any blocked practice. Those that stick to blocked practice are thus stuck to early stages of skill development. Random practisers show "meaningful" progress that leads to long-term retention and transfer.

Another benefit of random practice to applied sport situations is specificity. It is rare that any sport uses a blocked format. For instance, in golf they may use a different golf club on each swing during a tournament. In hockey and basketball, not one shot taken, save for free throw shooting, may be from the same position. In baseball, the batter is thrown a variety of pitches during practice such as a curve ball, fastball, and changeup. Interestingly enough, as discussed earlier, Hall, Domingues, and Cavazos (1994) et al. found that using a randomized format for throwing various baseball pitches to advanced batters resulted in superior learning.

2.11Conceptual Framework for the Study



This current study critically analyzed various fields of thought, theories, suggestions,and ideas presented in previous literature in relation to random practice and blocked practice approach of teaching sports skills in order to determine the main focus of the present study.According to Magill and Hall (1990), variable learning (random practice) leads to poor practice performance but better learning while learning without variability (blocked practice) leads to good practice performance but poor retention and transfer. Similarly, Schmidt & Bjork (1992) suggested further that interventions that enhance performance during training may have detrimental effects on learning, and conversely, instructional manipulations that degrade performance during skill acquisition may support the long term goals of training.

However, other researchers are also of the view that blocked practice is more appropriate for novice learners. According to Merbah and Meulemans (2011), several studies indicate that skill acquisition in novice subjects tends to be higher in blocked practice conditions while highly skilled subjects can take advantage of random practice conditions in both retention and transfer. Additionally, Guadagnoli (2004) proposed a framework for conceptualising the effects of different practice conditions in motor learning and suggest, purely hypothetically, that performance level is linked to task difficulty. He defines difficulty along two dimensions: nominal task difficulty and functional task difficulty. Nominal difficulty refers to a constant level of task difficulty, without taking into consideration who is performing the task or under what conditions; functional task difficulty takes into account the skill level of the subject and the conditions under which the task is being performed. He further suggested that, with a task of a given level of nominal difficulty, an individual at any skill level is likely to perform at a predictable level. For a beginner, performance outcome is expected to be high only under conditions of very low nominal task difficulty. As the task becomes more difficult, the expected level of performance for the beginner drops rapidly. It reaches a floor level of performance at a relatively low level of task difficulty. For the expert, only the most nominally difficult tasks would be expected to pose a problem. Therefore, if the nominal difficulty increases, performance will decrease and the rate of decline in performance will be more rapid for the lower-skilled performer. Overall, according to this point of view, both the complexity of the task and the experience of the learner determine the amount of learning that takes place. When the task is complex (with high attention, memory, and/or motor demands) or when the learner is relatively inexperienced, random practice may overload the system and its potential benefits could be disrupted.

Hall, Domingues, and Cavozos (1994) investigated the effect of random practice and blocked practice on baseball batting. Participants consisted of college level baseball players who had a high capacity to express the skill of batting. Participants performed 2 additional batting practice sessions per week, for 6 weeks. A pitcher would throw the batting participants a total of 15 curves, 15 change-ups, and 15 fastballs in a blocked or randomized manner. The transfer design was then delivered in both random and blocked practice scheduling. Results established that learning, as inferred by the retention trials, was greater in the random practice conditions than the blocked practice conditions.

Tsutsui et al. (1998) examined whether or not contextual interference effects are observed when the task to be learned involves the acquisition and retention of new motor patterns. Participants were instructed to perform random practice or blocked practice on a bimanual coordination task. Results again showed that acquisition performance was facilitated by blocked practice, but random practice resulted in better retention.Building on the findings of these scientists, Landin & Herbert (1997) investigated the effect of the degree of contextual interference on learning. Participants consisted of 30 undergraduate college students with 2 years of high school basketball experience and no intercollegiate competition. Participants were instructed to perform a basketball shot from six positions, with varying distances and angles to the basket. Participants were assigned to three experimental conditions: blocked, random, and randomized blocked practices. All participants performed a total of 30 shots, 5 shots per position, for 3 days. Participants under the blocked practice schedule performed 6 successive trials from all positions. Participants in the randomized-blocked practice condition performed three successive trials at each location and repeated the sequence twice. Participants in the random practice condition performed one trial per position in a serial arrangement and repeated the sequence six times. Results showed that randomized-blocked practice group were better for learning than both groups, as inferred from the retention trial. Further, acquisition performance was also best in the random-blocked practice condition.

Proteau et al. (1994) suggest that moderate contextual interference allows for repeated trials under one condition, facilitating the learner‘s ability to make error corrections on the subsequent trial, while concomitantly providing the contextual interference benefits of changing tasks every couple of sets instead of every set. It appears that the level of the learner may also influence these results. For instance, research found that advanced participants in an open sport skill task received much better results from random practice than novices. Shea, Kohl, and Indermill (1990) investigated the effect of contextual interference and the amount of practice on sensory motor skill acquisition in novices. Results indicated that blocked practice was actually better on retention tests after 50 trials. However, after 400 acquisition trials, random practice became superior to blocked practice for learning. Recently, Guadagnoli and Weber (1999) examined the effects of CI on a relatively difficult task (golf putting) in novice and advanced learners. Results showed that novice participants experienced superior results in blocked practice, while advanced participants received superior results in random practice formats. Further, studies on children have found that blocked practice may be of greater benefit than random practice for learning. These data suggest that blocked practice may be best to perform for novices practicing difficult tasks, and progress to random practice once a certain capacity to express a skill has been developed. It is suggested that for novices difficult tasks cause enough of a load at first so that the action-planning processes are being sufficiently challenged. Moreover, the attention demand would be higher in novices, and introducing a randomized format may cause information overload, suppressing learning (Magill and Hall, 1990). In this context, Landin & Herbert (1997) suggest that, moderate schedule may be best, because it provides learners with the opportunity to adjust to environmental as well as task variables. However, for professional athletes, who can perform tasks with relatively little attentional demand, it may be optimal to perform pure random practice. The authors suggest that these results could be influenced by self-efficacy, which is the confidence people have in their abilities to attain desired levels of performance (James, 2000). Random-blocked practice appear to allow for the benefit of contextual interference while maintaining performance equal to or greater than blocked practice, increasing the learner‘s confidence within themselves to perform the skill (self-efficacy). This hypothesis was supported by the findings of Simon and Bjork (2001). While self-efficacy could not overcome the benefits of random practice, studies have found that it is an important variable for enhancing performance (James, 2000), which is why the author suggests that it may contribute to the benefits of randomized-blocked practice. This can be especially important for beginning athletes, whose motivation is primarily extrinsic in nature. Thorndike‘s second law, the law of effect, suggests that if a response is satisfying to a learner, they will be more likely to repeat it. This is why prior experiences are so important. In this context, it is vital that instructors provide an environment that is conducive to success for their athletes. For instance, in order to enhance the self-efficacy of a team who is down, the coach may use a moderate level of contextual interference to enhance performance.

Afsanepurak et al., (2012) also conducted a study on three basketball passes and organised their practice in blocked, random and systematically increasing practices. Their results was consistent with that of Shea and Morgan (1979). As mentioned earlier, the current research studied the effect of high and low contextual interference on performance of three basketball passes (chest pass, overhead pass and sidearm pass). Moreover, this research adapted the study of Afsanepurak et al., (2012) on three basketball passes using low CI (blocked), and high CI(random) practices to assessthe random and blocked practices in motor skills learning.

This current study therefore, considered two teaching methodological approaches – a high variability (random practice) and a low variability (blocked practice) to determine the extent to which they would produce acquisition, retention and transfer of three taught basketball skills namely chest pass (CP), overhead pass (OP) and sidearm pass (SP). The random practice group performed the three skills in a random order not repeating the same format twice: CP,OP,SP; OP,CP,SP; SP,OPCP. The blocked practice group performed their trials in the blocked format: (CP,CP,CP); (OP,OP,OP); (SP,SP,SP), dividing the instructional time equally between the trial sessions. During the training, each participant in a group was made to perform 27 trials of each pass and a total of 81 trials during 9 sessions of practice (9 trials per session). This was done to determine how novice learners would be able to learn the three skills using the two methodological approaches and the type of results they would produce during acquisition, retention and transfer tests of the skills they have learned.

CHAPTER THREE

METHODOLOGY

This section of the study presents an overview of the methods that were used in the study. The areas covered consist of the research design, the population, sample and sampling techniques, instrumentation, validity and reliability of the instrument used, administration of the instrument, data collection and analysis procedures.

3.1Research Design

The study used a pretest – posttest quasi-experimental design to determine the effect of practising three basketball skill passes (chest pass, overhead pass and sidearm pass) on skill acquisition, transfer and retention. It was the pre-research assumption that randomization in the study could not guarantee that the two study samples will be equivalent at baseline. Similarly, one could not also be sure that in a study of this nature, convincingly demonstrating a causal inference or link between the treatment condition and the observed outcome, especially when certain confounding variables cannot be controlled or accounted for (Rossi, Lipsey & Freeman, 2004), was possible. As beginner players, it was also the pre-research assumption that the selected participants had never played the game of basketball prior to the study and were therefore considered beginners. Another reason for the use of this design was that randomization in selection for the study would not be an important criterion since participants were already preselected individuals who had never played basketball.

In spite of these assumptions, quasi-experiments are considered natural experiments though and as such their findings may be applied to other settings, allowing for some generalizations to be made about the population. Although a true experimental design would have best suited the purpose, however, it was acknowledged that using a quasi-experimental design could also minimize some threats to external validity as natural environments do not suffer the same problems of artificiality as compared to a well-controlled laboratory setting (Robson, Shannon, Goldenhar & Hale 2001).

3.2Population

The population for the study comprised of all students of the Presbyterian Boys' Senior High School (PRESEC), Legon in Accra. This school was selected based on convenience since the researcher teaches in the same school and accessibility was not a challenge to deal with. As a day and boarding institution, the school has a student population of two thousand, seven hundred and fifty-two (2,752) students constituting the sampling frame. The population segment targeted for the study were the freshmen. Members of this target population almost entirely come from the Junior High School system of the country where the game of basketball is not a constituent of the physical education and sports curriculum. It cannot be repudiated however that the study participants had never seen the game of basketball being played previously. The total number of freshmen in the target population was six hundred and one (601) students with an average age and height of 15 years and 1.65 meters respectively.

3.3Sample and Sampling Procedures

After purposively selecting the freshmen with a population of 601, a total of sixty (60) of them, constituting about 10% of the targeted units, were randomly selected as the sample for the study. This number was deemed adequate enough to meet the quantum of data expected for this study compared to previous such studies. This number was also chosen because it reflected the limits of the budget and the time that was available to administer the test units. However, according to Miaoulis and Michener (1976), in addition to the purpose of the study and population size, three criteria usually needed to be specified to determine the appropriate sample size are: the level of precision, level of confidence, and the degree of variability in the attributes being measured. An estimated sampling error of +/-10 percentage points and a confidence level of 95% (P = .05) were assumed from previous studies with same variables in different sports increasing the reliability of the test instrument. This confidence was also buttressed by the presumed homogeneous nature of the target population. There were 20 classes for Form One students in the Presbyterian Boys' Senior High school. These classes were labelled as; 1A1, 1A2, 1A3, 1A4, 1B1, 1B2, 1B3, 1B4, 1C, 1D1, 1D2, 1E, 1F, 1G, 1H, 1J, 1K, 1L, 1M, and 1N with an average class size of 45 students each. The simple random sampling technique was however, utilized in selecting two classes from the 20 classes using the lottery method. Each class was assigned a unique number. All the numbers were placed in a brown plastic bowl and mixed thoroughly. With a blind-fold, the researcher picked two numbered tags from the bowl. The two classes picked by the researcher automatically formed the targeted sample for the study.

The classes selected were 1B4 and 1K with class sizes of 42 and 40 respectively. The same lottery method was used to finally select 30 students from each of the two classes. Since the Form 1 classes were many, randomly selecting the samples from the whole year group altogether would have been difficult to do. This was because, it was possible that the participants would not have come from the same class. Thus, working with samples that were too spread out in majority of the classes would have caused a lot of test administration challenges. The selected participants were then selectively assigned to the two experimental groups namely the blocked practice and random practice groups. In doing so, participants were grouped according to the classes they belonged to, for convenience purpose and assigned to one of the sample groups. No incidence of mortality was recorded hence all the 60 participants fully took part in the study.

3.4Instrumentation

The main instruments used for data collection were three basketball passing skills tests and a wall with standard criteria measurements on it. The basketball passes employed for the study were chest pass, overhead pass and sidearm pass. These three passes were selected because they are basic basketball passes preferable for teaching novice learners.Krause, (1991) defines passing in basketball as a process of transferring a ball from one player to another or a target. There are several types of passes used in basketball. According to Krause (1991), the type of pass used depends on the distance the ball must travel and the location of the target. The manner in which the ball is caught depends on the location of the passed ball in terms of height and trajectory. These passes are described below:

1. Chest pass - It is the most frequently used form of passing in basketball, which is effective for short passes and is used when an opposing player is not in the intended path of the ball.

2. The Two-Handed Overhead pass - It is similar to the chest pass and used to pass over short distances especially when a player wants to pass to a target above the reach of an opponent.

3. The Sidearm pass - The sidearm pass is recommended when an offensive player is closely guarded and has to pass the ball around a defender. Except for the position of the ball in the preparation phase, executing of the sidearm pass is similar to the overhead pass.

For the measurements on the wall, 20 horizontal lines with 10cm space between each two lines were drawn on a wall at a 4-meter distance from the participants (during the acquisition stage). The lines were scaled from +9 to -9 from top to bottom so that passing toward the space between the two uppermost lines and two lowermost lines would equal a score of 9 or -9 respectively.

3.5Research Setting

The study was carried out at the Presbyterian Boys' Senior High school (PRESEC), Legon in the Greater Accra Region of Ghana. The school is a boys' school located at about 400 meters away from the main campus of the University of Ghana, Legon. The school has an ultra-modern gymnasium furnished with state of the art equipment. Two methodologies known as the blocked practice and random practice were used to teach students the selected basketball passes. The equipment below were used in the tests administration; six (6) basketball balls, two (2) standard tape measures, cones, three (3) clipboards, pencils, pens, erasers, tables and chairs and white chalk or crayon. The experiment involved responding to a basketball stimulus with each task having a predetermined sequence.

The blocked practice group completed all tasks in the following order: chest pass, overhead pass and sidearm pass. By this, they practiced only chest pass which they completed before moving on to practice the overhead pass. Then after mastering the overhead pass, they finally moved on to practice the sidearm pass. The number of trials and distance from targets were equal for all the passes. The random practice group practiced the chest pass, overhead pass and sidearm pass in no particular order just that no more than two consecutive trials could occur for any one of the passes. Training was done in the school gymnasium with all members of the sample supervised by an experienced coach. The results of the experiment were split into an acquisition, retention and transfer phase. The reason why these teaching and or coaching approaches were used was to determine their effectiveness in skill acquisition, retention and transfer on the three basketball passing skills. (Magill & Hall, 1990).

3.6Validity and Reliability of the Instrument

A total of ten (10) male students in Form One from the West Africa Senior High school were pilot-tested to establish the reliability of the instrument with a reliability coefficient of .78 using the Kuder-Richardson's statistical procedure.

In order to check for validity of the instrument, a panel of experts in the Department of Physical Education, Recreation and Sports (HPERS) in the University of Education Winneba, were contacted to examine the instrument for content validation purposes. After a thorough examination of the Test instrument, approval was given for its use for the intended outcome.

3.7Administration and Data Collection Procedure

Permission was sought from the Headmaster of Presec, Legon to allow for the selected students to be used as participants for the study. All participants were required to have their parent's consent for participation as well as their own willingness to participate in the study. Two qualified and experienced basketball coaches were selected to assist the researcher in training the participants using the two approved methodologies. A pre-training session with the coaches was conducted by the researcher on the implementation of the methods used in carrying out all the required test.These coaches were given some form of orientation on the import of the study and the procedures or methodological approaches to be adopted in training. Before the process of test administration began, an introductory session was held where the coach explained thethree different types of basketball passes (chest pass, overhead pass and sidearm pass) to the participants.The scoring process was also elaborated by the researcher. Although the three skills mentioned above had different structures and different motor skill programmes, the number of trials and distance from targets was equal for all the passes.

In the experiment, participants stood at a 4-meter distance away from the wall and passed the ball toward the zero (0) point such that the ball did not hit the ground. A pre-test was conducted at the end of the introductory session to eliminate any learning effects and eliminate or control for some extraneous variables. The subjects were randomly assigned to the blocked practice and random practice groups (n1=n2=30). The pre-test was done to ensure that all participants were at an almost equivalent beginner level in basketball. At the skill acquisition level, each participant in a group was made to perform 27 trials for each pass and a total of 81 trials during 9 sessions of practice (9 trials per session). The blocked practice group performed 27 trials of the first pass (chest pass), 27 trials of the second pass (overhead pass) and 27 trials of the third pass (sidearm pass). The random practice group performed their trials in no specific order. Meanwhile, no more than two consecutive trials could occur for any one of the passes. Each group trained at different times with an assigned coach. Performances of participants during each of the nine practice sessions were recorded on assessment sheets and constantly scrutinized to be sure the correct practice approach with the test items had been implemented.

After the nine practice sessions, students were briefed on how the data was going to be collected after which each student was given the opportunity to perform three non-scoring trials. A post-test on acquisition, retention and transfer of the three basketball passes was conducted to examine how students had learned. The acquisition test was conducted soon after the nine practice sessions. The retention test was conducted a day after the practice period with 4 trials of each pass in a mini blocked practice schedule (2 trials of chest pass, 2 trials of overhead pass and 2 trials of sidearm pass and the pattern continued until 12 trials were performed).

For the transfer test, 4 trials of each pass at a 5-meter distance from the wall were performed by each participant two weeks after the practice sessions. Scoring was based on the area on the wall where each participant was able to hit the ball to without bouncing the ball since the lines were scaled from +9 to -9 from top to bottom. Thus, passes that were directed toward the space between the two uppermost lines and two lowermost lines equated to a score of +9 or -9 respectively. Any ball that bounced before hitting the wall scored no marks (0).

3.8Data Analysis Process

Differences between the pre-test and post-test scores were subjected to analysis of variance to evaluate the significance of mean differences between the three treatment levels among the two groups of participants. ANOVA provided much flexibility in designing this study and interpreting the results. As a repeated-measures design, the samples were tested in different treatment conditions especially when the study had two independent variables: two different teaching approaches (Independent Variable 1) and three different basketball skills (Independent Variable 2), thereby providing a factorial design. The Dependent Variable for the study was each participant's score on the standardized-achievement-tests. ANOVA was deemed appropriate because it allows for comparison of many variables with much more flexibility and significantly reduces the possibility of making a Type-1 error which is a very important advantage in research. The goal of the current study was to measure the amount of variability between the groups and to explain where the variability came from. Therefore, means and standard deviations of participant's scores were analysed to determine how groups differed from each other. For a day and two weeks after practice scores, a 2 (groups) by 3 (measurement periods) analysis of variance was used to evaluate the significant effect of the skills learnt. An independent samples t-test was also used to test for significant differences in duration (a day and two weeks) of after skills practice sessions between the random practice and blocked practice groups. Tables and figures were then used for the presentation of the data.

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSIONS

This chapter is focused on the analysis and interpretation of participants' scores in order to make an inference according to the objectives and hypotheses set in the study. The results and discussions are addressed under the following sub-headings:

4.1One hour after Skills Practice (Acquisition Stage)

The Table 4.1 below describes the means and standard deviations scores of the two groups (RPG & BPG) based on the skills taught (Chest pass, Overhead pass & Sidearm passes in Basketball) after an hour practice.

Table 4.1: Means and Standard Deviation Scores of Participants' Performance in Basketball Skills after an Hour of Skills Practice.

		N	Mean	Std. Deviation	Std. Error
Chest pass	Random	30	28.57	2.079	.380
	Blocked	30	33.73	1.081	.197
	Total	**60**	**31.15**	**3.080**	**.398**
Overhead pass	Random	30	29.57	2.128	.389
	Blocked	30	34.07	.785	.143
	Total	**60**	**31.82**	**2.771**	**.358**
Side Arm Pass	Random	30	28.97	2.697	.492
	Blocked	30	33.87	1.042	.190
	Total	**60**	**31.42**	**3.196**	**.413**

The chest pass showed average scores for the random practice group (RPG) as 28.57, whereas for blocked practice group (BPG) the average mean score was 33.73, while in the overhead pass, the RPG had a mean score of 29.57 and BPG recorded a mean score of 34.07. On the sidearm pass, the mean scores for RPG and BPG were 28.97 and 33.87 respectively. The results based on an hour skill practice by the participants in the two groups fall on a straight line continuum, though the blocked practice group had a higher mean than the random practice group. This corroborates Magill's (2000)assertion that the variety of environmental features experienced during the practice of skills may influence performance. The results also matches the findings of Neimati, Shojaee and Kohandel (2006) that emphasized on expectations in the Schmitdt's Schema theory that successful performance of a skill depends on the amount of variability of practice. The higher mean and standard deviation scores of the BPG conforms to earlier studies (Herbert et al., 1996 &Guadagnoli, et al., 1999) which indicated that skill acquisition in learners tends to be higher in low interference practice as in blocked practice situations.

Figure 1 below shows the mean plot of chest pass after an hour of skill practiceby both random and blocked practice groups.

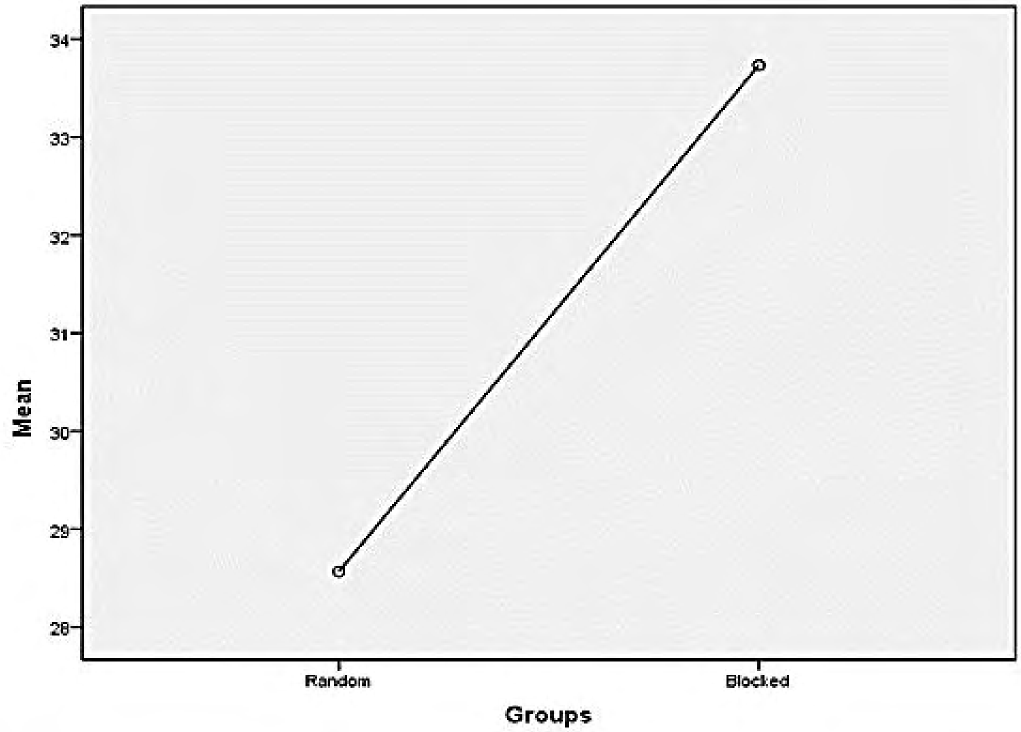


Fig. 1: Mean plots of Chest Pass in Basketball after an hour.

The chart revealed that although the BPG had a higher mean than the RPG both remain on the same continuum. The higher means advantage but lower SD scores showed that the BPG participants had higher level of knowledge acquisition in the chest pass than the RPG.

The Figure 2 below presents the mean plot of overhead pass after an hour of skill practice of both the random and blocked practice groups.

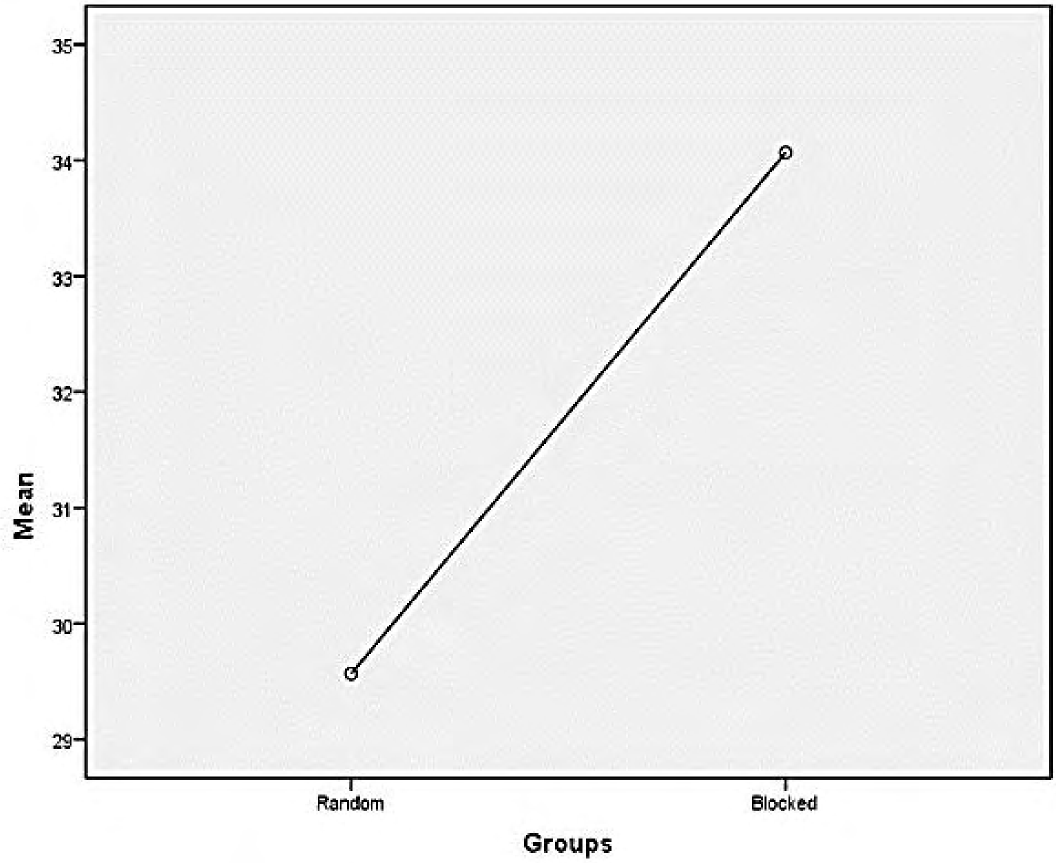


Fig. 2: Mean plots of Overhead Pass in Basketball after an hour.

The chart revealed thatalthough both groups are on the same continuum, the BPG had higher means than the RPG. This means that there was a higher level of knowledge acquisition in the overhead pass in blocked practice than random practice.

The Figure 3 below shows the mean plot of sidearm pass after an hour of skill practiceof both the random and blocked practice groups.

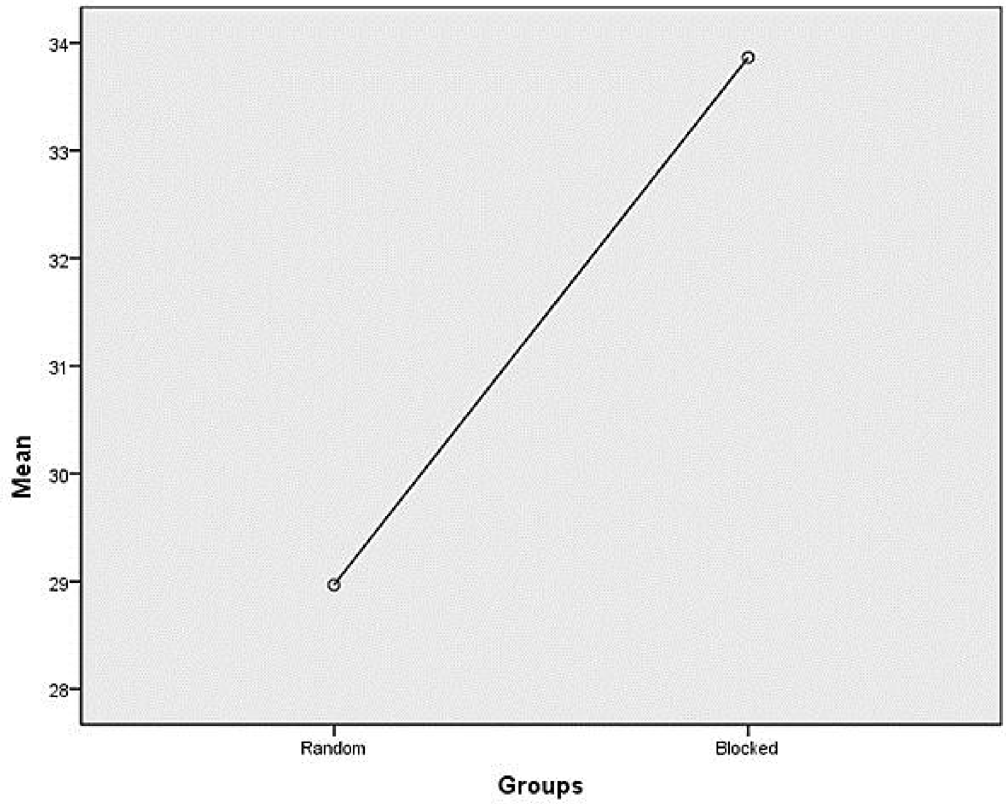


Fig. 3: Mean plots of Sidearm Pass in Basketball after an hour.

For the sidearm pass, Fig. 3 reveals that after an hour of skill practice of both the random and blocked groups, blocked practice produced a higher mean score than random practice. This is an indication that participants in the blocked practice had a higher knowledge acquisition than the random practice for the sidearm pass.

4.2One Day after Skills Practice (Retention Stage)

Table 4.2 below indicates the means and standard deviation scores of both random and blocked practices in Basketball.

Table 4.2:Means and Standard Deviation Scores of Participants' Performance in Basketball Skills after a Day of SkillsPractice.

		N	Mean	Std. Deviation	Std. Error
Chest pass	Random	30	33.17	1.599	.292
	Blocked	30	29.07	1.818	.332
	Total	**60**	**31.12**	**2.675**	**.345**
Side Arm Pass	Random	30	33.33	1.213	.221
	Blocked	30	30.27	2.196	.401
	Total	**60**	**31.80**	**2.342**	**.302**
Overhead pass	Random	30	32.77	1.382	.252
	Blocked	30	29.63	1.650	.301
	Total	**60**	**31.20**	**2.185**	**.282**

The mean score on chest pass was 33.17 for random practice, whereas for blocked practice it was 29.07. The means for sidearm pass was slightly higher in random practice (33.33) than in blocked practice (30.27) while in the overhead pass the mean scores for random and blocked practices were 32.77 and 29.63 respectively. The results revealed that random practice after a day of skill training produced more favourable results than blocked practice. While results for random practice were lower than those for blocked practice after an hour of practice (Table 4.1), the results obtained after a day of skill training showed a decrease in the means of the blocked practice groups (29.07, 30.27 and 29.63) as against that of random practice (33.17, 33.33 and 32.77) which had appreciated in the chest, sidearm and overhead passes respectively.

Figure 4 below describes the mean plot of chest pass after a day's skill practice in random and blocked practices.

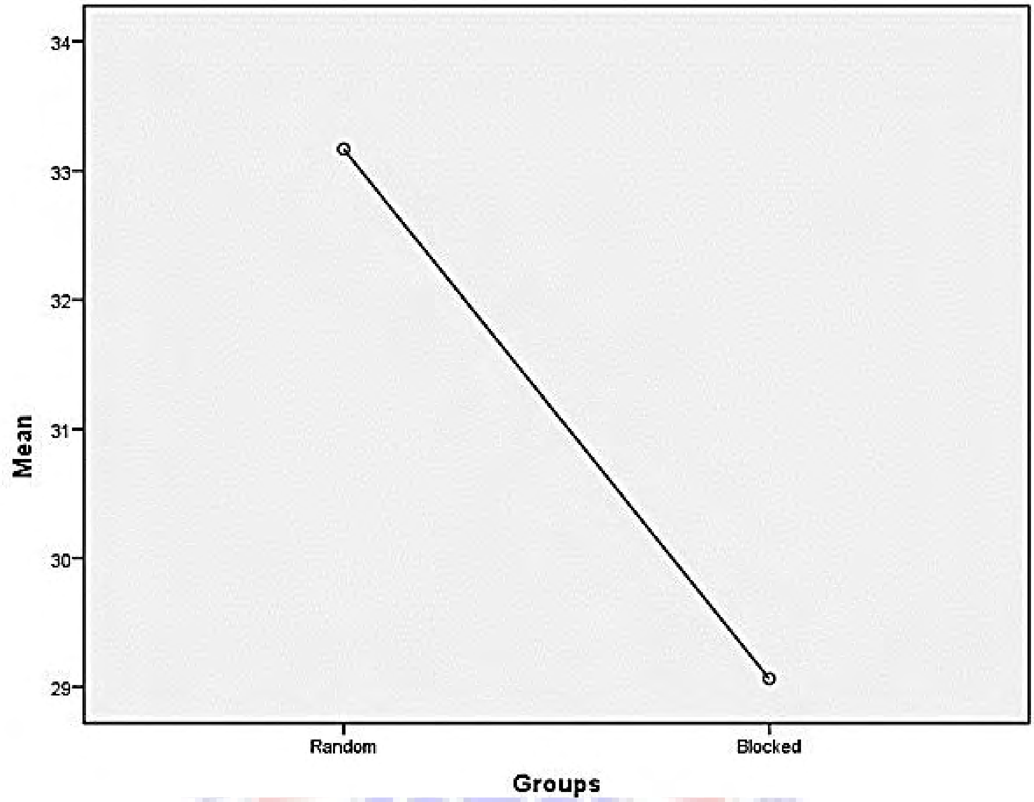


Fig. 4: Mean plots of Chest Pass in Basketball after a day

However, the chart has shifted to the right with a higher mean displayed for random practice than blocked practice although both remain on a straight line continuum. This shows that retention of skill after a day of training is influenced positively for random practice in variations of high contextual interference conditions which is more beneficial to learning more than in low contextual interference conditions such as that obtained in blocked practices.

The Fig. 5 below presents the mean plot of overhead pass after a day's skill practice using random and blocked practice approaches.

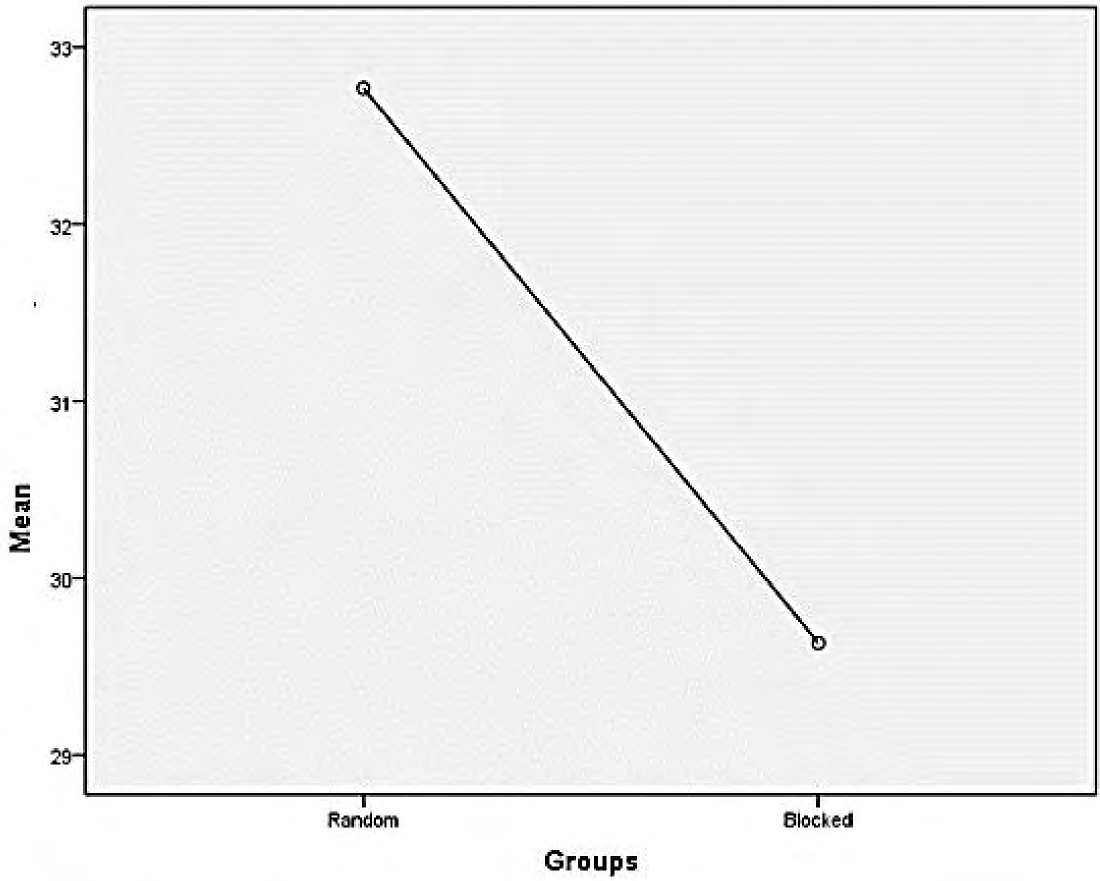


Fig. 5: Mean plots of Overhead Pass in Basketball after a day

The chart reveals that random practice produced higher means than blocked practice. Hence, retention of the skills learnt during random practice tend to be beneficial to learning than in blocked practice.

Figure 6 below describes the mean plot of the sidearm pass after a day's skill practice using the random and blocked practice approaches.

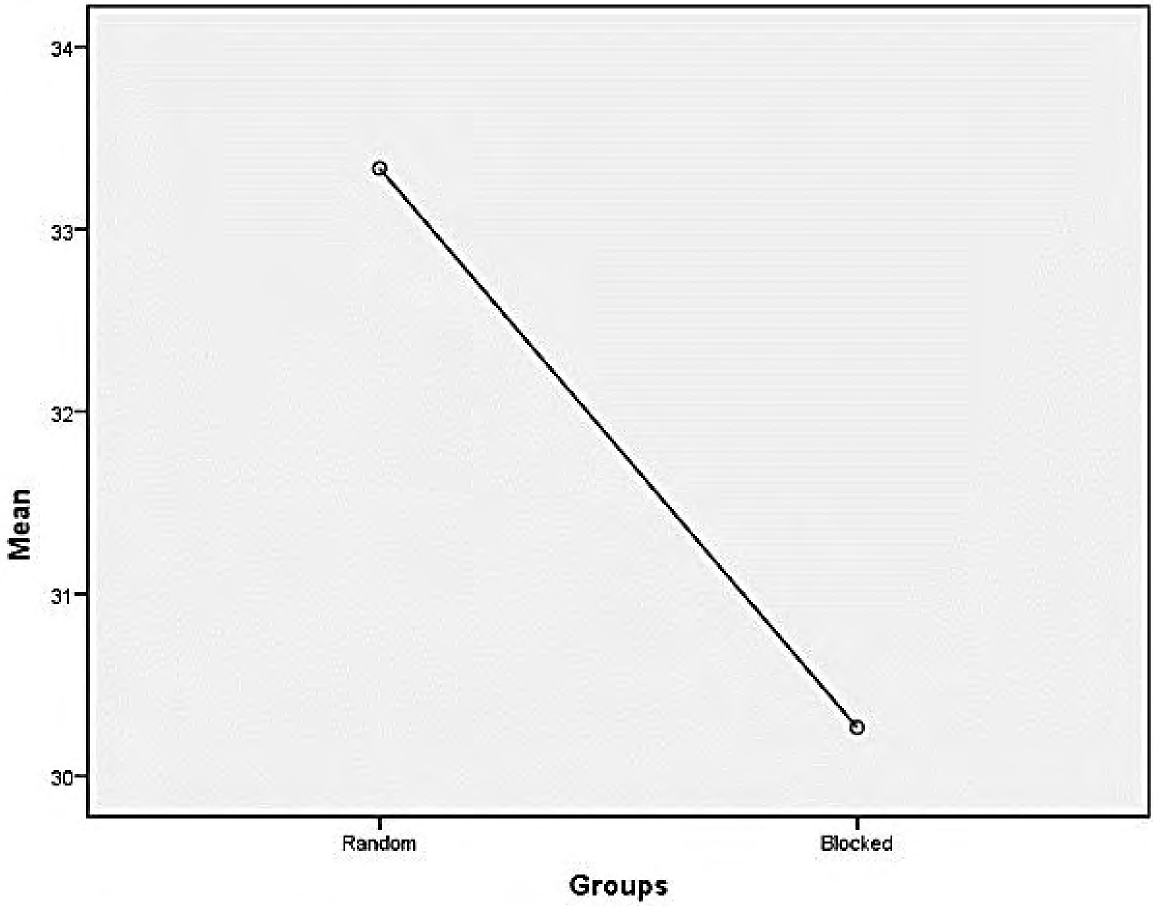


Fig. 6: Mean plots of Sidearm Pass in Basketball after a day

The chart reveals that random practice produces higher means than blocked practice; in other words random practice sessions tend to benefit learning more than blocked practices.

4.32-Weeks after Skills Practice (Transfer Stage)

Table 4.3 below presents the means and standard deviation scores for random and blocked practices in selected basketball skills.

Table 4.3: Means and Standard Deviation Scores ofParticipants' Performance in BasketballSkills after 2-Weeks of SkillsPractice.

	N	Mean	Std. Deviation	Std. Error

Overhead pass	Random	30	34.23	1.040	.190
	Blocked	30	28.00	1.983	.362
	Total	**60**	**31.12**	**3.513**	**.454**
Side Arm Pass	Random	30	34.17	1.053	.192
	Blocked	30	28.87	2.662	.486
	Total	**60**	**31.52**	**3.342**	**.431**
Chest pass	Random	30	33.83	1.440	.263
	Blocked	30	27.87	2.897	.529
	Total	**60**	**30.85**	**3.768**	**.486**

The overhead pass indicates mean scores of 34.23 and 28.00 for random and blocked practices respectively. However, in the sidearm pass, random practice produced a mean score of 34.17 while blocked practice recorded a mean score of 28.87. The mean scores in chest pass for random and blocked practices were 33.83 and 27.87 respectively. The results showed a continuum increase in mean scores for random practice but a gradual decrease in mean scores from the blocked practice session. Two weeks after practice sessions, the mean scores for RPG continued to appreciate (34.23, 34.17 and 33.83) whiles that of BPG continued to decline (28.0, 28.87 and 27.87) with concomitant increase of the SD scores in the chest, sidearm and overhead passes respectively.

Figure 7 below presents the mean plot for the 2-weeks after the skill practice session for both RPG and BPG.

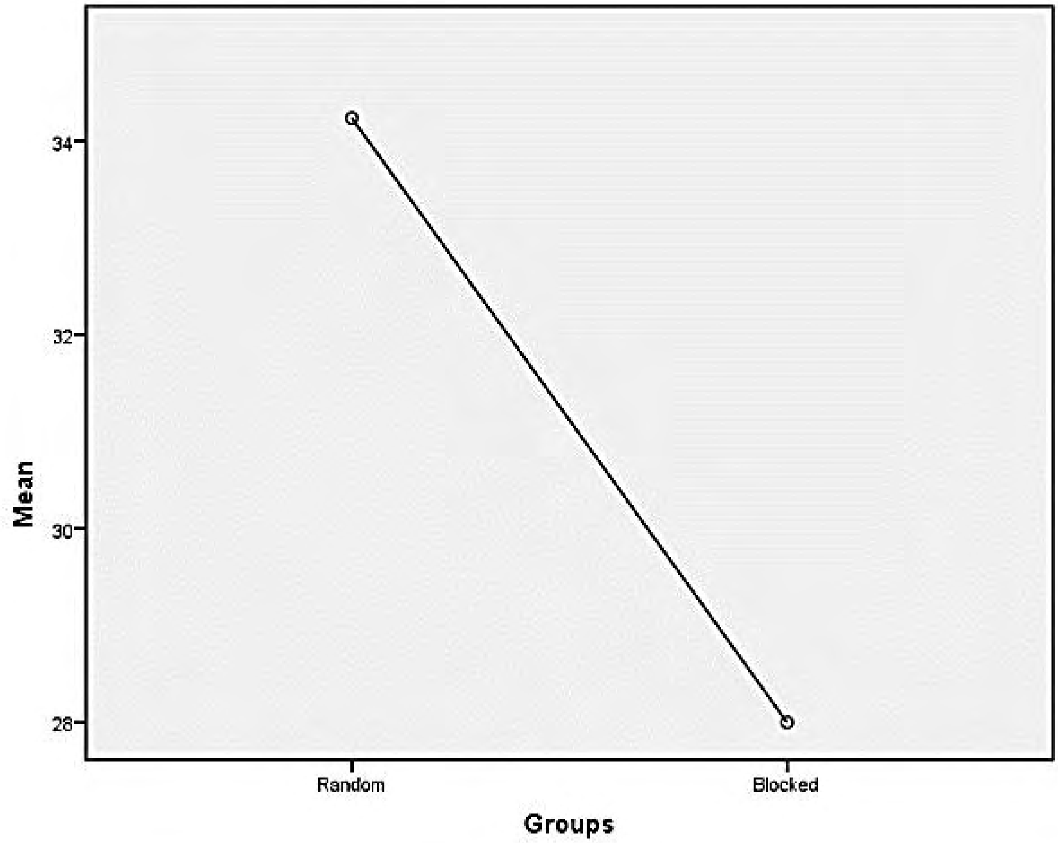


Fig. 7: Mean plots of Overhead Pass in Basketball after 2-weeks practice

The chart tends to maintain its form as for the one-day session graph, showing a maintenance of the straight line continuum from upper right to lower left in favour of the random practice group. This is an indication that random practice led to higher performances after two weeks compared to blocked practice which conflicts with the notion that contextual interference hinders learning.

Figure 8 below indicates the mean plot of sidearm pass 2-weeks after skill training sessions with the random and blocked practice approaches.

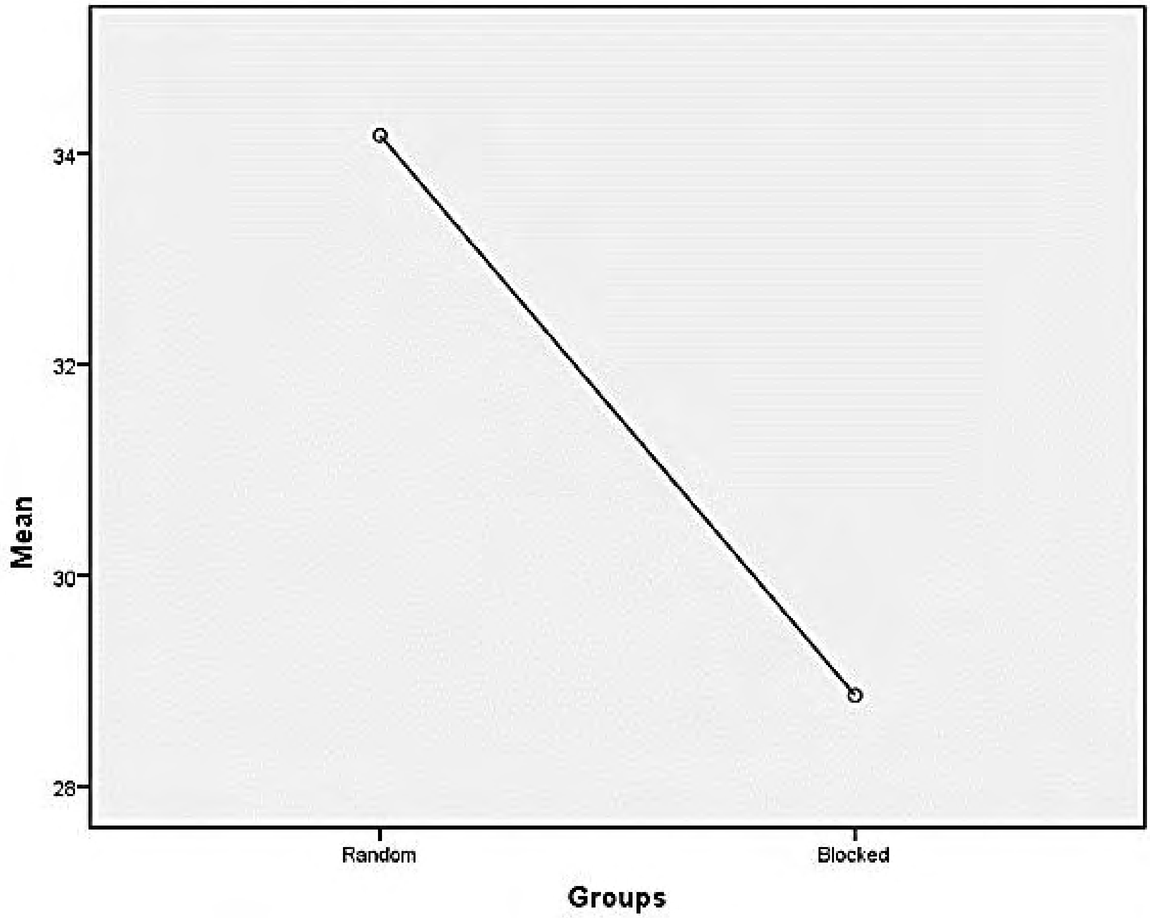


Fig. 8: Mean plots of Sidearm Pass in Basketball after 2-weeks practice

The chart tends to shift slightly to the right indicating the same pattern as in Fig. 7 for both groups and an increase and decrease in mean scores of the random and blocked practices respectively.

Figure 9 below indicates the mean plot for the chest pass after 2-weeks after the skills practice sessions for both the random and blocked practice groups.

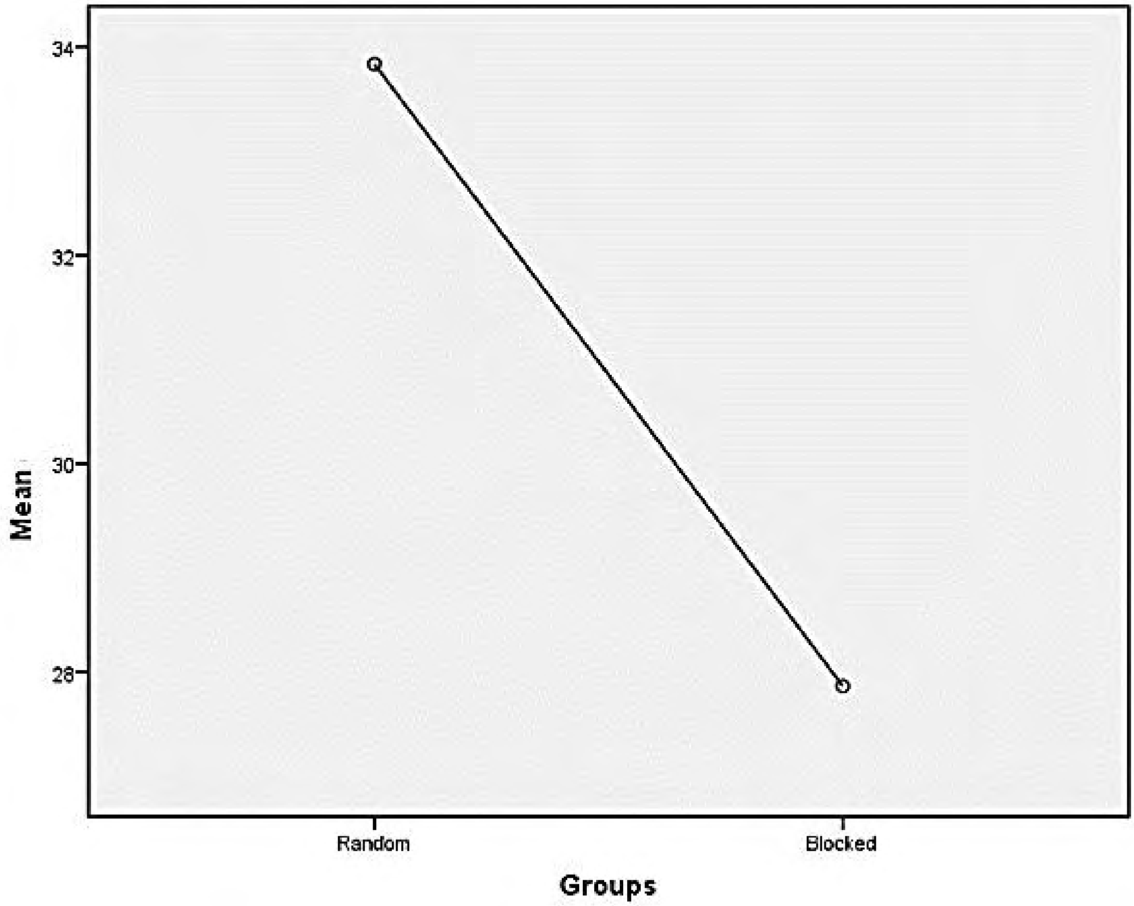


Fig. 9: Mean plots of Chest Pass in Basketball after 2-weeks practice

As in the previous charts for overhead and sidearm passes (Figs. 7 and 8), the mean SD scores followed similar patterns with superior performances from random practice compared to blocked practice.

4.4 ANOVA Test Results

The ANOVA test was used to test the significance of the differences of the mean scores previously analysed in the three skills based on the research hypothesis.

H_o1**:** There will be no significant difference in the skills performance (chest pass, overhead pass & sidearm pass) of participants between the random and blocked practice groups on retention and transfer of skills learnt.

Table 4.4: Results of ANOVA Test forParticipants'SkillsPerformances in the Random and Blocked Groups after a Day ofPractice.

ANOVA		Sum of Squares	df	Mean Square	F	
Chest pass	Between Groups	252.150	1	252.150	86.011	.000
	Within Groups	170.033	58	2.932		
	Total	**422.183**	**59**			
Side Arm Pass	Between Groups	141.067	1	141.067	44.824	.000
	Within Groups	182.533	58	3.147		
	Total	**323.600**	**59**			
Overhead pass	Between Groups	147.267	1	147.267	63.584	.000
	Within Groups	134.333	58	2.316		
	Total	**281.600**	**59**			

P< 0.05

The results above revealed significant differences among the three skills: chest pass, $F_{(1, 58)}$ = 86.01, p< .05; sidearm pass, $F_{(1, 58)}$ = 44.82, p< .05; and overhead pass,$F_{(1, 58)}$ = 63.58, p< .05 a day after practice. The F values show a significant difference in the means of skill performances in retention of the 3 skills between the RPG and BPG at p< .05.

Table 4.5: Results of ANOVA Test forParticipants'SkillsPerformances in the

Random and Blocked Groups after 2-WeeksofPractice.

ANOVA		Sum of Squares	df	Mean Square	F	Sig.
Overhead pass	Between Groups	582.817	1	582.817	232.539	.000
	Within Groups	145.367	58	2.506		
	Total	**728.183**	**59**			
Side Arm Pass	Between Groups	421.350	1	421.350	102.840	.000
	Within Groups	237.633	58	4.097		
	Total	**658.983**	**59**			
Chest pass	Between Groups	534.017	1	534.017	102.008	.000
	Within Groups	303.633	58	5.235		
	Total	**837.650**	**59**			

P < 0.05

The results above indicated that significant mean differences exist among the three skills: $F_{(1,\ 58)}, p < .05$ = 232.54, 102.84 and 102.01 for chest pass, sidearm pass and overhead pass respectively. For an F distribution, our critical value was ± 4 at p<.05 for a two-tailed test.

4.5T-test Statistical Analysis

It was necessary to test the significance of the combined total means of performances on the two measurement occasions between RPG and BPG

H_o 2: There will be no significant mean difference in performance between the RPG and BPGs' in the 2 measurement occasions (Retention and Transfer Stages).

$$H_o: \mu_{(RPG)} - \mu_{(BPG)} = 0$$

$$H_1: \mu_{(RPG)} - \mu_{(BPG)} \neq 0$$

With two independent samples (RPG and BPG), it was necessary to compare the groups in terms of retention and transfer of skills. It was important to know if learners would score higher or lower in skill performance based on the training method used. The goal was to use the data from the 2 samples as a basis for evaluating the mean difference between the two treatment procedures by looking at the differences between the groups under study.

Table 4.6: Results of T-test on Means and Standard Deviation Scores of Random and Blocked Practice Groups (a day and 2-weeks after training).

	Groups	N	Mean	Std. Deviation	Std. Error Mean
A day	Random	30	33.07	1.143	.209
	Blocked	30	29.70	1.149	.210
Two weeks	Random	30	34.03	.765	.140
	Blocked	30	28.23	1.633	.298

In Table 4.6, the variability (standard error) is very important because it shows how well the sample mean of RPG should approximate that of the BPG.The standard errors for the sample mean differences in table 4.6 shows the standard distances between the samples mean differences $\mu_{(RPG)}$ - $\mu_{(BPG)}$. The value of each standard error above shows the amount of error that is expected by chance between the sample means.

Table 4.7: Results of Independent Samples T-test for Equality of Means between Random and Blocked Practice Groups a Day and 2-Weeks after Practice.

		t-test for Equality of Means			
		T	df	Sig. (2-tailed)	Mean Difference
A day	Equal variances assumed	**11.378**	**58**	**.000**	**3.367**
	Equal variances not assumed	11.378	57.998	.000	3.367
Two weeks	Equal variances assumed	17.614	58	.000	5.800
	Equal variances not assumed	**17.614**	**41.136**	**.000**	**5.800**

P < 0.05

The t-test values $t_{(58)} = 17.61$ and 11.38, $p < .05$, two-tails, were higher than the critical t-value at that level which is ± 2. Our obtained values fell in the critical region, therefore, the null hypothesis is rejected. The results of the two training methods are significantly different on both occasions.

4.6Discussion of Findings

The aim of the current study was to analyze the effect of random and blocked practice conditions on the learning of three basketball skills (chest pass, overhead pass, and sidearm pass) among 15-yr.-old beginner basketball players. The discussion of the study's results was based on the research questions and hypotheses tested after an hour (Acquisition Stage), a day (Retention Stage) and two weeks (Transfer Stage) after a skill training session using the random and blocked practice approaches.

The results of thedescriptive analysisrevealed that an hour after skill practice, both blocked and random practice approaches were effective for acquisition of the three basketball skills (chest pass, overhead pass and sidearm pass) and that the participants fell in the same continuum of knowledge though the blocked practice method produced a higher mean score than the random practice session.This corroborates with Magill's (2000) assertion that the variability of environmental features experienced during the practice of skills may influence performance and that beginner learners will learn more effectively if they begin with blocked practice. This observation also agrees with the findings of Neimati, Shojaee and Kohandel (2006) which emphasized on the expectations in the Schmitdt's Schema theory of successful performance of a skill depending on the amount of variability of practice. It has been reported that in blocked practice, subjects are faced with few challenges in the early stages of practice, thus, are at an optimal performance environment in acquisition of skills (Porter, 2008).Several other studies, (Herbert et al., 1996;Guadagnoli, et al., 1999) further confirm that skill acquisition in novice learners tends to be higher in low interference conditions as was manifested in the performance of participants using the blocked practice method.

Guadagnoli (2004), suggested, purely hypothetically, that performance level can be linked to task difficulty for subjects with different levels of expertise and identifies difficulty along two dimensions: nominal task difficulty and functional task difficulty. Using a task of a given level of nominal difficulty, an individual at any skill level is likely to perform at a predictable level. For a beginner, performance outcome is expected to be high only under conditions of very low nominal task difficulty. However, the results of the current study do not agree with several other findings(e.g.Maslovat et al., 2004;Zetou, Michalopoulou, Giazitzi, & Kioumourtzoglou, 2007) which found inconsistent results using the random and blocked practice methods.

Results of this study also indicated that random practice produces higher performance outcomes than blocked practice in all the three skills tested for retention and transfer.Analysis of the data showed support for the retroactive interference theory of Shea and Graf (1994). Unlike the action plan reconstruction theory that underlines the advantages of random practice, retroactive interference focuses on the disadvantages of blocked practice. In the present study, the blocked practice group recorded lower mean scores performance at the initial stages of skill learning because according to the retroactive interference theory, later learned patterns in blocked practice tend to act backwards to attenuate the memory strength of earlier learned patterns. However, in random practice, the individual does not finish a skill before starting the next skill and thus is not subjected to the disadvantages of retroactive interference.

The results of the descriptive analysis of data obtained two weeks after the training session revealed that the random practice group performed better with higher mean scores than the blocked practice group in skill performance. The superiority of the random over the blocked practice after two weeks of training supported the findings of Magill and Hall (1990) who also applied the two methodological approaches to learning multiple tasks on two or more groups of people who practiced these tasks under different organizations of rehearsal. Their study indicated that random practice leads to poor acquisition but improves later during the retention and transfer phases.

Hypothesis one was tested using the ANOVA test to determine the differences between and within the two groups in the performance of the three basketball skills. After a day of practice, the results of the analysis of variance test revealed that the random practice group produced significantly higher mean scores in the 3 skills.Similarly, a day after training, the F-values showed that the random practice group recorded significantly higher mean scores in all the three skills than the blocked practice group but in the same continuum of skill acquisition.

The results of independent samples t-test revealed that there was a significant difference between the 2 approaches (random and blocked) in terms of overall learned skills. This results conclusively revealed that the random practice approach reported significantly higher levels of performances in the three skills (chest pass, overhead pass and sidearm pass) than the blocked practice approach a day and two weeks after the practice session. The current results is consistent with the findings of Lee and White (1990) who suggested that a random practice schedule could delay inattention and loss of interest and therefore enhances learning therefore, the amount of practice in complex tasks improves retention and transfer of learned skills.

Findings of the current study revealed that the random practice produced progressively significant results associated with retention and transfer of learned skills. Random practices therefore improve learning since processing is more elaborate, distinct and meaningful to the learner and information processing is less elaborate as individuals under blocked conditions engage in intra-task rather than inter-task processing through repetitive practice of the same skill. Guadagnoli and Lee (2004), in their challenge-point hypothesis, also suggested that cognitive processing during practice depends on task difficulty. The nature of the task, practice conditions, and skill level of the learner interact to determine the difficulty of challenges in practice trials. For instance, random practice is more challenging than blocked practice and thus leads to higher levels of learning.

Coker (2003), suggested that the effectiveness of a training program should not be measured by the speed of acquisition or the level of performance reached at the end of practice opportunities but by the learner’s performance in real-world settings that are the reason for the training. The improvement in performance observed at the retention (1 day) and transfer (two weeks) stages of the motor programme is consistent with conclusions drawn by Lee and Magill (1985), that a blocked practice schedule benefits performance during acquisition because it obviates the need to re-plan movements between tasks, whereas participants in a random practice schedule need to engage in these time consuming re-planning activities. They subsequently showed that when participants in a random practice schedule were given sufficient time in between learning tasks to plan the upcoming response the acquisition benefit, often apparent with blocked practice schedule, disappears with time.The results of the present research support the conclusions drawn by Memmert (2006), who in a similar study found that results of blocked practice were similarly lower than that of random practices in situations of retention and transfer.

In a similar study, Wrisberg and Liu (1991) introduced random and blocked practices in tennis finding no differences in acquisition, but significantly higher retention scores on the short tennis serve. However, in the transfer phase, both the short and long serves indicateda significant improvement.Numerous other studies have found that random practice is superior to block practice for learning. These include studies on learning badminton serves (Wrisberb, 1991), volleyball skills (Bortoli et al., 1992), (Smith & Davies, 1995), baseball (Hall, Domingues & Cavazos, 1994) and basketball (Landin & Herbert, 1997). Al-Ameer and Toole (1993) in a study asked participants to perform a similar task to the Shea and Morgan (1979) study. Results again found that, relative to random practice, blocked practice enhances performance but depresses learning, while random practice depresses performance but enhances both retention and transfer.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1Summary

This chapter of the study summarises findings in relation to the objectives and results of the study, conclusions and recommendations. The study sought to investigate and identify the effectiveness of two teaching methodological approaches in the teaching of basketball using three skills namely chest pass, overhead pass and sidearm pass and collecting data at three different levels (an hour, a day and two weeks) after skill practices.

The findings based on an hour of skill practice by the participants in the two groups revealed that both blocked practice and random practice methods were effective during acquisition of the three basketball skills and that the participants fell in the same continuum of knowledge although the blocked practice method produced higher means than the random practice method in all the skills tested. However, while results for random practice were lower than those for blocked practice after an hour of practice, the findings obtained after a day of skill training showed a decrease in the means of the blocked practice group as against that of random practice which had appreciated in the chest, sidearm and overhead passes respectively. Furthermore, the results of the descriptive analysis of data obtained two weeks after the training session indicated that the random practice group performed better with higher mean scores than the blocked practice group in the performance of the skills.

In addition, the results of ANOVA test after a day of practice showed that random practice group recorded significantly better mean scores in all the three skills than the blocked practice group though both fell in the same continuum of skill acquisition. The analysis from the independent samples t-test revealed that there was a significant difference between the two approaches in terms of overall learned skills. Hence, it was revealed that the random practice method progressively reported significantly higher levels of performances in the three skills than the blocked practice method a day (retention) and two weeks (transfer) after the practice session. These results support the findings of the Contextual Interference (CI) effect by Magill and Hall, (1990) in the learning of the three basketball skills (chest, sidearm and overhead passes) in a field setting.

Participants in the blocked practice group produced higher scores in one hour after skill practice session. However, data collected after a day and two weeks of the practice session shows that participants in the random practice group produced higher scores than those in the blocked practice group. Also, participants in the former group progressively improved their scores longitudinally over later measurement occasions. The results revealed that there was a significant difference between the practice groups in a day and two weeks of skill practice. Previous and present studies have established that repetitive practice of a skill in a training session has a detrimental effect on the learning (retention and transfer) of motor skills when teaching is based solely on blocked practice. The application of this finding by coaches or teachers will greatly enhance the quality of teaching and learning of motor skills and thereby help produce athletes with a mastery of game skills as well as adequate decision-making capacity in competitive situations.

5.2 Conclusions

There seems to be something about the way we practice motor skills that really matters when it comes to skill transfer and long-term retention. It turns out that several studies done on these two skill training approaches by coaches or teachers have shown that random practice is significantly better at leading to long-term skill retention and application than the block practice approach. Arguably, the blocked practice approach is marked by low levels of what is called cognitive interference, while random practice is marked by high levels of cognitive interference. In simple terms, this means that random practice setups challenge the learner's cognitive and motor systems to deal with the interference of each task on the next activity – an element that keeps him/her on his/her toes and allows for greater retention and skill transfer.

Further evidence has been adduced through this study and previous studies that repetitive blocked practice leads to a kind of rote learning that allows for better performance during training sessions but less skill transfer to competitions and novel situations, as well as lower retention levels over time. One explanation for this is that the demands on active problem-solving and engagement during blocked practice is lower than during random practice. Basically, during random practice, when an athlete is forced to work through various skills presented randomly in a single training session, he/she must necessarily make an adaptation of the cognitive system so that he/she can execute appropriate motor patterns, upon demand. This would require an identification of similarities and differences among tasks before designating which motor pattern applies.

The Elaboration Hypothesis is often used to explain this phenomenon.This hypothesis states that when a learner performs a series of separate skills in a random order, he/she is able to compare and contrast the different skills and as such recognizes the similarities and differences between the skills. As a result of the understanding and feeling of how each movement is distinctive, the learner is able to store the movement more effectively within his/her long-term memory. In contrast, during blocked practice with repetitive motor patterning, the athlete effortlessly relies onlyon memory and automaticity of movement to execute the task.So the adage "Short term pain for long term gain" seems to hold true for the random practice design, while "Practice makes perfect" seems to be true for the blocked practice design.

Consequently, blocked practice leads to better performance during training sessions, making athletes and coaches have a false sense of confidence that is shattered during competitions, where predictability and rote learning are not guaranteed. The study by Simon and Bjork (2001) advises coaches who are often of the view when their athletes are making progress in training they are learning but when they are struggling they are not learning. This kind of thinking perhaps misleads teachers/coaches to often push athletes toward training conditions that are far from optimal. This is often marked by high intensity block practices without reference to the notion that because the task and goal are exactly the same on each attempt, the learner simply uses the solution generated on early trials in performing the next skill trial eliminating the learner’s need to solve any problem on every trial and the need to practice the decision-making required during a competition. Accordingly, blocked practice is useful in the fundamental development of some skills, although it produces an artificially high level of performance initially giving coaches and players a false sense of accomplishment. Indeed, blocked practice produces effective performance during early stages, but does not create lasting learning. Therefore, the utilization of random practice is advocated once players have become familiar with the skills. Practice of multiple tasks in a random (high contextual interference) practice schedule will result in greater retention and transfer than tasks practiced in a blocked practice schedule (low contextual interference). The real success shows up in retention and ultimately in transfer performance of skills.

In conclusion, the beneficial effects of random practice over blocked practice appear to be due to the following factors:

1. Random practice compels the learner to become more actively engaged in the learning process by excluding simple repetitions of actions.
2. Random practice provides the learner with opportunity to acquire more meaningful and distinguishable memories of the various tasks, thus increasing memory strength and decreasing confusion among tasks.
3. Random practices are proven to be superior to blocked practices with regard to retention of learning and better performance over time.
4. The random practice design does not lend itself to better performance compared to the blocked design on the day of practice. In other words, the athlete and coach will notice poorer initial practice performance within the practice setting. However, the athlete will perform the skills more effectively in the next practice session compared to the blocked design.

5.3 Recommendations

In view of the above conclusions, it is recommended to sports coaches, teachers of physical education in Senior High Schools or researchers in this domain among others that:

1. If the main objective is to improve upon students' ability to retain and transfer skills they have learnt into more competitive or real-world settings, then the random practice method would produce much higher performance outcomes.
2. If the main objective is merely to acquire technical skills for acquisition assessment purposes then the blocked practice approach would produce much superior outcomes than the random practice method.
3. Teachers and coaches should have adequate knowledge of the solution-generation process in the learning of sports skills since previous studies on the elaboration hypothesis shows that durable memories for tasks increase performance capabilities of learners as evidenced in retention and transfer.
4. More research on these two competing teaching and coaching methods should be conducted to help teachers and coaches understand the complexities associated with the learning of new sports skills and relearning or refinement of previously learned skills by athletes.

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