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The Inclusion Of Biomechanical Principles When Coaching Handball To Enhance Performance In Secondary School Athletes In The Goromonzi District

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DECLARATION

This dissertation is confirmed to be my original work and has not been presented for a degree in any other university. The dissertation has been complemented and referenced. Text, data, graphs or tables have been borrowed from other works like internet sources which are specifically accredited with referencing in accordance with antiplagiarism regulations.

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DEDICATION

I dedicate this thesis to all the coaches and athletes who participate in the game of handball;

ABSTRACT

Motivation and support are keys to success, they play a crucial role in setting the goals of secondary school sports. This study focuses on enhancing performance in handball athletes through the application of biomechanical principles among secondary schools in Goromonzi district secondary schools participated in the study. Eligible participants were given consent forms based on their availability at the stations, they were given questionnaires based on the study and were instructed on how to fill out the questionnaires so that they return them completed. At the next session, all questionnaires were received. while executing skills as they were instructed by their coaches during the training. Key factors affecting the performance of handball in secondary schools in the Goromonzi district might be a result of lack application of biomechanical principles, and limited access to resources and facilities. Based on these findings, confidence-building exercises an application of correct principles during the raining sessions will change their performance positively. The application of biomechanical principles can be an effective way to enhance performance among secondary school handball players in Goromonzi District. Practical recommendations from this research emphasize the application of the principles by coaches. There is a need to Future research should involve conducting studies in line with other sports to explore the positivity of application of biomechanical principles in handball among secondary school athletes.

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CHAPTER 1: PROBLEM IDENTIFICATION AND FORMULATION

1.0 Introduction

This chapter presents the background to the study as well as articulating the statement of the problem. The chapter highlighted the formulated objectives as derived from the central problem and corresponding research questions presented. The significance of the study was explained, highlighting possible beneficiaries of the research.

1.1 Background to the study

The notable progress that has so far been made in the sporting world is attributed to numerous research findings which were and are still being carried out to improve performance. Hall (2009) postulates that modern world sport success is guided by one' s knowledge of different new discoveries and scientific principles that form the basis of excellence. Performance is becoming more complex due to new knowledge being explored and applied. To that effect, research activities in order to meet these new challenges have become essential. Laban (2008:7) rightly posits that, the necessary ' feel' for biomechanical ideas cannot be achieved by textbook study and paperwork. Simple experiments to illustrate each step of the development are essential. The scope of biomechanics through scientific studies is to enable athletes realize their optimal physical potential hence become the researchers' obligation.

Sport, world over and in Zimbabwe particularly, is becoming a fast growing industry, such that the skills taught to the youth and upcoming athletes should seek to prepare them to become useful products of the education system when they join the elite sporting world. It is therefore essential to ensure that skills taught to primary school athletes contain important elements that are practised at high levels of competition. Looking at the way Zimbabwean primary schools' handball athletes execute passes, there are clear indications of a lack of technical efficiency. Kimmet and Auty (2003) propound that the primary goal of biomechanics is to improve performance. The official rules and equipment used at any level of handball competition, primary school inclusive, are the same; therefore, the efficiency in skills execution should be more or less the same. It therefore follows that primary school handball athletes can as well master the techniques that separate their performance from that of elite athletes if biomechanical principles are applied as accordingly.

Biomechanics is a core discipline in most physical activities (sporting undertakings) because it is regarded as fundamental in the exercise. McGinnis (2004:4) defines Biomechanics as the "branch of science concerned with understanding the interrelationships of structure and function of living beings concerning the kinematics and kinetics of motion." This field involves the description and the study of human movement causes (Knudson, 2007). In accordance of Hall (2007), it is the application of mechanical principles in the study of living organisms.

Few tours to the areas where handball was played (pre-tournament friendly matches in the Rusike cluster), the researcher noticed that there are several factors affecting skill acquisition that are directly related to the lack of practising and installing principles of biomechanics. Trainers and coaches at times assume that every player knows all the basics and start implementing their coaching knowledge at a certain level which is a bit complex for athletes. This brought challenges in the mastering of some skills by the athletes without the basic skills. For example, a player would be asked to perform a pivot skill while she has not been taught the correct coaching points used when performing such a skill.

Some trainers can do more oral instruction and less demonstration during their training or coaching sessions. Players experienced just a little time of being assessed, evaluated and corrected. The researcher noticed that the athletes had been experiencing some injuries, affecting them in their port performance. These injuries included dislocations, torn muscles and even sprained ankles. According to Knudson (2007), human performance can be enhanced in many ways as their effectiveness encompasses anatomical factors, neuromuscular skills, psychological capacities and cognitive abilities. Biomechanics is essentially the science of movement technique and much tends to be utilized in sports where technique is a dominant factor rather than physical structure or psychological capacities.

Biomechanics in sport incorporates detailed analysis of sports movement to minimize the risk of injury and improve sport performance. Hence, the researcher is more concerned with the need to minimize injuries and enhance skills among handball athletes.

At a Primary School of concern, the researcher had to trace back the team' s achievements for the past years. It was position 4o out of 5 schools at a zonal level. It was also noticed that for some years no players were selected to represent the team at the district level. The problem was identified as the researcher had conversations with the zonal sports directors, team captains, team

players and other teaching staff in sport. Handball was noticed that it was a sporting discipline not well participated in the school, most probably because coaches and trainers did not live up to the expectations. Training of the team was just done in the name of duty. This might mean that the player trainers failed to implicate the biomechanical principles in handball. Some of the Players had to retreat due to the injuries sustained. Judging from the team' s performance, there might be a fact that biomechanical principles were not implicated in sport. Trainersho have limited knowledge tend not to know what they train. This will end up leading to incompetence in a certain sport and athletes may perform poorly. The researcher' s concerns were raised as he observed how badly the team competed during the pre-season/pre-tournament friendly matches against the neighbouring schools. He realized there was a wide gap between the athletes and the biomechanical principles to instil proper skill mastery. The researcher privately investigated the cause of that gap and learnt that most trainers were too busy for the teams; as a result, the athletes with little or no knowledge began training sessions on their own.

In this view, the capacity to practise technically efficient skills pre-exists in young athletes because they can reproduce models of performances that they copy from their role models in competitive sport. What is only required is to set the correct models for imitation during training and apply the biomechanical principles to improve their performance. Grisogono (2011:421) however claims that the question of whether the study of biomechanics is valuable in today' s world is debatable.

Although authors have written textbooks about biomechanics and handball in general. It is against a backdrop that this research was carried out to justify the use of applied biomechanics to improve primary school handball athletes technical efficiency in the two-handed over head, chest, bounce and one-handed shoulder pass.

1.2 statement of the problem

Sports coaches naturally want the best for their athletes to help them improve their performance and reduce their risk of injuries. Biomechanical principles and research should be the primary sources of knowledge used in qualitative analysis and improvements of sports. The use of biomechanical principles in any activity especially in Primary Schools is considered to be very crucial as it is the fundamental level during which the basic skills shaping an athlete into a world-class start is developed. Biomechanical principles and their application establish a basis of

understanding how things work, predicting the results of an effort and ultimately influencing learners to behave the way trainers want. According to Jansen (2001), in a real-world setting learners often gain knowledge through experience and social interaction rather than direct instruction. When the coaches/trainers bring in specified coaching points, adequate demonstrations, quality assessments and proper evaluation their athletes are likely to link with them. Hence, the problem of poor skill acquisition is averted. The use of direct instruction in the training grounds discourages learners' creativity, ability to learn, improvisation skills and eagerness to learn more. However, there will always be a gap when scientific principles make the difference between basic skill and technical efficiency. Against this backdrop, this study seeks to incorporate biomechanics into the handball game with the view of testing its applicability in the improvement of primary school handball athletes' performance.

Primary Research Question

How can secondary school athletes improve their technical performance in the Goromonzi district?

1.3 Purpose of the study

The study was conducted to improve performance in the execution of the two-handed overhead pass, chest pass and the one-handed shoulder pass through the application of biomechanical principles among primary school handball athletes.

1.4. Subsidiary Research questions

1. Which are the common biomechanical faults among primary school handball athletes in their skills execution?
2. What corrective biomechanical measurs can be taken against the identified faults in athletes' skill execution?
3. In what way does applied biomechanics improve the athletes' technical efficiency in executing the handball skills

1.5 Research objectives

1. Determine common biomechanical failures among primary school handball athletes in the execution of their skills.
2. Evaluate what corrective biomechanical measures can be taken against the identified failures in the execution of athletes' skills.
3. Determine how applied biomechanics improves the technical efficiency of athletes in the execution of handball skills.

1.6 Importance of the study

By practising techniques that are more or less similar to their role models, athletes will gain booming confidence that will give them a great command of passing and the game of handball game as a whole. Performing highly refined passing skills will enable them to enjoy performance superiority over weaker opponents. In this regard, their self-esteem and self-actualization will be fulfilled through handball. Athletes will be in a position to match any standards of play as they mature in the game without difficulty. Thus they will be exposed to the realms of handball skills that will enable them to make a smooth transition from school life competition into the competitive elite world. With improved skills, athletes will, hopefully, be self-reliant individuals in later life.

As is demanded by the contemporary sporting world, it is hoped that this research will help coaches acquire invaluable knowledge of approaching the handball game from a scientific perspective. Primary school coaches will therefore expose the athletes to the realms of the game at an early age. Coaches will also acquire knowledge of other biomechanical benefits that will improve their own performance in their coaching as well as their athletes' passing skills.

This research seeks to make the school a place where ' raw' athletes are ' processed' to become competitive ' products' who can progressively realize their full potential. It is hoped that this research will equip schools with literature on passing that is not only modern but meaningful and usable in later life. The same knowledge will also play an important role in moulding formidable school handball teams. Sport nowadays provides recreation and entertainment for the majority of people of all age groups. It is therefore hoped that with

improved performance, the primary school handball athletes will provide entertainment and recreation to the community and more importantly, initiate the appreciation of the girl child by wider society. The researcher desires that the community club members will also use the findings of this study to perfect their own skills since the improvement of skill using biomechanics applies to any level of the handball game.

Since no research has been carried out on the use of applied biomechanics to improve primary school primary school handball athletes' passing skills, this research will open avenues for other researchers to probe into the use of biomechanics to improve skills not covered by this study It will also enable other researchers to find more knowledge about other scientific aspects that may be implemented to improve similar or other skills of young athletes in handball and sport in general.

1.7 Summary

The chapter mainly focused on the problem and its setting. It looked at the background of the problem, the sub problems and the significance of the study.

CHAPTER 2 REVIEW OF RELATED LITERATURE

2.1 Introduction

The central objective of this chapter is to review the literature related to the problem under study. In order to extrapolate ideas from previous researchers, the chapter reviewed related literature guided by the subheadings like: understanding biomechanics, the common biomechanical faults among primary school handball athletes, corrective biomechanical measures and the incorporation of biomechanical principles to improve the athletes' technical efficiency in executing the handball skills.

2.2 Understanding biomechanics

A number of research findings have affirmed that success in sport is based on the conglomeration of scientific bodies of knowledge. Bizley (2006) highlights that the control of movement which contributes to an effective and efficient technique is a key requirement for success in sport. It therefore becomes obligatory for the researcher to establish the best scientific solutions that counteract problems which deter quality performance. Kanhukamwe and Tapera (2003) expound that, just as physiology is the scientific base for training, biomechanics is the scientific base for technique.

Considering the above mentioned facts, the central objective of this chapter is to review on findings of other researchers and authors to the influence of biomechanics on the improvement of handball passing techniques. This chapter is going to reveal the general influence of biomechanics, maintaining stability, force application, factors influencing projectile motion, accuracy and movement analysis in the two handed-over head, the chest, the bounce and the one-handed shoulder passes and the ideal stance for all passes. Since the research is going practically engage biomechanical principles to improve passing techniques, common faults will be revealed as each passing skill will be looked at.

2.3 Theoretical underpinnings

2.3.1 The general influence of biomechanics on performance

The primary goal of biomechanical analysis of sport is to improve performance in sport and exercise. Biomechanics as Kane (2007) posits, applies mechanical principles and mathematical technique to the investigation of the whole body action. To that effect, so authors like Beashel

and Taylor purport that the application of biomechanics forms the basis for the understanding of the control of human movement. Thus, biomechanics analyses and provides predictive outcome of a particular body action which can be improved or corrected to come up with desired body movement. Therefore the research aims that, basic understanding of the principles of movement can help to identify and correct problems with technique.

Passing in handball is reliant on technique and a smooth flow of human movement. In order to come up with technically efficient methods of passing, coaches must have a biomechanical understanding of the flow of work into and out of the human body. Biomechanical methods of training should commence at an early age of the athletes' life. In concurrence, Pangrazi and Dauer (2015) expound that young athletes should be taught to analyse their own performance by applying some of the biomechanical principles. There need to select aspects of the laws of mechanics which are relevant to handball passing and systematically apply them in order to improve the athletes' technique at an early age.

2.3.2 Maintaining stability

To be able to perform a pass in handball, the body must be in a stable position that allows free movement of all body parts before, during and after applying force. One common cause of poor passing observed among young handball athletes is that, during the execution they adduct their hip joints probably for fear of violating the foot fault rule. As a result they stumble after releasing the ball thereby disrupting the smooth flow of movement. The force that will be applied behind the ball will be inadequate to compliment a good pass. Research indicates that stability has a supreme role in the successful performance of any sporting activity. This mean that, Stability reflects balance and equilibrium which affect performance of any sport.

It is for these reasons that Bucher (2013) proposes that a stable base is necessary when one is applying force to a projectile. Most research studies have revealed suggestive principles of equilibrium as a possible solution to maintaining balance. The principles' implications can be applied to improve performance in handball passing.

2.3.2.1 Principle of Equilibrium I

Davies et al, purport that the principle states that, the nearer the line of gravity falls to the centre of the base of support the greater the probability of maintaining balance.

Accordingly, what causes the stumble is that the line of gravity is easily displaced from the base' s centre because of the poor stance that the athletes adopt. There is therefore need to correct the stance and this can be achieved by applying Principle II

2.3.2.2 Principle of Equilibrium II

The principle states that, the probability of maintaining balance is increased when the centre of gravity is lowered in relation to the base.

It is recommended that knee joints should be flexed slightly as one executes a throw. By so doing, the centre of gravity would be lowered, thus increasing the probability of maintaining stability. Laban (2010) also argues that this action is vital in executing any pass as it brings the whole body into action.

2.3.2.3 Principle of Equilibrium III

The principle stipulates that; the further one body segment moves away from the line of gravity, the greater the probability of losing balance, unless another segment moves to compensate for it.

Notably, during the execution of the one-handed shoulder pass particularly, athletes lose balance because only the throwing arm moves freely. The centre of gravity moves in the direction any part of the body moves. What athletes must be taught is to co-ordinate the use of their arms and legs such that as one part moves away, the other moves in the opposite direction as compensatory action. In the one-handed shoulder pass, while the throwing arm reaches back at the start of action, the non-throwing arm should be in front. In the two handed over head pass, while the upper body moves back, the lower body should start accelerating forwards, Payne and Payne (2001). The compensatory action will keep the center of gravity directly above the base.

2.3.2.4 Principle of Equilibrium V

The principle states that, rotating movement increases stability in throwing, an athlete should start with a forwards motion of the hip and rotate the body thus adding force to the thrown ball.

The rotation is one very important component during throwing as it ensures that the body is in position through the development of a torque. To aid stability, Tarkanian and Warren (2001) argue that beginners should step towards the person to whom they are passing. While the action increases stability, a step towards the intended target improves sequential acceleration of the body parts and athletes also gain territorial advantage.

2.4 Force application

Passing in handball is reliant on applying force which is adequate to set the ball in motion to the intended target. The passes executed by primary school handball athletes, in most cases, are too weak, too powerful or misdirected.

Force is a fundamental mechanical quantity responsible for overcoming an object' s inertia. The effect of force on a body is influenced by the size or magnitude of force, direction and position of application. In this regard, Kane (2007) propounds that Newton' s three Laws of Motion may be used to account for observed phenomena in sport. Laban (2000:19) purports that, rationalistic explanations of the movements of the human body insists on the fact that it is subject to the laws of inanimate motion.

Knowing the implications of the laws will enable coaches to apply them to counteract observed flaws in passing since both bodies (the human body and the ball) must possess adequate motion properties during the execution of any passes. Logically, Honeybourne et al (2006) posit that it is important to let athletes learn to gauge how much force should be applied in any given situation.

2.4.1 Newton' s first Law of Motion

The Law stipulates that ...a body continues in its state of rest or of uniform motion unless a force acts on it.

The situational implication of this law in handball is that to execute any pass, athletes must be able to generate sufficient force from their bodies and transfer adequate motion properties to the ball to complement an effective pass. They also need to make smooth movements that do not negatively affect the point at which force is applied on the ball. Findings by Davies et al (2003) affirm that movement only occurs when sufficient force to overcome inertia has been applied.

2.4.2 Newton' s second Law of Motion

The acceleration of an object is directly proportional to the force causing it and is inversely proportional to the mass of the object and the change takes place in the direction in which the force is applied.

Accordingly, what misdirects most of the primary school handball athletes' passes is the application of force off the ball' s centre of gravity. When executing passes, fingers and thumbs should be well spread. This scientifically ensures that force is applied over the ball' s large

surface area thereby reducing chances of applying force off the gravitational centre. Apart from misdirecting, applying force off the ball' s gravitational centre as Tarkanian and Warren (2001) claim causes some modification to the ball' s flight path due to spin making it even difficult for the receiver to anticipate the flight path of the ball. Cradling faults must therefore be corrected in the execution of each pass in order to counteract the overall pattern of the ball' s movement.

2.4.3 Newton' s third Law of Motion

The law states that, for every action there is an equal and opposite reaction.

The lack of opposition of body parts is one observed cause of gross error in generally all passes executed by the primary school handball athletes. When propelling objects, the co-ordinated use of legs and arms is of significant importance. In line with the proposition of the Principle of Equilibrium III, in a one-handed shoulder pass, the non-throwing arm should act in opposition with the throwing arm, the opposite foot to the throwing arm must also be in front Thomas (2017). In the two handed over head, chest and bounce passes, the upper and lower bodies should also be moved in opposition, Payne and Payne (2001). The action' s double standards enable the body, first, to maintain stability and second, to generate adequate force.

2.5 Accuracy

Accuracy enables a team retain possession of the ball. Therefore, biomechanical techniques that improve athletes' passing accuracy are essential since an effective pass is determined by its accuracy. Thomas (2007) postulates that a good throwing skill requires accuracy and varying amounts of strength.

In concurrence, this is achieved by ensuring that the throwing arm releases the ball at point in the arc at which the point is tangent to the target. The More than one release point correspond to an accurate performance. In the one-handed shoulder pass this action an increased release zone. Athletes must, therefore, be taught to release the ball in a line tangential to the receiver by flattening the arc followed by the throwing arm.

2.6 Leverage

Complementary movement to ensure accuracy in the application of force is of paramount importance. Findings by Bucher (2003) reveal that the efficiency of body movement is made through a system of levers. To that effect, Honeybourne et al (2006) argue that the type of lever

formed by joint plays a crucial role in determining the quality of movement produced. levers can enable one get mechanical advantage by producing either speed or strength. Bucher (2003) postulates that the speed of the throw depends on the speed of the arm which can be increased by lengthening the arm to the fullest. In a chest pass where the speed of release should compensate for the low height and angle of release, leverage should be emphasized to add impetus to the ball resulting in quality passes. In a one-handed shoulder pass where large quantities of force may be required, leverage may be emphasized. With practice, athletes may be taught to manipulate their arm extension to vary the speed, strength and direction of their passes as the situation may demand.

2.7 The follow through

Generally, research affirms that arm extension in form of a follow through is a vital component in handball passing, ...the follow through is the extension of arms, hand and fingers as ball is released.

The follow through increases contact time between the player and the ball which subsequently increases its momentum and gives it direction. It also reduces error and directs the projectile to the intended target accurately. The inadequacy of impetus and accuracy commonly observed in the chest and one-handed shoulder passes may be counteracted by the follow through.

2.8 Factors influencing projectile motion.

An individual through his experience of watching how objects travel in space learns about the probable order and temporal relations of these events.

It is therefore important for coaches and athletes to experience and understand the factors that influence the ball' s flight path. More so, the behaviour of the ball whilst in flight is greatly determined by these factors and understanding them will, to a considerable extent, improve the passes executed by primary school handball athletes.

2.8.1 The speed of release

The greater the speed of release the greater the horizontal range. Accordingly, the speed of release is the principal determinant in the flight time and the horizontal distance that the ball will cover. That is why Bucher (2003) precisely points out that the speed of the throw depends on the speed of the hand at the moment the ball is released.

2.8.2 The angle of release

It determines how far an object will travel. If the angle of release is too high, the horizontal distance that the ball will cover reduces. This so, because the ball will possess more motion properties in the vertical component than horizontally. Inversely, if the angle of release is too low, the vertical component of the ball will reduce and so will the flight time and the horizontal distance travelled. Davies et al (2003) expound that the ideal angle of release is 45 degrees which has both the vertical and horizontal components that are equal.

2.9 Movement analysis

Honeybourne et al (2006) expound that to complete an anatomical and mechanical analysis of a motor skill, one should be able to describe a skill and its purpose, evaluate performance in terms of muscle and joint action and correct the faults where applicable. Laban (2000:18) argues that: The flow of movement is strongly influenced by the order in which parts of the body are set in motion.

In sports, body parts that are strongest and slowest around the centre of gravity must move first followed by the lighter and faster extremities. This accordingly, is known as sequential acceleration. Laban (2000) propounds that movements which originate in the centre of the body then flow gradually out towards the extremities of the arms are generally free flowing than those in which the centre does not move when arms begin to move.

Notably, primary school handball athletes have a tendency to move upper limbs only when executing passes while the centre of the body is almost motionless. This limited action is particularly in contradiction with the stipulations of the Principle of equilibrium V. Analytically, it also lacks the aspect of successive force summation which results in a pass that possesses insufficient impetus, speed and direction transferred to the ball. It is recommended that an athlete should start with a forward motion of the hip then rotate the body to add force to the thrown ball.

Due to slight variations in the flow of movement and different influences of the ball motion in each pass, the research will review literature on the analysis of each pass separately in order to highlight particular biomechanical findings that may improve its execution.

2.9.1 The two-handed overhead pass

One observed cause of failure to execute the two-handed overhead pass among primary school handball athletes is that they exaggerate the arm movement such that the ball is released during the arms' downward motion. In accordance with the stipulations of the factors influencing projectile motion, what impairs the pass is that this action decreases both the angle and height of release. To correct that, Davies et al (2003) assert that an angle of 45 degrees is ideal for the realization of both the horizontal and vertical components. Accordingly, an increase in the height of release increases the horizontal distance that a ball travels. By logical argument, athletes must be taught to release the ball at an angle approximately 45 degrees and combine this with an increase in the height of release. Zvomuya (2003) therefore posits that the ball should be released as the elbows straighten just above the head. Barker (2001) expounds that to add impetus to the ball, the arms, wrists and fingers must direct the ball with a powerful flick action. The same further proposes that there should be more of recoil from the powerful flick action instead of a follow through. It is therefore accurate to conclude that there is very little follow through in this type of pass.

The two-handed overhead pass provides a natural way of executing lob passes. As pupils practise using this pass they will also explore its advantages as a pass that is also purposeful in getting past a defender. This pass is achieved by placing the hands under the ball. The high flick action that completes the action will direct the ball upwards. In accordance with Newton's first Law of Motion as cited by Davies et al (2003) the ball will accelerate in the direction in which the force is applied. It should however be emphasized to the athletes that there should be some amount of force directed towards the receiver. If more force is applied upwards it would imply that the angle and height of release will have been increased. This accordingly would mean that the ball will gain more in the vertical component and less in the horizontal.

Another common flaw observed in the execution of the two-handed overhead pass is that young athletes tend to swing arms and the ball over the side of the line of the body. As a result, the ball travels towards the direction opposite the shoulder over which the ball goes because that is where more force is generated from. To that end, it loses strength, speed and accuracy. The main emphasis to correct the fault is to teach the young athletes to ensure that the arms' joint action is along the sagittal plane Thompson and Floyd (2004). The arms must move directly over the line of the body. This action ensures that the ball travels along in a straight path towards the receiver. Advantageously, if the thrower is facing the receiver, the ball will travel towards them. The

smooth movement may also reduce the chances of injury to the shoulder girdle as inappropriate force application may also lead to injury. Grisogono (2001)

2.9.2 The chest pass

Notably, primary school handball athletes have a tendency to hold the ball with fingers cradled forwards. As a result it travels in the direction of force applied by the most powerful arm. Lacking in accuracy and strength, the pass may not reach the receiver or otherwise reach below waist level, making it difficult for the receiver to control. Hoy and Carter (2000) expound that beginners must first learn and master cradling the ball with either sides. The All Australia Association Handbook (Undated) states that both hands should be behind the ball. Barker (2001) adds that the palms of the hands should face inwards with both thumbs pointing downwards at an angle of 45 degrees. The ball must be drawn to the chest by rotating the forearms to ' roll' the ball to chest height. It suggests that the pass is executed from a low height of release. According to the factors influencing projectile motion cited in Hall (2009), if a ball is released at a low height it has reduced flight time, vertical and horizontal components. There is therefore need to compensate for these reductions.

The decrease in the height and angle of release in the chest pass must be compensated by the speed of release. Davies et al (2003) assert that the greater the initial velocity the ball possesses, the greater the horizontal distance it will cover.

Thomas (2007) claims that the wrists should be snapped as fingers and thumbs push the ball with a vigorous flick. Snapping the fingers forward such that the index finger on each hand points in the direction of the pass provides additional speed. In another view, the weight transference from the back foot to the front foot by stepping towards the receiver also aids increasing the speed of release. With practice, athletes will learn to manipulate their arm extension, wrist and finger action to vary the amounts of strength of the chest pass as the situation may demand.

2.9.3 The bounce pass

The major problem observed in the execution of this pass by primary school handball athletes is that in most cases, it lacks accuracy as the ball is made to bounce either too high or low for the receiver to control. Davies et al (2003) posit that during a backspin, the friction force propels the ball backwards such that the angle of rebound increases. Accordingly, a ball that adopts topspin

will realize a force that propels it forwards such that the angle of rebound decreases. Therefore athletes need to be taught arm action that produces a ball adopting a backspin. In line with afore-cited assertion, it means that the ball will gain vertical velocity such that it will rise after contacting the ground and reach the zero point of acceleration around waist level, making it easier for the receiver to control.

To produce a perfect bounce pass, the grip in the bounce pass is the same as the chest pass. The difference is that in the bounce pass, the arms are thrust forwards and downwards with thumbs in after releasing the ball. Tarkanian and Warren (2001) propound that the ball should be released with a snap of wrists and fingers with the palms of the hands facing forwards. For the pass to be more accurate, Hoy and Carter (2000) advice that the ball should aim to bounce off the ground at appoint approximately two thirds between the thrower and the receiver. The distance is approximately a point which enables the ball to have an oblique impact and by the time it gets to the receiver, it realizes a gradual decrease in vertical projection to almost zero at the maximum height of the rebound, the ball should be received between knee and waist height.

2.9.4 The one-handed shoulder pass

The one-handed shoulder pass is ideal for long range passes because of its increased height of release in combination with the 45 degrees optimal angle of release. However, the faulty components observed in this pass were that of inadequacy of impetus and accuracy. This may be due to the fact that the pass is executed using one arm which may be difficult for primary school handball athletes.

Due to large amounts of force required in the execution of this pass, athletes must first adopt a stable stance by broadening the base of support with the foot opposite the throwing arm in front, to increase the base towards the direction of force. Inorder to maximise velocity of release, athletes must be taught to reach as far backwards as possible while attempting to accelerate the lower body forward. This action according to Davies et al (2003) increases the distance and time over which the final delivery force will be applied.

Leverage is of supreme importance because by increasing the force arm through arm extension, as Honeybourne et al (2006) argue, athletes will also transfer significant force that will enable the ball to cover long distances. The transfer of weight from the back to the front foot must also be done in order to first, develop a torque and second to generate force as stipulated by the

Principle of Equilibrium V. It also ensures that the body is in opposition. Newton' s Third law of Motion suggests that for any sporting activity to be successful body parts must be moved in opposition.

Accuracy is also very vital in this passing technique. Athletes must be taught to flatten the arc followed by the arm during the throw and release of the ball at the point tangential to the receiver, Bucher (2003). This action. The Handball Association Handbook (Undated) expounds that to aid accuracy, the shoulder opposite the throwing arm must point to the direction of the pass. The final action of the wrist and fingers' snap must give the ball a backspin.

2.10 The ideal stance for all passes

The propose that feet should be shoulder width apart or the other may be in front. Thus athletes will be creating a stable base according to the stipulation of the Principle of Equilibrium II. Knees must be slightly bent, to lower the centre of gravity as suggested by the Principle of Equilibrium III. Toes must point forwards with weight on the balls of the feet and head up so that the athlete may see who to pass the ball to. The back must be reasonably straight to ensure that the weight of the body is directly above the base of support as stipulated by the Principle of Equilibrium I. The hands and in this particular stance, must be ready for action. The stance allows the body to move equally well in any direction without losing stability. Advantageously, the athletes will be able to select from a number of options, who to pass to and deliver the pass accurately.

2.11. Incorporation of applied biomechanics improve the athletes' performance in executing the handball skills

Handball is one of the most common team sports played throughout Zimbabwean primary schools. It is a physically demanding dynamic sport that requires a high degree of strength, flexibility, speed and fitness. With an increasing number of young non-elite athletes engaging in high demand sports there is an increased risk of injury. Injuries result in reduced playing time and potentially end the season early for sports participants. Additionally, injury in youth may have longer term consequences that limit participation in sport and reduce general physical activity. McGinnis (2013 says Handball exposes the lower limb to high impact forces, particularly during jumping and landing. The lower leg, knee, ankle and foot are amongst the

most common sites of injury among young athletes. Knee injuries are highlighted as being the most severe in relation to disability and ongoing healthcare related costs.

Traditionally, pre-participation and performance assessments are used to assess athletes prior to activity. Results from these screens are often used to create functional or performance goals, however they may fail to address the individual' s specific biomechanical needs. Performance tests often fail to evaluate the quality of movement in an individual' s performance and little consideration is given to faulty movement patterns that may limit performance and predispose the athlete to injury. The way an athlete activates their muscles and moves influences how a joint is loaded and potentially the associated risk of injury. Several authors have suggested the best time to test movement quality in landing tasks is in youth athletes as it represents the best opportunity for establishing good habits and maintaining good movement patterns throughout a playing career. It should however be noted that the current evidence linking assessments

of movement quality to injury risk and/or athletic performance is somewhat unclear and depends on the movement task/assessment tool being investigated. From several perspectives including continued player development, appropriate coach development and financial cost there is a clear need to understand the movement quality and landing techniques of primary school handball players.

Biomechanics can play a crucial role in performance enhancement. It is important for athletes of all ages and skill levels to understand the importance of education to develop proper mechanics. Education can come in multiple forms, but with the emphasis on the visual learner in today' s society, visual feedback is one of the most effective ways to modify an athlete' s technique and allow them to perform at the most efficient level possible. An athlete' s ability to perform efficiently and injury free are two key features in performance outcome and can both be improved with Biomechanical analysis.

2.12 Summary

This chapter reviewed literature pertaining to the general influence of biomechanics on performance. The aspects of maintaining stability, force application, and projectile motion which are essential biomechanical components in executing handball passes were reviewed as well. Literature was also reviewed on how performance can be improved in handball. The chapter highlighted common faults among primary school handball athletes and sought to establish what

other authorities have found out as regards to how techniques can be corrected and improved. This chapter thus reviewed literature on the movement analysis of the two-handed overhead, the chest, the bounce and the one-handed shoulder passes. Lastly, the chapter presented the ideal stance that athletes may adopt when they execute either of the reviewed passes**.**

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter is going to describe the research design, choice of population, sampling procedure, research instruments and their justification, how the instruments were administered and how data were collected and analysed.

3.2. Research methodology

This study largely used mixed methods research of interventions nature. Mixed methods research is a contemporary research design that engages both qualitative and quantitative approaches of gathering data with a number of advantages that goes with it. Accordingly, enumerated advantages encompass the increase in the accuracy of data and that it provides a more complete picture of a phenomenon under study than would be yielded by a single approach. It also aids sampling where questionnaire might be used to screen potential participants who might then be approached for interview purposes.

According to Yin (2011), mixed methods research design is credited for generating well balanced data from various data sources thereby reducing bias and increase credibility of findings. Thus, the generating of both primary and secondary data in this research study using both qualitative and quantitative methods had a positive effect of increasing the validity and reliability of research outcomes.

3.3 Research design

This researcher chose a case study design. With regards to the phenomenon under this research study notably a primary School' a combination of data solicited from qualitative and quantitative paradigms generated balanced data that resulted in accurate and reliable research findings. Although critics of the case study design argue that data handling from this research is challenging as (Green 2003) also acknowledges, the merits of this design far out- weigh its demerits. There are a number of advantages for using a case study research design which include its ability to allow ideas and hypotheses to emerge from careful and detailed observation; allowing for exploration of solutions for complex issues and the gaining of new knowledge and skills. As one of its main components, the case study seeks a complete understanding of a social

phenomenon through the researcher's immersion into the situation. In the study, the researcher studied a group of handball athletes by observing their behaviour before, during and after being exposed to biomechanical principles and how this ultimately influenced their technical efficiency in passing.

3.4 Population

In terms of this research, the population comprised of netball 632 learners and 15 teachers at the school under study. The school is situated in Gorormonzi District. Since the population was too large.

3.5 Sample

This study focused on one Secondary School handball athletes. For the purpose of this study the sample was drawn from a total of eighteen athletes from the school teams. Fourteen athletes were selected.

3.6 Sampling procedure

For the generalization purpose, stratified random sampling was used. In order to come up with an optimum sample which could fulfil the requirements of reliability and representativeness, the following steps were taken. With the help of the coaches, two athletes were drawn from each group, the best and the weakest. These athletes were put into categories. Category A made up of the best and Category B made up of the weakest. Athletes were numbered 1-14.

3.7 Research instruments

For the purpose of this study, the researcher used some instruments which provided primary information and was very suitable for the study. These instruments enabled the researcher to generate credible and well balanced data since both primary and secondary data were availed from purposively selected respondents and data sources.

3.7.1Questionnaire

In view of this, the researcher distributed questionnaires to all the respondents used in this study. The questionnaires had both closed and open ended questions to be answered by respondents. The closed questions facilitated ease quick answers while the open ended type were meant to solicit finer details of data from respondents.

The questionnaire was deemed suitable for this research study for its ability to collect large amounts of data from a number of respondents within a short period of time and in a relatively cost effective way. It was also selected by the researcher for its capability to produce consistent and standardized data from which validity and reliability is ensured.

However, one disadvantage of the questionnaire was its inability to capture qualitative data about respondents' behaviour and change of emotions which could best be done by the face-to-face interviews. In an effort to down-play the effect of this demerit, the researcher employed observation in the research study to counter balance final outcomes of the research study.

the enhance understanding and access to required data, an attribute which the questionnaire shares with no other research instrument.

3.7.2 Observation

Observation is done on spot to elicit information directly observing actions and not passing or receiving information from the respondent. Data can be collected numerically or from feelings of respondents. Therefore the observation instrument is quantitative and qualitative in nature.

The researcher by observing events, first-hand information was gathered and that provided reliable information. A minimal resources and time was used by the researcher as data was collected directly from the source and these are the advantages of using the observation method

The researcher concentrated much on observing and recording actions as they do not repeat. Participant behaviour changed as they noticed that they were being observed. Thus the observer had limited control of the situations under observations. These are the disadvantages of using the observation method for data collection.

3.8 Data collection procedure

It assisted the researcher to gain credibility from the respondents. The researcher had to create a good rapport with the respondents in order to dispel fear and suspicion. The coach also explained the purpose of the study and assured respondents of confidentiality of information.

Questionnaires were personally distributed to the coaches and athlets for completion and they were collected soon afterwards. Interviews were personally conducted on a face-to-face basis with the athletes, coaches and managers. . Observations were made during training sessions.

Data were also collected by way of observation. Observations were made at the beginning, midway and at the end of the study to identify the common faults and the effects of the experimental factor. Each athlete was given 10 chances to execute a pass each time an observation was made. For a movement that was correctly performed, a tally would be indicated under the ‘ correct’ column and no tally would be recorded for an incorrect performance. If the tallies in the ‘ correct’ column outnumbered those under the ‘ incorrect’ column, two scores were awarded. If the tallies on both sides were equal, one score was awarded. No score was awarded if the tallies under the ‘ incorrect’ column outnumbered those under ‘ correct.’ A total score of the observed movement for every passing skill would be indicated on the last column of the observation sheet used each time.

3.9 Data presentation

Data collected were tabulated and presented in thick descriptions. The tables presented group mean performance ratings obtained each time an observation was made. Graphs were also used to represent group mean values of performance in each pass. The sample table is shown in Fig 3.2.

Fig 3.2 Sample table

Type of pass	**Two-handed overhead**	**Chest**	**Bounce**	**One handed shoulder**
Improvements %	**%**	**%**	**%**	**%**

3.10 Data analysis techniques

Raw data do not provide direct answers to a research.’ In view of such thoughts, there is need to carefully manipulate and analyse data in order to come up with reliable conclusions.

In this research, the researcher, with the aid of what was practically observed, made a comparison between the variations obtaining in group mean performances to reflect on the initial performance of the athletes. Comparison between the differences in group mean performance scores obtained from the first, second and third observations were made to determine the effect of the corrective biomechanical measures taken. Finally, the researcher compared the group mean performance scores obtained from the first and second observations to determine the way

in which the applied biomechanics had improved the technical efficiency of primary school handball athletes in the passing skills studied into.

3.11 Trustworthiness

Quality in educational research requires the researcher to focus on the accuracy of his/her findings. According to Cohen, et al (2007) it must be maintained throughout the research process, irrespective of the paradigm being used. The quality of the research can be achieved if the data are reliable, valid and trustworthy, and are triangulated. According to Lincoln and Guba (2005) trustworthiness allows the researcher to reassure his/her audiences that the findings are valuable and worth paying attention to. The questions asked and the arguments based on the findings need to be effective. Therefore the observation instrument is quantitative and qualitative in nature.

The researcher by observing events, first-hand information was gathered and that provided reliable information. A minimal resources and time was used by the researcher as data was collected directly from the source and these are the advantages of using the observation method

The researcher concentrated much on observing and recording actions as they do not repeat. Participant behaviour changed as they noticed that they were being observed. Thus the observer had limited control of the situations under observations. These are the disadvantages of using the observation method for data collection.

3.11.1 Validity and reliability

Reliability refers to trustworthiness of observations or data, while validity refers to the trustworthiness of interpretations or conclusions. Validity and reliability ensure that the researcher is able to reassure his/her audience about the trustworthiness of the data. The researcher aims at understanding and interpreting the world in terms of those concerned.

Mears (2009)) further argues that validity and reliability in the qualitative paradigm must draw on its credibility, transferability, dependability and conformability to determine the value of the study, both in the process and findings. Credibility of the research findings can be gained through prolonged engagement and persistent observation. This requires the researcher to spend quality time with the participants considering their performance in their competitions. August (2010) suggests that the “ persistent observer can identify the characteristics and details that are most relevant to the issue being investigated” .

3.11.2 Triangulation

Triangulation is used in order to gather the best data, in that qualitative researchers will gather rich description of the interested area. Brewer and Hunter (2006) stated that the multi-method approach allows investigators to " attack a research problem with an arsenal of methods that have non overlapping weaknesses in addition to their complementary strengths" . This multi-method approach covers qualitative research techniques such as interviewing, participant observation and interpretive analysis where different sources of information can be combined to address the same research question. Triangulation is expected to enhance the researcher' s ability and effort to assess the accuracy of the findings and thus assure the reader that they are reliable (Creswell 2009). It adds quality when multiple sources of data are used to study a particular phenomenon

In this study, the semi-structured questionnaires and observations added quality to the research, because the researcher was able to observe the participants in action and observe whether what they had stated in the interviews aligned with their actual practices during the competition. According to Cohen et al (2011) Triangulation will check for consistency in the findings and give the researcher increased confidence.

3.12 Ethical considerations

According to Creswell (2003), the following ethical issues must be considered in the research process; respecting the rights of participants; honouring research sites; and reporting research fully and honestly. Participants were not forced to participate in the interviews and were fully informed of the purpose of the study. For this study confidentiality and anonymity were ensured by the researcher and pseudonyms were used. Participants were informed that their participation was voluntary and there were no rewards or victimization for partaking or choosing not to participate in this study.

It is important that the participants are informed about the purpose of the investigation and what is to take place because this respects the rights of the respondents (Cohen et al., 2011). The research should be able to tailor the explanations so that athletes and teachers easily understand the interview process and what would be involved. The participants were informed of possible risks and benefits from participating in the research project and they were made fully aware that they had the right to withdraw at a time which would be agreed upon.

3.12. Summary

This chapter looked at the methodology that was used to gather data. To come out with a sample for the study, purposive sampling was done. Questionnaires and observations were used to solicit data from the targeted population. The sampled population consisted of 18 respondents that is 14 athletes and 5 coaches. The next chapter will focus on data presentation and analysis of gathered data.

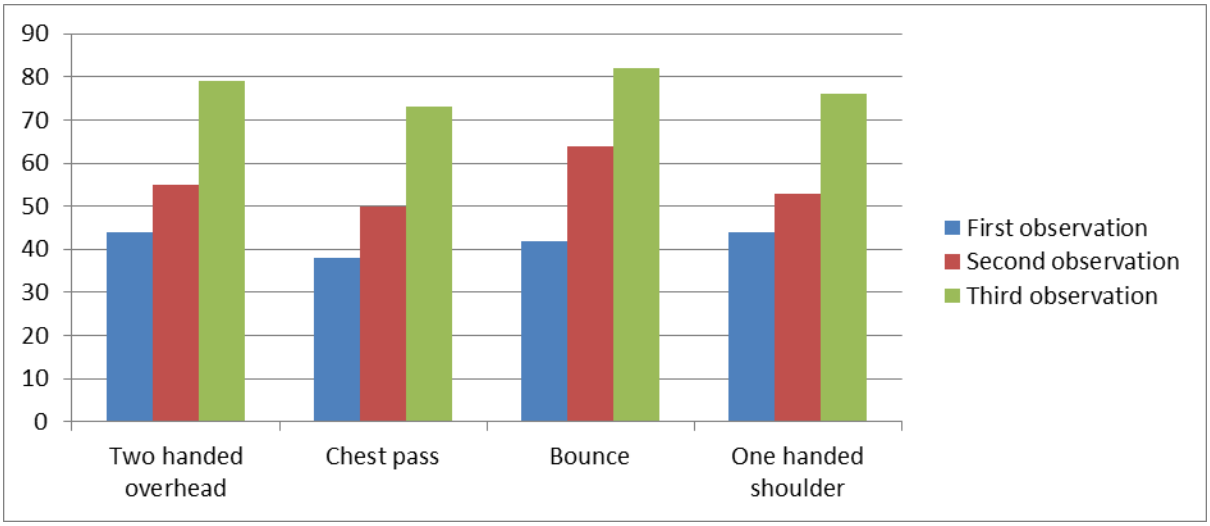
CHAPTER 4

ANALYSIS OF THE RESULTS

4.1. Introduction

This chapter dealt with the presentation, analysis, discussion and interpretation of data collected in the field in order to find the ways of incorporating biomechanics to improve secondary school handball athletes passing skills. Quantitative and qualitative data collected through the use of questionnaires, observations, analyzed, discussed and interpreted in respective sections in the form of tables and descriptions. The analysis, discussion and interpretation of data was done relative to sub-research questions and related literature. The interpretation of data was enhanced by the comparison of group mean performances in three observations made. The performance improvement percentage was used to determine the extent to which applied biomechanics improved the athletes' technical efficiency in passing skills probed into.

4.2 Presenting data gathered from observations



Findings pertaining to the biomechanical faults observed in the first observation

Table 4.2.1 Showing the difference between first and second observation' s findings

Pass	Two-handed overhead	Chest	Bounce	One-handed shoulder
Improvement %	11	12	22	9

4.3.1 Two-handed over head pass

Findings shown in Fig 4.1 reveal that the group' s mean performance was below the minimum expected standard. The group mean score which was 44% was below the minimum expected performance of 50%. The majority of the athletes observably, could not adopt the correct stance. Instead of creating a broader base to increase the probability of maintaining balance as stated in the Principle of Equilibrium II, athletes decreased and narrowed the base by adducting their hip joints. The sequence of force summation was not properly followed and erroneous movement was observed. The athletes would swing their arms and the ball over the side of one shoulder and not directly over the line of the body. In cases where the arms were swung over the line of the body, the majority of the athletes exaggerated the downward motion of the arms during the throwing action. This exaggeration resulted in the decrease of the height and angle of release, resulting in poor low passes. Biomechanically, the observed faults may be attributed to the below average performance score realized.

4.3.2 The chest pass

Notably, the chest pass was performed below the minimum expected performance as the group mean performance score was 38%. This was largely due to very low speed of release. Athletes could not adopt the correct stance, which also affected the sequence of force summation. Observably, athletes did not fully extend their arms to add impetus to the ball. Athletes did not make a follow through after releasing the ball resulting in inadequate contact time between the ball and the athlete. The flick action was not powerful such that the extra strength that the action is meant to add was absent. This lack of complementary arm movements to compensate for the decrease in the height of release meant that the passes would not cover adequate horizontal distance.

4.3.2 The bounce pass

The group mean performance score was 42% which was below minimum expected score and reflective of biomechanical technique deficiency. While some athletes adopted a fair stance, the athletes' arm movement was notably faulty as some made the ball contact the ground with more

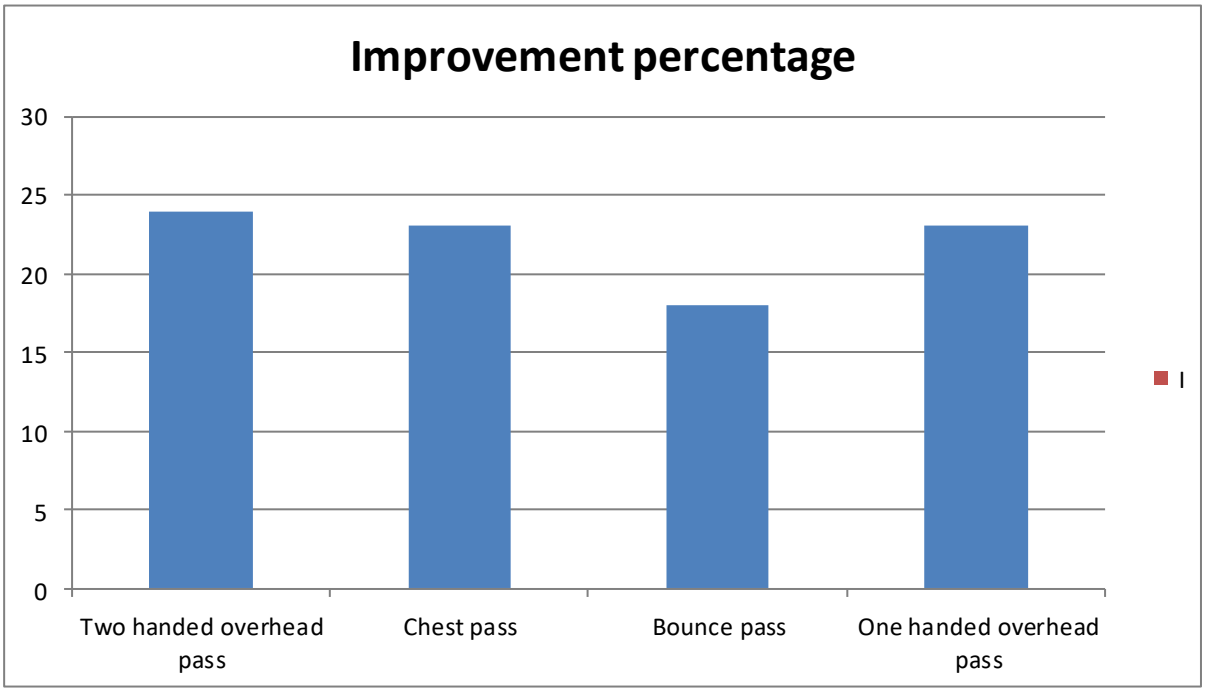
of direct than oblique impact. The majority made their ball either adopt the wrong or too much spin. As a result, the angle of rebound would either be too high or too low for the receiver to control. In worst cases the ball would make awkward bounces which were unpredictable.

4.3.3 The one-handed shoulder pass

The findings reveal a group mean performance of 44% which was also below the minimum expected score. The athletes observably had faulty sequence of force summation. The centre of the athletes' bodies hardly moved, contrary to Laban (1980)' s recommendations that movement should originate from the centre of the body then out towards lighter and faster extremities. The athletes limited the distance over which velocity was transferred to the ball because of insufficient arm extension and follow through. No efforts were observed to increase the release zone and the probability of delivering an accurate pass by flattening the arc as Kanhukamwe and Tapera (2003) recommend. The athletes' body movement had very minimal opposition of body parts. The principal contributing factor being that because of the pass' demand for large quantities of force, the stance that athletes adopted was prohibitive of free body movement.

Generally, the results of the first observation tend to indicate the initial group performance. The results reveal that the athletes' performance was poor due to faulty technique. Since no systematic experimental factor had been introduced, the results seem to indicate that at the beginning of the study, the athletes' performance was generally below the minimum expected score of 50%.

4.4 Presentation and discussion on Third Observation findings pertaining to the corrective biomechanical measures taken for the third observation



4.5.1 Discussion on third observation findings pertaining to the corrective biomechanical measures taken

4.5.1.1 The two-handed over head pass

The performance in this pass doubled the previous observation' s improvement score. Findings reflect a 24% increase. Athletes observably, could manage to make a step towards the receiver, which in effect, ensured that the whole body was brought into action, Bucher (1983). More so, the action increased the probability of maintaining stability. The elimination of the exaggerated arm extension which initially led to poor passes corrected the height of release. Combined with the mastery of the flick action, athletes produced passes that covered a considerable horizontal distance. Mastery of the opposition of the upper and lower bodies enhanced major changes in the sequence of force summation to produce a refined flow of movement.

4.5.1.2 The chest pass

As illustrated in Fig 4.3 the group mean performance improved by almost double the previous improvement score. Major changes observed may be attributed to the mastery of the step towards the receiver. This action enabled athletes to add impetus to the ball. Athletes also managed to vary the length of their arm extension thereby varying the strength of the pass as the situation demanded. The mastery of the complementary actions compensated for the low height of release and saw the speed of release increasing significantly. The findings seem to reveal that the corrective measures taken improved the athletes' performance.

4.5.1.3 The bounce pass

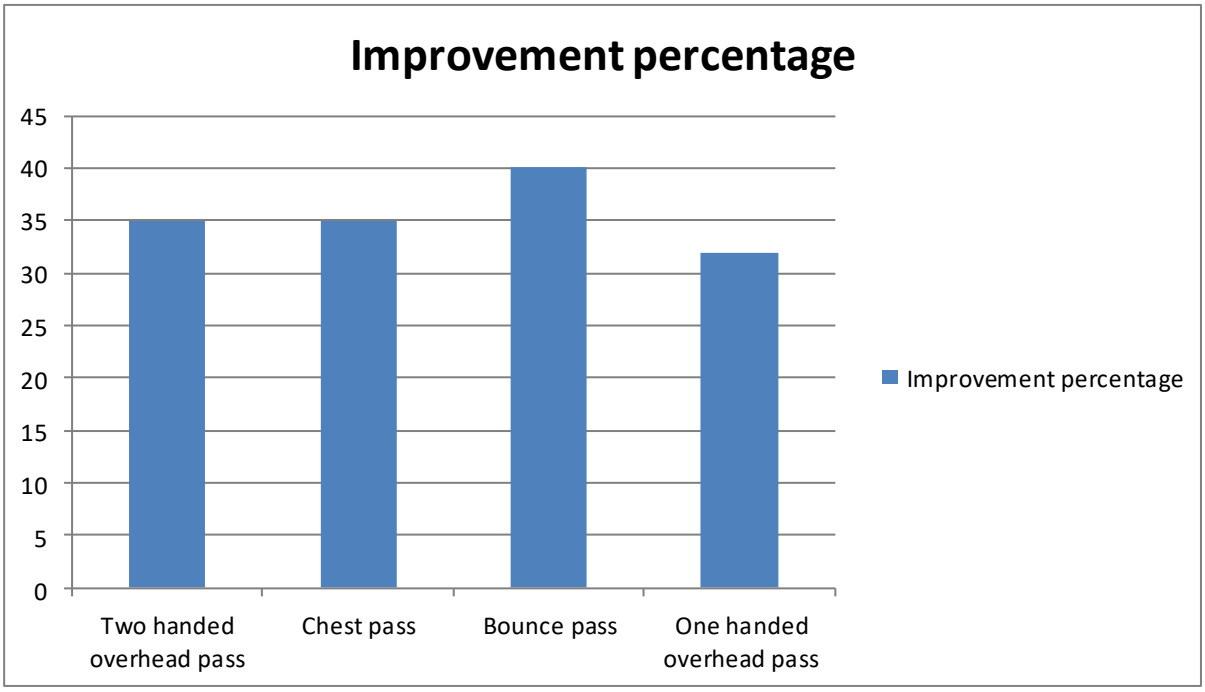
The findings reveal a decline in the percentage of improvement from the previous observation. Major changes were observed in the mastery of bouncing the ball on the ground two thirds away from the receiver. This ensured an oblique impact, which according to Kanhukamwe and Tapera (2003) has a supreme role in the angle of rebound. With an improvement in the amount and type of spin, the thrown ball improved in accuracy as the vertical velocity that the ball gained was adequate and manageable for the receiver to comfortably catch the ball. The 18% was probably due to the refinement of previously acquired techniques. The decline could be a reflection of the fact that athletes had little to gain from the corrective measures or that they mastered much of the principles in the previous observation.

4.5.1.4 The one-handed shoulder pass

Unlike the previous observations, the group mean score improved by 23%, double the performance. Corrective measures to improve on the opposition of body parts played a vital role in bringing the whole body into action. Apart from increasing the probability of maintaining stability, the action may also have influenced an increase in the quantity of motion properties transferred to the ball. The majority notably mastered the technique of flattening the arc which indeed increased the probability of delivering accurate passes. The action had double impact with the follow through to increase contact time. Kanhukamwe and Tapera (2003).

4.6 Findings pertaining to the effect of applied biomechanics on the athletes' technical efficiency

Fig. 4.6.1 Graph presentation on group improvement percentage between first and third observation



Discussion on findings pertaining to the effect of applied biomechanics on the_athletes' technical efficiency

4.6.2 The two-handed over head pass

Table 4.4 and Fig 4.4 show that the group realized 35% performance improvement. Reference to Fig 4.1 reveals that at the end of the study, athletes had reached 9% from the initial 44%. Notably athletes managed to maintain stability during the passing action by adopting the correct stance. They also produced a smooth flow of movement, through sequential force summation, which eliminated the chances of getting injured. The smooth flow also ensured that athletes produced accurate passes considering the changes observed in the height of release and arm movement. A step towards the receiver helped much in bringing of the whole body into action as

well as gaining territorial advantage as this reduced the distance between the thrower and the receiver.

4.6.3 The chest pass

The findings shown in Fig 4.4 indicate that the group mean performance gained by 35% to end at 73% up from 38%. Unlike during the first observation, at the end of the study athletes could adopt a stable stance which allowed free movement of the whole body especially the extremities. The employment of compensatory arm movements such as arm extension, the follow through and the flick action enabled athletes add impetus and accuracy. The athletes could also manipulate their body actions to produce varied passes as the situation demanded. They also gained territorial advantage by stepping towards the receiver.

4.6.4 The bounce pass

Fig 4.4 reflects that the bounce pass realized the highest percentage in performance improvement of 32% to end at 76% up from 44%. The increase in the distance over which force was transferred to the ball, contact time and opposition of body parts improved the horizontal range that the ball covered, which is characteristic of the pass. Athletes managed to manipulate with the contact time and distance of force application to vary the strengths of the passes. The technique of increasing the height of release and a release angle of approximately 45 degrees was also mastered and this reduced the risk of injuring the shoulder girdle while it also increase the horizontal range covered, Kanhukamwe and Tapera (2003). Using one hand, athletes managed improved in accuracy by flattening the arc followed by the arm, Bucher (1983). The step towards the receiver in this pass helped much to absorb the large quantities of force generated by the upper body during the throw, thereby maintaining stability are applied or if they are inappropriately applied.

4.8 Summary

This chapter focused on the presentation, analysis and interpretation of findings in relation to research objectives. The next chapter focused on the summary of the entire research study and the conclusions drawn from the findings. The chapter also summarized the previous chapters and made recommendations based on the study’ s revelations.

CHAPTER 5: DISCUSSION

5.1 INTRODUCTION

This chapter focuses on brief discussion of the results that were presented in the previous chapter. Focus is mainly on the research findings, their summary, other insights that were brought by the results as well as the limitations of the study.

5.2.1 Is there application of biomechanical principles to handball athletes in secondary schools in Gorormonzi?

The results showed the non-existence of application biomechanical principles in the coaching of handball athletes in secondary schools in Goromonzi district. There was a divergence from the results that were obtained from the instruments used to collect data. The results were obtained through questionnaires and observations. Most of the respondents had no idea of application of biomechanical principles to handball athletes in secondary schools in Gorormonzi unless a hint or more explanation was given. Such an opportunity was to be present if interviews were done.

Biomechanics is the science concerned with the internal and external forces acting on the human body and the effects produced by these forces. At the highest levels of sports in which techniques play a major role, improvement comes so often from careful attention to detail that no coach can afford to leave these details to chance or guesswork. Carr (2004). For such coaches, knowledge of biomechanics might be regarded as essential. This area of performance analysis is widespread in predominantly in handball where complex full body movement is required

5.2.2 How effective are the biomechanical principles in the coaching of handball in the secondary schools Goromonzi district?

Indications are that all the passes realized positive gains which reflect a positive effect of the experimental factor. Findings reveal that applied biomechanics improved the athletes' stance and the flow of movement in all the passes. The flow contributed to the mastery of essential passing techniques which were technically efficient and accurate. Thus improved the athletes to be technically competent, feel confident when in possession of the ball and be able to utilize the possession to maximum effect.

Williams and O' Donoghue (2005) assert that handball is a physically demanding involving rapid acceleration, quick changes in direction, sudden breaking, jumps and balance, placing great demand on the body. The study established that biomechanics plays a role in preventing injury among handballers. This is particularly important among young athletes as injuries either temporarily or permanently forces young handballers out of sport.

The findings of the study have shown that biomechanics indeed improves the performance of handball secondary school handball athletes if coaches apply the principles correctly and systematically. The findings have also revealed that athletes' technical efficiency can be positively influenced by applied biomechanical principles. The findings suggest that secondary school handball athletes' technical efficiency in handball passing can be improved if biomechanical principles are effectively used to identify and correct faults. On the contrary, the findings revealed that performance may be slightly improved if corrective measures of little effect are applied or if they are inappropriately applied.

5.2.3 What can be done to improve the application of biomechanical principles in coaching handball?

There is need to engage the sport scientists who have enough knowledge on biomechanical principles and encourage coaches to do continuous and develop new biomechanical applications. There also need to do the tailor coaching to individual athletes.

5.2.4 NEW INSIGHTS

5.2.5 Findings

There has not been a study focusing on application of biomechanical principles in handball athletes in secondary schools which may make the findings, suggestions and framework with new insights that may involve the inclusion of biomechanical principles in handball coaching.

5.2.6 Theoratical Framework

The research findings were used to organise, connect and develop the ideas that have a positive role in the application of biomechanical principles in the coaching of handball in secondary

schools in Goromonzi district. The framework is a blend of efforts that work around athletes struggling to perform well as a result of lacking proper coaching.

5.2.7 Validation of the Framework

Data for validation of was collected through questionnaires and observations after sending them to five coaches in the district which were selected randomly. Their expertise is mainly in handball coaching. The data collected was grouped according to time their responses.

5.2.8. **The Significance of the Framework**

The framework will assist all handball coaches in identifying the correct biomechanical principles to apply when coaching handball at any level for performance enhancement and even prevention of injuries at large.

5.2.9 LIMITATIONS OF THE STUDY

As with the majority of studies, the design of the proposed study is subject to limitations. The study could have used more coaches and athletes but due to the geographical dispersion, the researcher chose to use only five. It would cost the researcher a lot to carry out a research with a lot of coaches and athletes. The researcher therefore used the surrounded coaches and athletes. The researcher needed time to gather more important data on how coaches are operating. In order to manage this, the study involved purposively selected active participants and coaches in order to provide time for accurate physical measurements and gathering of data that satisfies the reliability and validity research expectations.

5.3 CHAPTER SUMMARY

The research questions raised in this study were answered in this chapter. This was an idea to close the gaps between theory and practice. It also created a framework derived from the data collected.

CHAPTER 6: CONCLUSIONS AND RECOMANDATIONS

6.1.1 Introduction

The central objective of this chapter is to summarise the whole research study. The summary provides the purview of the findings revealed in the previous chapter. The chapter explains the study' s proceedings and highlights some of the major problems encountered during the course of the study and the conclusions thereupon. The conclusions sought to provide answers to the research which attempted to establish the extent to which applied biomechanics can influence the technical efficiency of secondary school handball athletes in the two-handed over head, chest, bounce and one-handed shoulder passes. Recommendations as guidelines for coaches and future researchers are presented to mark the end of the chapter.

While physiological factors play a vital role in sport performance, research by Honeybourne et al (1996) affirms that biomechanics improves performance. Although secondary school handball athletes are young, they have the pre-existing capacity to perform or imitate highly refined movement techniques in more or less the same way it is presented by an expert. It is this pre-existing capacity that this study sought to improve through the application of some biomechanical principles to their handball passing skills. A number of research studies have focused more on using biomechanics to improve the performance of adult and elite athletes hence the need to carry out a research of this nature. The research alluded to other findings and sought to establish the extent to which applied biomechanics can influence the technical efficiency of secondary school handball athletes in the two-handed over head, chest, bounce and one-handed shoulder passes. Data were solicited through observing the subjects' responses to the experimental factor. The findings were tabulated, presented on graphs, analysed and interpreted.

During the course of the study, three observations were made. The findings in the first observation revealed that the athletes' initial performance was below the minimum expected standard as the group mean performance for all passes was below 50%, thus lacked technical efficiency. The application of biomechanical principles seems to have improved the athletes' performance since all passes realized some degree of improvement after the experimental factor was applied. Significant changes were noted in the second and third observations. The group

mean performance was used to determine the level of performance during the study period and the variations in each observation' s findings led to the conclusions.

6.1.3 Conclusions

Based on the findings of the study the following conclusions were arrived at. It was concluded that biomechanics can be used to identify common errors among secondary school handball athletes. The findings also led to the conclusion that applied biomechanics can improve the performance of secondary school hantball athletes in the two-handed over head, chest, bounce and one-handed shoulder passes. There are no biological limitations that can inhibit the athletes from practicing the correct techniques. It was also concluded that young handball athletes positively respond to biomechanical principles if they are applied in a rudimentary and logical manner since they are eager to improve their performance.

6.1.4 Recommendations

A number of problems were encountered and new experiences were learnt during the course of this study. To this effect, the researcher came up with some recommendations with the hope that they will benefit coaches and future research studies.

6.1.5 Coaches must first identify common errors in the flow of movement in order to be able to correct them.

6.1.6 Coaches need to select applicable biomechanical concepts relevant to secondary school handball athletes' faults and apply them systematically.

6.1.7Findings have revealed that performance improves with practice, as such, coaches must incorporate biomechanical principles in their training sessions in order to continuously perfect their athletes' technical efficiency.

6.1.8 While biomechanics improves techniques, physiological and motivational factors must be incorporated during practice sessions as without them the application of the experimental factor may yield unreliable results.

6.1.9Refresher courses and workshops on biomechanical methods of coaching must be regularly held for teachers and coaches in order to equip them with biomechanical

knowledge and skills.

6.2Adequate time must be availed when carrying out such studies.

6.3 Chapter Summary

This chapter discussed the findings of the research objectives which were used for this study. It also looked at the conclusions of those findings revealing the researcher' s recommendations that can be implored in enehancement of perfoemance in handball athletes in Gorormonzidistrict through application of proper biomechanical principles at the correct age.

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APPENDIX 1

QUESTIONNAIRE

Introduction

My name is Regis Masara. I am a student at Bindura University of Science Education pursuing a Masters Degree in Sports Science. I am researching on the application of Biomechanical principles in the coaching of handball in schools. I am kindly inviting you to help by responding to this questionnaire. The responses you will give will be organised in such a way that neither your name nor your organisation will be identified Participation in this survey is voluntary.

Instructions:

1. Kindly read and understand the information in all sections.

2. Kindly be as honest as possible when giving your responses.

3. For enquires please don’ t hesitate I will be at your disposal.

4. Tick in the correct box.

5. Do not write your name on this questionnaire.

1, Gender

Male		Female	

2. Age

Below 20		21-30		31-40		41-50		51-60		Over 60	

3. Highest Academic qualifications

No formal Education	
Primary	
Secondary	
Certificate	
Diploma	
Graduate	
Postgraduate	

Single		Married		Divorced		Widowed	

4. How long have you participated in school handball?

Less than 1 year		1-5 years		5-10 Years		More than 10 years	

5.Please indicate the extent to which you agree with the following statements by ticking in the appropriate box

Statement	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
I am applying motion analysis in the coaching handball					

in secondary schools in the Goromonzi district					
I am using the biomechanical principle of force application in coaching handball in secondary schools in the Goromonzi district					
I am using the biomechanical principle of balance and stability in coaching handball in secondary schools in the Goromonzi district					
I use biomechanical principles in coaching handball in secondary schools in the Goromonzi district to identify risk factors and develop training programs that minimize injury risk					
The current levels of application of biomechanical principles by handball coaches in secondary schools in Goromonzi district have a positive impact on athlete performance					

7.What effective biomechanical principles can handball coaches in secondary schools in the Goromonzi District apply to enhance athletes' performance?.

……
……
……
……

Thank you

APPENDIX 2

INFORMED CONSENT FORM

Title of Project: The inclusion of biomechanical principles for performance enhencement in handball athles in secondary schools in goromonzi district

Principal Investigator: [ ]

Participant Information

1. I have read the Participant Information Sheet and had the opportunity to ask the researcher any questions.

2. I understand that participation in this research study is entirely voluntary.

3. I am aware that I can refuse consent and withdraw from the study at any time without any implications.

4. I understand that my participation will be kept confidential and my anonymity will be maintained.

5. I acknowledge that the purpose of this research focusing on performance enhencement in handball athles in secondary schools in goromonzi district by applying biomechanical principles.

6. I understand that my participation will involve attending training session.

7. I understand that the data collected during this study will be used for research purposes only and may be published or presented in academic forums.

By signing below, I confirm that I have read and understood the information provided above and voluntarily agree to participate in this research study.

Participant's Signature: _____

Date: _____

APPENDIX 3

CONFIDENTIALITY AGREEMENT

This Confidentiality Agreement is entered into by and between [ ] ("Researcher") and [……] ("Participant") (collectively referred to as the "Parties") on this [……].

1. Purpose

The purpose of this Agreement is to protect the confidentiality of any information shared between the Researcher and the Participant during the course of the research study titled "The inclusion of biomechanical principles for performance enhencement in handball athles in secondary schools in goromonzi district"

2. Confidential Information

Confidential Information refers to any data, documents, or materials related to the Study that are not publicly available. This includes, but is not limited to, research findings, participant data, research methodologies, and any other information shared between the Parties.

3. Obligations

3.1 The Researcher agrees to:

- Maintain the confidentiality of all Confidential Information received from the Participant.

- Use the Confidential Information solely for the purpose of conducting the Study.

- Not disclose or share the Confidential Information with any third party without prior written consent from the Participant.

3.2 The Participant agrees to:

- Provide accurate and truthful information to the Researcher.

- Treat any information shared by the Researcher as confidential.

- Not disclose or share any Confidential Information received from the Researcher with any third party without prior written consent.

4. Duration

This Agreement shall remain in effect for the duration of the Study and for a period of [……] thereafter.

5. Governing Law

This Agreement shall be governed by and construed in accordance with the laws of [Jurisdiction]. Any disputes arising out of or in connection with this Agreement shall be subject to the exclusive jurisdiction of the courts of [Jurisdiction].

By signing below, both Parties acknowledge that they have read and understood this Agreement and agree to be bound by its terms.

Researcher

[……]

[**Date**……]

Participant:

[……]

[……]

[**Date**……]