

## BIO- MECHANICS IN SPORTS, EMPLOYING FUN PLAY AS A TOOL TO INTRODUCING PHYSICS AS PART OF BASIC SCIENCE AT THE SENIOR PRIMARY SCHOOL LEVEL

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### ABSTRACT

*The study of structure and function of biological systems such as humans, animals, plants, organs, and cells by means of the methods of mechanics described biomechanics. This paper examines the need to encourage physics teaching at the primary school level. In doing this, the paper defines the concept of science, states the objectives of science teaching at the primary schools as enumerated by National Primary Education Commission (NPEC) and discusses the philosophical and psychological basis for its inclusion. Sporting activities that can facilitate the learning of physics concepts were also x-rayed. Finally, the paper among other recommendations, Physics curriculum should be restructured to meet the need of learners at the primary school level, it will serve as a litmus test to choosing physics at the senior secondary school. STAN physics panel should be bestowed with the responsibility of sensitizing physics teachers on any new innovation through workshops.*

### INTRODUCTION

Biomechanics involves study of the structure and function of biological systems such as humans, animals, plants, organs, and cells by means of the methods of mechanics. Biomechanics in sports can be stated as the muscular joint and skeletal actions of the body during the execution of a given task, skills or techniques. Proper understanding of biomechanics relating to sports skill has the greatest implications on sports performance, rehabilitation, and injury prevention, along with sport mastery. Primary Education as the bedrock of our educational continuum requires a solid foundation in science, especially in an age when science and technology have become part-and-parcel of the world culture. The body of science comprises of special knowledge, skills, attitudes as well as concepts which relates to one another, giving a view of the world, nature and man.

'Teach a child in the way he should go and when he is old, he will not depart from it" it is a typical Biblical quotation. Human learning is similar according to Ango (2002) because it involves processes which require an understanding mind. An early experience in science will have a strong effect on the Child's behaviour at child hood and on other subsequent learning. An adult who is science retarded may dislike science for life. Early experience in science would usually have much better effect on latter science experience making the learner more competent and rational as a result, the child needs to be introduced to certain concepts of physics right from the primary school.

Since Children at the Primary School are full of curiosity about nature and have immature minds, any worthwhile objectives must aim at achieving what is possible and relevant. The objectives of teaching science at the primary school level according to Ango (2002) are:

- I. To develop interest and curiosity in Children.
- II. To give opportunity for Children to know themselves and the world around them.
- III. To begin to develop a good use of Children senses.
- IV. To develop in Children the ability to solve problems through method of science.
- V. To prepare them for higher science and to develop good health habits in Children,
- VI. To sharpen the powers of observation in the child.

VII. To erase some superstitious beliefs through acquiring information or explanation of the facts of the matter through science.

Teachers need to understand that a child is an energy system and in all the universe the child does not find anything useful therefore the child uses its energy to develop intelligence through interaction with both living and non living things Usman(2005).

Physics in sports deals with the analysis of human motion; complete understanding of the action or part of the body necessitates the knowledge of anatomy. The question of efficiency of human mechanism largely depends on physics, the physical laws governing matter such as laws of gravity, types of levers and the law of inertia is most paramount. Man is a thinking Animal and his movement is disturb if he is having a problem in his mind. A man with an emotional problem, anxiety, fear insecurity or inability to meet basic needs definitely his movement will lead his thoughts. Knowledge of psychological principle will help reduce some of these problems.

Since emphasis on teaching and learning at the primary school is "learning by doing", and encourage group work NPEC (1996), the teacher should organize and motivate learners as they learn by doing.

**Philosophical bases of the study:-** Although education should serve a society and its purpose are affected by the opinions of the People, time, place and the learner in that society, the opinions of leading philosophers from different part of the world and at different time cannot be kept under the carpet. The thought according to Akinpelu (2007) Education should be studied because they have proved to be relevant even in our own times and society. Since education is a result of the accumulation of relevant knowledge. The following philosopher's contributions are relevant to this study:

Plato, a follower of Socrates, his ideas that relate to Primary Education are found in the ideal society where all Children should be reared and educated together from nursery, kindergarten and primary education at the end of which they would be streamed according to their individual abilities.

According to Plato, Education should be an instrument for reconstruction of the state for development; it involves adopting a National ideology which invariably will mean defining an appropriate educational system, Plato also acknowledges the need to consider the ability of the child at the end of the primary education. He advocated that at the primary stage children at the age of seven to ten years old, should be educated on games, sports, basic elements of reading, storytelling for moral and spiritual development. Plato was the first philosopher to appreciate the value of the environment in learning, knowing that a Childs mind is impressionable and affected by the environment. Plato idea of producing men who are beautiful in mind and body is still of relevance in primary education. Both the cognitive, psychomotor and affective domains must be trained for the development of the educated man.

Pestalozzi like J.J. Rousseau was a naturalist who believed that the child has hidden powers that unfold as he grows up to become an adult; he observed that education must harmonize with nature. Any topic to be taught to the child must be reduced to the minimum element and gradually build up step by step. The child intellectual ability is individualistic and is the result of nature and nurture.

Jean Jacques Rousseau was of the opinion that the child's emotions should never be forced to learnt anything which is of no interest to him. He emphasize that children should only be taught through amusement. Their education must be child centered. According to Rousseau, teachers should always love their pupils, respect their individual nature, guide and device them sympathetically. They should inculcate in their pupils the desire to learn. Past experience must be

considered when beginning a lesson. This is very pertinent because of individual difference among learners. Each child's readiness for new activities should be observed, so that both content and teaching methodology is properly guided considering the psychology of the child. On the whole one thing stands out clear from these philosophers 'children enjoy play' unachukwu (1990), observed that children can learn a lot from their environment through play. Play makes learning easy, interesting and challenging.

**Psychological Basis Of the Study:-** Bruner cited in Ajaegbu, K.J. U (1999), In his theories on the need to return back to intellectual approach in learning. The theory development is base on four themes: structure, readiness, intuition and motivation. Bruner emphasized on the structure of the subject matter to be learned. He claim the understanding of what is to be learned is made easy through permitting other things to be relating to it meaningfully. Good teaching should therefore emphasize structure of the subject. He also believed that with this approach and foundations any subject may be taught to any at any age and at any level through reducing the content level. Age in this content emphasizes readiness of the learner. Bruner mentioned that it is vital that the learner should be motivated; in his words "stimulated to learn" teachers must device methods that permit the student to discover for himself the generalization that lie behind a particular operation. Piaget advocated that the child activity select and interprets environmental information in the construction of his own knowledge rather than passive copying the information just as it is presented to his senses. In his words according to Ajaegbu (1999), observed that the mind builds its knowledge, structured by taking external data and interpreting them, transforming them and re-organizing them. Cognition like other forms of biological adaptation always exhibits two simulation and complementary aspect which Piaget refers to as assimilation and accommodation. Piaget has a genetic approach to how cognitive development takes place. He maintain that cognitive development followed a well define sequence of stages beginning with a relatively simple behaviour of the infant and traces the progression to ever more complex level of activity. He divided the period into developmental stages and each stage is characterized according to Piaget, by particular types of cognitive function.

### **Teachable topics in physics using the fun of sports:**

A body is said to be in motion when it changes its position with its surrounding (Ike 2002). Most athletics require the performance to impart motion to an external object; movement cannot take place without motion being applied. The force use in athletics is those produce by muscular contraction in combination with the force of gravity.

**Levers:** - The lever is a radial revolving around a fixed axis known as fulcrum (F) with effort (E) moved and resistance (R) to be overcome by it. There are three classes of levers discussed below:-

#### **First Class Levers:-**

The effort and the load are on opposite side of the fulcrum, movement of the effort results in movement of the load in opposite direction. When the fulcrum is central, effort must be equal the load. When the fulcrum is nearer the effort, effort must be greater than the load. This type of lever according to Akinpelu (2007) produces movement in the trunk and head with very little actual shortening of the muscles concerned. The head is very nearly balanced on the neck so as to maintained up right posture but when the head is tilted towards, more of its weight is in front of the fulcrum, so that a more strong pull is needed to hold it steady or bring it up right again.

**Second Class Lever:** - The load is between the fulcrum and effort and movement of the effort result in movement of the load in the same direction. The effort is less than the load, but any distance involve is greater than the effort. The raising of a body on a tip toe is an action that uses

this type of lever; such action is made possible by shift of the centre of gravity of the body over the ball at the foot.

**Third Class Lever;** The effort is exerted between the fulcrum and the load, movement of the effort result in movement of the load in the same direction.

### **Factors modifying motion;**

Friction, air resistance and viscosity are factors that facilitate one form of motion yet hinder another, for instance, friction is a greater help to the runner because it enable him to exert minimum effort without dangerously slipping, yet on the other hand friction hinders the rolling of a ball as in hockey. One of the major problems in sports is to be able to overcome these factors while in action.

**Balance and stability;** A body said to be balance when an even adjustment exist between apposite forces. A balance centre is located in the inner ear. The kinestatic sense of the eyes all plays a role in maintaining balance. Men need stability or balance when at rest (static balance) and when in motion (dynamic balance). Men must be able to maintained balance since it is a motor skill, example static balance on tip toe standing; standing on one foot; head stand and hand stand without losing one's balance. Those of dynamics are; - walking on a balance beam, walking on a tie rope, standing in a moving vehicle. Stability is very important in sports particularly in driving tennis ball and trapping in soccer (foot ball).

### **Newton laws of motion.**

There are three basic laws Newton propounded that holds for all condition according to Ike (2002). These laws are;

**i. Newton's first law of motion:** - This law states that an object which is at rest will remain there unless acted upon by an external force. Similarly, an object moving in a straight line will continue to do so unless acted upon by an external force; the implication of this law is that shot put, javelin or any other equipment will remain in the same position unless a greater force is applied, similarly shot put or javelin when in air will continue to sail unless it is acted by another force usually gravitational. Another implication is that in races, force is acted upon by an object to retard a moving object and bring it to rest.

**Newton's Second Law Of Motion:** - The law states that the velocity of the moving object will remain constant unless a force act upon it, when such a force occurred the change in velocity increase or decrease will be directly proportional to the amount of force causing the change and inversely proportional to the mass of the object. For example, in shot putting the athlete who is stronger and thus able to expend more force will toss the 12-pound shot farther than an athlete who possesses less strength. Also, an athlete will find more force needed to propel a 16-pound shot than a 12-pound shot. In a body contact a small man can knock his opponent by developing high speed. Your ability to accelerate an object depends on the strength of your muscles (Wuest and Bucher 2006).

### **Newton's third law of motion**

The thrust against the water in swimming is another example of an equal and opposite reaction the water pushes the swimmer forward with the force equal to the force exerted by the swimmer on the backward thrust of the strokes. (Wuest and Bucher 2006).

**Momentum:** - Momentum is the quantity of motion possessed by a moving object. It is a measure of both speed and mass. The greater the speed of the body the greater the momentum and the greater the mass of the body the greater the momentum. If two balls have the same mass, the one with the most speed will go farthest. If one object has greater mass than the

other and the same speed, the one with the greater mass will go farthest. The more momentum an object has the longer it will remain in motion. When jumping for distance, the jumper runs very fast before taking off so as to build enough momentum to enable him go further horizontal in the air before the force. The force of gravity pulls his body down to the ground.

When a moving body of mass  $m$ , and initial velocity  $u$ , hits a stationary body of mass  $M_2$  and initial velocity  $U_2$ , the one that is moving may stop and transfer momentum to the stationary body and both may move with a final velocity ( $v$ ). The two bodies are therefore related by the law of conservation of linear momentum which states that the sum of momentum before collision is equal to the sum of momentum after collision.  $M_1U_1+M_2U_2= (M_1+M_2)v$ : the following are concepts which children should learn about momentum.

- i. Momentum is affected by both speed and mass.
- ii. The greater the speed of an object, the greater the momentum
- iii. The greater the mass of an object, the greater the momentum
- iv. Momentum may be transferred from one object to another

**Projectiles:**

Since many physical education activities required projection of the body or object in to the air. A projectile is any object that is sent in motion in to space. The body is a projectile as it moves through space, in a jump, dive, or a rebound in trampolining; of course, any ball, ring or shuttle as it is thrown or hit becomes a projectile. The flight a projectile travels in space is affected by force of gravity, air resistance, angle of release or angle of struck, spin, the degree of initial force that launched it.

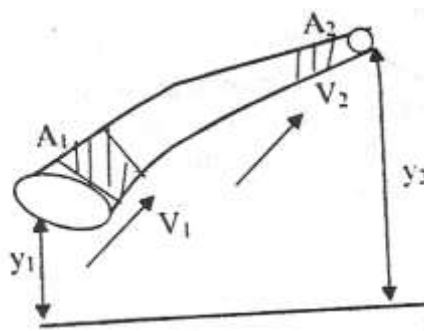
Galileo made the first break through in the description of projectile motion near the earth, he realized that the horizontal and vertical components of the motion can be treated independently, while the horizontal component proceeds with the constant speed, the vertical component experiences a constant downward acceleration.

**Bernoulli’s principle.**

This states that the sum of pressure at any point plus the kinetic energy per unit volume plus potential energy per unit volume is always a constant for an incompressible fluid flowing along a vertical flow tube varying in cross sectional area, since its velocity changes Ike (2008).

$$P + \frac{1}{2}\rho v^2 + \rho gy = \text{constant}$$

Diagram. Fig 1



The work done by the liquid = pressure change x volume change =  $(p_1-p_2)^2 dv$ .

But  $(p_1-p_2)dv = \frac{1}{2}dm(V_2-V_1^2) + dm g(y_2-y_1)$

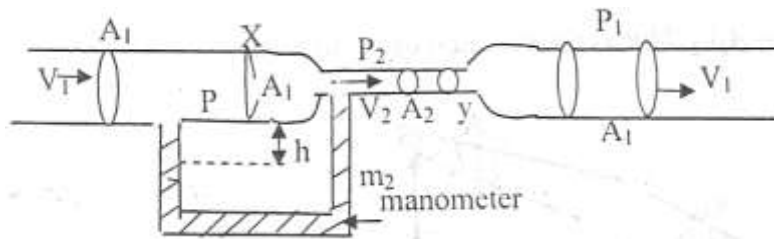
$$P_1 - p_2 = \frac{1}{2}\rho(V_2^2 - V_1^2) + \rho g(y_2 - y_1) \text{ but } \rho = dm/dv$$

$$P_1 + \frac{1}{2}\rho V_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho V_2^2 + \rho g y_2$$

Hence  $P + \frac{1}{2} \rho v^2 + \rho gy = \text{constant}$ . Where  $p =$  pressure at any part of the tube,  $v =$  velocity.  $Y =$  height of the pipe.  $\rho =$  density of the fluid.

For horizontal pipes the  $\rho gh$  become equal and the Bernoulli's equation reduces to  $P + \frac{1}{2} \rho v^2 = \text{constant}$ , so that  $P_1 + \frac{1}{2} \rho v_1^2 = P_2 + \frac{1}{2} \rho v_2^2$ .

**Principle of Venturi meter.** Another form of Bernoulli's principle is seen in fig 2 below.



From fig 2, the venturi meter relation for horizontal pipes where  $v_2 \gg v_1$ , then the relation  $p_1 - p_2 = \frac{1}{2} \rho v_2^2$  holds. The venturimeter uses the Bernoulli's

Principle for this special case. The velocity of a liquid in the main tube of venturi tube is given by the expression.

$$V_1^2 = \frac{2\rho_1 gh}{\rho_1 \left\{ \frac{A_1^2}{A_2^2} \right\} - 1} = kh$$

Where  $k =$  venturi constant,  $\rho_1 =$  density of mercury,  $\rho =$  density of liquid.

The venturi meter measures the volume of gas or liquid per second flowing through gas pipes or oil pipes. The construction is that of two tubes of different diameters (one large and one small) connected together. The areas of cross section are  $A_1$  and  $A_2$  respectively. A manometer  $m_1$  and a narrower section  $y$  of an  $A_2$  horizontal pipe carrying a steady flow of liquid. A manometer  $m_2$  is connected between a wide section  $x$  of an area  $A_1$  and a narrower section  $y$  of area  $A_2$  of horizontal pipe carrying steady flow of liquid. A manometer  $m_2$  is connected in the narrower section  $y$ , the velocity  $v_2$  is greater than the velocity  $v_1$  and the pressure  $p_2$  at  $y$  is less than the pressure  $p_1$  at  $x$ . The manometer then has a difference in levels  $h$ , if liquid of density is used.

Suppose  $Q$  is the volume/second of the blood flowing at  $x$  or at  $y$ .

Then  $Q = A_2 V_2 = A_1 V_1$

From Bernoulli's principle,  $P_1 + \frac{1}{2} \rho V_1^2 = P_2 + \frac{1}{2} \rho V_2^2$ . But  $V_2 = \frac{Q}{A_2}$

And  $V_1 = \frac{Q}{A_1}$ . Therefore  $h\rho g = \frac{\rho}{2} \left[ \frac{Q^2}{A_2^2} - \frac{Q^2}{A_1^2} \right]$

$$Q = \frac{2h\rho g A_1^2 A_2^2}{\rho (A_1^2 - A_2^2)}$$

$Q = Kh$ ,  $K =$  venturi constant.

What makes a curve ball curve is the presence of stitches on it. The pitcher's finger holds the ball along a seam, so when the ball is thrown with a snapping motion it has topspin friction provided by the stitches causes a thin layer of air to move around the spinning ball in such a way that air pressure on top of the ball is greater than on the bottom, causing the ball to curve downward and the batter to miscalculate the position of the ball. The ball phenomenon occurs partly because of the relationship between the pressure of the fluid and its velocity. This principle describes Bernoulli's principle. According to Bernoulli's principle which is illustrated by the

equations above, the faster a fluid moves the less pressure it exerts. A spinning base ball has more air turbulence on top of the ball, producing slower air speed over the ball. Meanwhile air moving under the ball accelerates and moves faster, producing less pressure on the bottom of the ball, the ball moves downward faster than would normally be expected. When the base ball is caught, the momentum of the moving ball is transferred to the glove. The outfielders and catchers decrease the force of the ball by moving their hand with the ball as they catch it slowing down the impact. This along with the padding in the glove, increases the time impact (impulse), thus decreasing the force with which the ball hits the glove. Protective padding in all sporting equipments and shoes follows this same principle.

### **Sporting activities with fun of Physics.**

**Starting Races:** - It has been discovered that the crouch position is the best because many principles are involved. The individual goes on to one knee, hip high and that means the centre of gravity is transferred to the arms, the person is at a dangerous position as any small force applied will make him to fall. The leg maintain leverage, the lever has a space and it is meant for force, the knee has to be flexed so that by the time the knee is strong more force would be gathered, when the knee is flexed force is generated. Then there is a follow in the direction of push, the greater the push, the greater the movement.

**Actual Running:-** the athlete start by going up gradually and when the actual running is going on the athlete start with small strides. The athlete tries to maintain maximum speed if not he will be accelerating and decelerating and this implies the expenditure of more energy. The athlete inclined forward at least at an angle of  $20^{\circ}$  to enable him set his center of gravity forward as he acquires less effort; this also implies that the resistance of air is also reduced. It is safer to maintain constant speed than to increase or decrease.

### **Long Jump:-**

In long jump the stages include the approach, ran, take off and flight in the air and landing. Long jumpers are usually sprinters; good speed helps in the development of this power. The athlete is expected to go on crouch position and run, he stamps one of his feet on the take off board and make an upward and forward movement, the athletes then swing his arms upward to increase the center of gravity to lift him up to join the  $45^{\circ}$  he then brings the hand backward and forward, by the time the athlete complete the flight the hands come from up and down, they go back to balance the pull of the centre of gravity, then forward to landing.

**JAVELINE:** - Like in any other games and throwing events, the aim of the athlete is to transfer momentum from the arm to the javelin so that the javelin covers an optimal distance. The principle involve in javelin is that the object acquires the motion of any object to which it is attached, consequently an objects held at the hand and when released continues to move in the same direction with the same speed until it is acted upon by another external force; vertical component ( $U\sin\theta$ ). In javelin throwing the athletes build up force in the trope, as the thrower approaches the retaining line at full speed, he implants the other foot either by cross steps or by the trope, this sudden break in motion is suppose to lift the javelin with the speed and direction it has acquired.

**High jump:** - The athlete or jumper clears the bar in a sitting position. He moves his legs in the air during the bar clearance, when the jumper approaches, he strikes the take off point with the left foot and shoot the right foot vigorously up ward parallel to the bar, he projects himself vertically on the top of the vertical projection.

**Shot put:** - This will remain in the same position unless force is applied to it (Newton first law of motion). Shot-put will continue to sail in the atmosphere if there is no force of gravity that will propel it down ward; this obeys the law of gravity.

## CONCLUSION

Introducing physics at the senior primary school through sports will not only help pupils understand the concept of physics at that level but will serve as a spring board for better understanding of complicated concepts when exposed to at the senior secondary schools. Physics unlike other sciences witness low enrolment, this is not unconnected to the fear attach to rigorous mathematical computation, which emanated from the theory sometimes not understood properly and most often lead to rote learning. Since children learn better by doing, sports will provide a better avenue for such meaningful learning; this kind of learning is popular in Japan, children are encouraged to learn to discriminate tiny variations in routines as they are repeated. This education style has help Japanese to perfect and improve new technology that other countries have not developed, children are advised not to see an object but to see through the object and to improve it. Through this method Japanese record for innovation, marketing, and improvement of imported technologies and rapid development of new technologies attest to success of their educational philosophers. Nigeria in her quest for technological advancement can borrow a leave from Japan, if our vision 2020 is to be made. Learning elementary physics in the primary school will motivate pupils to choose physics as a course in their subsequent studies.

## RECOMMENDATION

- i. Physics curriculum should be restructured to meet the need of learners at the primary school; it will serve as a litmus test to choosing physics at the senior secondary school.
- ii. STAN physics panel should be bestowed with the responsibility of sensitizing physics teachers on any new innovation through workshops.

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