Interview with Michael F. Shaughessy
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"Sports are FUNdamental to Learning "

1) Dr. Badiru, tell us about yourself and your education and experiences.

Thank you, Michael. I am delighted to have an opportunity for this interview. First, I love the caption of this interview: "Sports are FUNdamental to Learning"

As an educator, I am interested in any effort that facilitates learning. The cliché of having fun while learning is important for knowledge retention. I am presently a professor of systems engineering at the Air Force Institute of Technology, which is a graduate school of engineering and management at Wright Patterson Air Force Base in Dayton, Ohio. I was previously an industrial engineering professor at the University of Tennessee – Knoxville, and before that I was a professor at the University of Oklahoma in Norman. These are two sports-soaked institutions. My educational background is in industrial engineering and mathematics. I have taught mathematics and engineering at the college level for over 30 years.

2) How did YOU first get involved in science and sports? Or should I say sports and science?

I am originally from Nigeria where European football (soccer) is as bigger as college football is here in the US. My high school, Saint Finbarr's College, was nationally acclaimed throughout Nigeria as a soccer powerhouse. That was where I first got into the rhythm of the game. The school emphasized soccer and academics almost at the same level and that got me thinking about the inseparable relationship between sports and intellectual pursuits. I came to the US in 1975 to study engineering at the Tennessee Technological University; and I played for the school's soccer team in 1976 and 1977 and got an opportunity to practice what I called "smart soccer." It was after I started teaching engineering at the University of Oklahoma in 1985 that I began to formulate the idea of writing about the scientific approach to soccer. I joined an adult soccer team in Norman, OK and began to experiment with the phenomenon of physics on the soccer field. I kept pieces of

notes in those days and notes eventually formed the foundation for what emerged as the book on "The Physics of Soccer." After I retired from competitive soccer in 1996, I started developing the book manuscript.

Now, I enjoy soccer just as much writing about it instead of writhing in pain playing it with my old bones aged muscles.

3) Let's talk about force and motion- and let's talk about basketball since this is March madness month. When watching a game, or playing a game of basketball, what can kids learn about arcs, the need to use force to establish position, dribbling, and shooting?

Everything in life is driven by some form of force even if we don't explicitly perceive the "forcing" action. Even the most fundamental activities we undertake, such as eating and walking involve the application of force in one direction or another. Talking about force and motion, it is important to recall Newton's Laws of Motion:

The First Law says that "An object at rest tends to stay at rest and an object in motion tends to stay in motion with the same speed and in the same direction unless acted upon by an unbalanced force. Thus, a ball at rest stays at rest until acted upon by a force, such as kick.

The Second Law says that "The acceleration of an object, as produced by a net force, is directly proportional to the magnitude of the net force, in the same direction as the net force, and inversely proportional to the mass of the object. In sports analogy, the acceleration that a soccer ball achieves is based on its weight and the kicking force applied it. The second law is expressed by the equation $F = ma$**, where F is the net force acting on the object. This equation sets the net force equal to the product of the mass times the acceleration. Acceleration (a) is the rate of change of velocity (v), and velocity is the rate of change of distance.**

The Third Law says that "For every action, there is an equal and opposite reaction. A force is a push or a pull upon an object that results from its interaction with another object. Forces result from interactions between objects. According to Newton, whenever objects A and B interact with each other, they exert forces upon each other. When a soccer player sits in a chair, his body exerts a downward force

on the chair, and the chair exerts an upward force on his body. There are two forces resulting from this interaction: a force on the chair and a force on the body. These two forces are called *action* and *reaction* forces. In soccer, for every action on the ball, there is an equal and opposite reaction. The ball pushes against the foot whenever the foot pushes against the ball. For a eating analogy, when you eat, you apply a chewing force on the food, but the food actually pushes back with a reaction force.

You asked specifically about basketball. I am writing this as a I watch the NCAA basketball final between Duke and Butler; and I can see the effects on forces and arcs in real time. The arc of the basketball is initiated by the force and direction exerted upon it by the player. With practice and spatial reasoning, a player can better direct the ball to where the ball needs to go. What kids can learn from this is that selective positioning on the court can maximize opportunities to execute dribbling and shooting more effectively. So, using force to establish position is an example of Newton's Third Law of motion.

4) What about passing and rebounding ?

The same force and motion analysis mentioned above apply to passing and rebounding. Passing represents an execution of Newton's Second Law of Motion. The amount of force applied to the ball in a certain direction is informed by the location of the passing target. If you think of rebounding as "recovering" or "bouncing back," you will see the presence of Newton's Third Law of Motion.

5) You talk about sequencing- which sports seem to rely more on this skill than others?

Sequencing relates to the series of passing shots taken to get the ball into a desired final state or position. The idea is not to have use too many sequences because the series may become too complex and may breakdown. It is best to keep the series of passes simple. For example, if there was no shot clock in basketball, players could go in endless sequencing or series of passes that may not lead to a meaningful result. The ball sports that rely more on sequencing include soccer and basketball. Golf, football, and baseball require sequencing to a lesser extent.

6) Let's talk about developing the " weaker " side of the body- such as in having kids kick a soccer ball with the weaker foot. What kind of skills does this help develop? ANd how is science involved?

Learning to kick with the weaker foot is a cherished skill in soccer. This skill helps a player to develop more as a total player and it helps to improve the player's coordination and enhances reaction time. The science involved here is to force oneself to direct signals to the brain so that the brain can send proper motor signals to the muscles. Have you ever experienced an increase in your urgency to use the bathroom the second a bathroom is within reach? That is the brain prematurely sending signals to muscles of certain organs in anticipation of the forthcoming relief. One can actually train the brain to ignore the sight of bathroom and focus on other senses until the appropriate time when the person is ready to use the bathroom. There is a lot of science behind the call of nature.

7) Tell us about the Physics of Soccer- and how math is involved. And tell us where we can get a copy of your book?

The Physics of Soccer presents a FUNdamental connection between sports and science. Playing sports is fun for kids. Linking sports to science makes science itself fun and less intimidating. If science is presented under a fun framework, it will be better embraced as a career path. The goal of ***The Physics of Soccer: Using Math and Science to Improve Your Game*** is to demystify science and make it fun for kids by providing specific examples of how science influences our everyday lives. Math is involved through analysis of on-field geometry and formations. Calculations involving how a ball bounces can be useful for assessing how to use ricochet to direct the ball's path.

The book is available through several sources, including the following:

Amazon.com:
http://www.amazon.com/Physics-Soccer-Using-Science-Improve/dp/1440192243/ref=sr_1_1?ie=UTF8&s=books&qid=1264267329&sr=1-1

BarnesandNoble.com:

http://search.barnesandnoble.com/The-Physics-Of-Soccer/Deji-Badiru/e/9781440192241/?itm=1

iUniverse.com:
http://www.iuniverse.com/Bookstore/BookDetail.aspx?BookId=SKU-000139656
The book also has its own website, www.PhysicsOfSoccer.com, where more information can be obtained.

8) Is there any one sport that relies on physics and gravity more than others? (I enjoy basketball and tennis myself).

Most ball-based sports rely on physics and gravity. I think soccer, football, and basketball, because of their contact sport aspects, are more amenable to the application of physics.

9) What have I neglected to ask ?

How about providing a summary of what players need to pay attention to in order to achieve a more effective performance? I think players should be attentive to the following factors that can alter the state of play from a scientific standpoint:

Tips for Science and Soccer (or STEM and Sports, in general)

- Wind direction and speed as they affect ball movement
- Friction as it affects slippery playing surface
- Humidity as it affects air moisture on and around the soccer ball
- Gravity as it affects downward motion of the ball
- Evaporation as it affects player comfort and health
- Force of collision as it may affect player motion and stability
- Ball inflation level as it affects bounce and mobility

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