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RESEARCH QUESTION:

How can Multiple Intelligence and Multimedia Learning theories be applied to collegiate basketball instructional design utilizing emerging mobile technologies?

ABSTRACT:

In 2011 there were 34,024 student-athletes participating in the sport of basketball for NCAA (National Collegiate Athletic Association) affiliated institutions of higher learning. The majority of these students enter 4-year institutions as freshmen and are required to learn a significant amount of basketball tactical plays in order to compete. College basketball tends to have a high attrition rate of freshmen student-athletes who must successfully make the transition from high school to college. These students are challenged on at least three fronts. They must successfully transition from high school to college academic standards. They must successfully transition from high school to college physical athletic standards with respect to strength and conditioning. Third, they must successfully transition from high school to college standards with respect to the acquisition of knowledge about this higher level game of basketball. Specifically, they must be able to learn basketball tactical plays in a short amount of time in order to succeed. If this specific knowledge is not acquired the student-athlete has a higher likelihood of quitting the team or having the student-athlete's athletic scholarship rescinded by the head coach the following year.

This paper discusses how collegiate basketball instructional design can be positively impacted by the integration of instructional technologies and learning theories. Specifically, this paper will discuss how Multimedia Learning and Multiple Intelligence learning theories can be applied to collegiate basketball instructional design. This paper will also discuss how Adobe Flash Professional can utilized to provide a mobile multimedia learning experience driven by a student-athlete's specific intelligence and multimedia design principles.

The end product is a multimedia instructional mobile iPad application created in Flash that adapts the design principles of Richard Mayer (Multimedia Learning Theory) while acknowledging and making use of a basketball player's unique bodily-kinesthetic and visual-spatial intelligence as defined by Howard Gardner (Multiple Intelligence Theory). The product could potentially be integrated with and complement the traditional coach directed on-court instruction.

The purpose of this educational app is to aid freshmen student-athletes' acquisition of knowledge within the collegiate basketball instruction domain. This has the potential to lead to a lower attrition rate of freshmen student-athletes and increased graduation rates.

RESEARCH RATIONALE:

Two learning theories were researched, Richard Mayer's Multimedia Learning Theory and Howard Gardner's Multiple Intelligence Theory.
I chose to study Multimedia Learning because of my experience as a multimedia producer for University of San Francisco's Women's Basketball team. Part of my job was to produce instructional/educational media for the team. However, I found this process was more of a guess and check procedure rather than being grounded in any type of learning theory. I saw the potential power of multimedia instruction but lacked the knowledge of how to create such instructional messages.

I chose to study Multiple Intelligence Theory because of my desire to explore a collegiate basketball student-athlete's unique intelligence. I wished to find a way to leverage a successful athlete's dominant intelligence in a beneficial way for the student-athletes cognitive development.

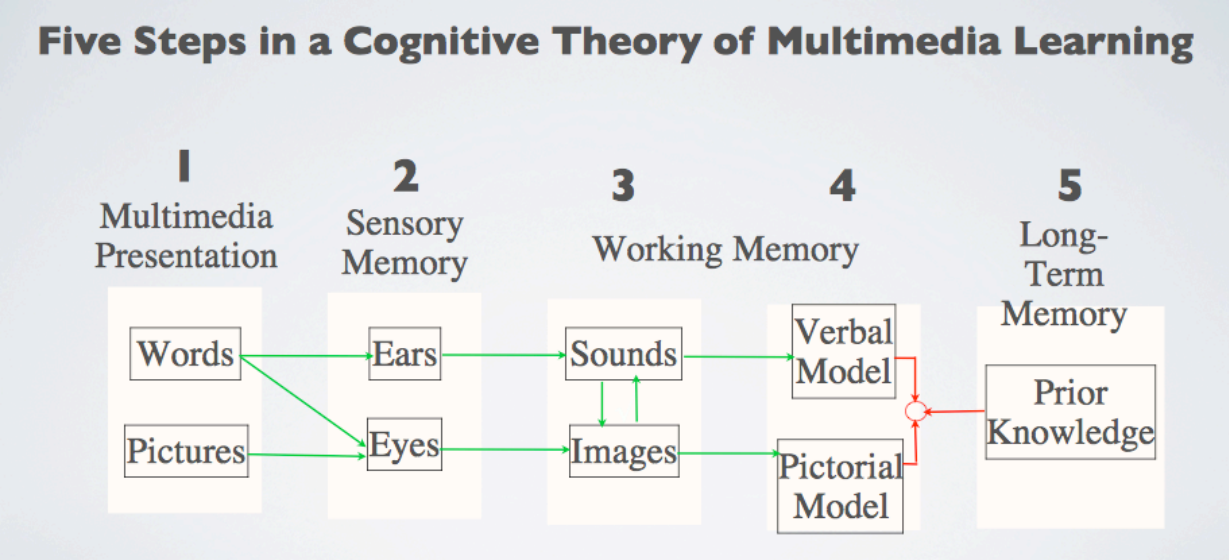
The following is a summary of the learning theories researched and knowledge gained about these theories.

Cognitive Theory of Multimedia Learning - Richard Mayer

Overview:
The cognitive theory of multimedia learning starts off by stating that instructional messages should be developed in light of how the human mind works. Within this cognitive approach Mayer discusses how words and pictures are qualitatively different yet complement each other and that human understanding occurs when learners are able to integrate visual and verbal representations. It in the process of trying to build connections between words and pictures, learners are able to create a deeper understanding than from words or pictures alone. This results in a meaningful learning experience, the goal of multimedia learning. (Mayer, 2001).

Assumptions of Multimedia Learning:
Mayer bases his cognitive theory of multimedia learning on three main assumptions:
1) Dual Channel - states that humans possess separate channels for visual and auditory and information (Mayer, 2001)
2) Limited Capacity - states that humans are limited in the amount of information they can process at one time. (Mayer, 2001)
3) Active Processing - states that humans have meaningful and transferable learning experiences when they engage in active learning as defined by "attending to relevant incoming information, organizing selected information into coherent mental representations, and integrating mental representations with other knowledge". (Mayer, 2001)

Five Steps in a Cognitive Theory of Multimedia Learning:
Mayer builds upon the three previously mentioned assumptions of dual channel, limited capacity and active processing to present steps which must be executed in order for meaningful learning to occur from a multimedia message. Below is a chart of these 5 steps:



Step 1:
The learner selects relevant words from an instructional message.

Step 2:
The learner selects relevant images from an instructional message.

Step 3:
The learner organizes selected words.

Step 4:
The learner organized selected images.

Step 5:
The learner integrates the constructed verbal model and pictorial model with the learner's existing knowledge.

<u>Multimedia Design Principles:</u>
Mayer states seven instructional design principles that guide effective multimedia instructional design:

1) Multimedia Principle - students learn better from words and pictures than from words alone.
The multimedia principle is the foundational principle of multimedia learning. According to Mayer, it is the combination of words and pictures that leads to better learning than from words or pictures alone. The dual channel assumption supports this principle. Presenting a verbal and pictorial model to a learner maximizes the learners capacity as information enters both the auditory and visual channel. Also, the interaction of the two channels in working memory allows learners to build mental models and aid moving information from short term to long-term memory when integrated with a learner's existing knowledge of a specific domain (Mayer, 2001).

2) Spatial Contiguity Principle - students learn better when corresponding words and pictures are presented near rather than far from each other on a screen or page. (Mayer, 2001)

The spatial contiguity principle is based on the limited capacity assumption. If the corresponding text and illustrations of an instructional message are placed far apart the learner has to expend cognitive resources to find corresponding text/illustrations on the screen which could be used for active processing of the multimedia message. Therefore, Mayer suggests the use of integrated presentations, where text is placed next to its corresponding illustration and possibly with keywords placed within the illustration itself.

3) Temporal Contiguity Principle - students learn better when corresponding words and pictures are presented simultaneously rather than successively. (Mayer, 2001)

The temporal contiguity principle treats time as an economic resource. According to this principle, learners are more likely to understand multimedia messages when words and pictures are presented simultaneously rather than successively. Simultaneous presentations increases the likelihood that the learner will be able to retain the verbal/ pictorial representations in their working memory.

4) Coherence Principle - students learn better when extraneous material is excluded rather than included (Mayer, 2001).

The coherence principle states that less is more. Mayer states that irrelevant text and illustrations should be removed. Extraneous sound/music should be removed and nonessential words should be removed. These unnecessary,extraneous, and irrelevant materials compete with cognitive resources that should be devoted to carrying out the five steps of multimedia learning.

5) Modality Principle - students learn better from a multimedia message when words are presented as spoken words rather than on-screen text (Mayer, 2001).

The modality principle states that the most effective instructional messages are concise narrated animation. The narration/animation combination is preferred over the on-screen text/animation combination because the latter combination leads to cognitive overload in the visual channel and leaves the auditory channel untapped.

6) Redundancy Principle - students learn better from animation and narration rather than animation, narration and on-screen text (Mayer, 2001).

The redundancy principle states that the combination of animation/narration/text causes cognitive overload for two reasons. First, similar to the modality principle, the combination of animation/text compete for limited resources in the visual channel. Second, the learner expends additional cognitive resources as the learner attempts to reconcile two streams of identical information. One stream in the auditory channel with the narration and one stream in the visual channel with the on-screen text.

7) Individual Differences Principle - design effects are stronger for low knowledge learners than for high knowledge learners and for high spatial learners than low spatial learners.

The previously listed principles were focused on the instructional design conditions necessary for effective multimedia learning to occur. The individual differences principle

is focused on who benefits the most from proper multimedia instructional design. Mayer states these two groups are low knowledge learners and high spatial learners.
Low knowledge learners: Mayer states that high knowledge learners already have "domain specific knowledge". Thus they are able to more readily build mental models from only verbal instruction or from a poorly designed multimedia instructional message.
High spatial learners: When learners are presented with multimedia instructional messages they need to be able to create, hold, and use mental images in their working memory in order for meaningful learning to occur. High spatial learners can more easily hold pictorial models in their working memory allowing for more interaction between the pictorial model and the verbal model. Allowing for connections to form and mental models to emerge from those connections.

High spatial ability / cognition can also be looked at as high spatial intelligence which leads to the second theory researched, Multiple Intelligences Theory

Multiple Intelligences Theory - Howard Gardner

Howard Gardner introduced the theory of Multiple Intelligences with his book *Frames of Mind* in 1983. Multiple intelligences challenges the traditional notion of intelligence. Gardner argues that human intelligence cannot be universally measured. Gardner argues that the IQ test is skewed towards two distinct types of intelligence which he has termed logical-mathematical and linguistic intelligences. Gardner argues that intelligence (1993):

> *"entails the ability to solve problems or fashion products that are of consequence in a particular cultural setting or community. The problem solving skill allows one to approach a situation in which a goal is to be obtained and to locate the appropriate route to that goal"*

In addition, Gardner (1993) views intelligence as raw biological potentials to process information and problem solve. This human potential may or may not be activated in an individual based on that individual culture's values and beliefs.

Instead of one universal intelligence initially listed seven intelligences in *Frames of Mind.* An eighth intelligence (naturalistic) was subsequently added following the publication of *Frames of Mind.* Gardner states that all normal humans possess each of these intelligences. However, individuals differ in the degree of skill in that intelligence as well as the combination (intelligence) profile.

-Eight intelligences:

1) linguisitic -
2) logical-mathematical -
3) musical -
4) interpersonal
5) intrapersonal
6) naturalistic
7) bodily-kinesthetic
8) spatial

The two intelligences that were further researched for this paper are bodily-kinesthetic and spatial intelligences.

Bodily-Kinesthetic Intelligence:
This intelligence has been defined as “the ability to problem solve or fashion products using one’s whole body, or parts of the body” (Gardner, 1993). Bodily-kinesthetic learners process information through the sensations they feel in their bodies and learn through movement and touch (Jasmine, 1996). Individuals with this intelligence prefer to communicate information by demonstration and modeling. As such, individuals with high bodily-kinesthetic awareness include athletes, dancers, actors and surgeons (Gardner, 1983).

Visual-Spatial Intelligence:
This intelligence has been defined by Gardner as “the ability to form a mental model of a spatial world and to be able to maneuver and operate using that model” (Gardner 1993). Individuals with high visual-spatial intelligence tend to think in pictures and are able to learn readily from from visual presentations (Jasmine 1996).

Howard Gardner’s Multiple Intelligence theory has evolved since it’s inception in 1983. Gardner has stated that he did not believe his list of intelligences to be exhaustive and believes more intelligences will be added to the list if they prove to fit his detailed selection criteria (Gardner, 1983).

DESCRIPTION OF LEARNING:
The purpose of this research paper was to explore how multimedia learning and multiple intelligences could be applied to collegiate basketball instructional design utilizing mobile technologies.

This research has revealed links between multimedia learning, multiple intelligences, basketball instructional design and mobile educational apps. We may begin by looking at the learner in this situation, the freshmen collegiate student-athlete.

(1) This individual exhibits a high bodily-kinesthetic intelligence. Gardner has identified athletes as being in this group. Collegiate athletes are required to continually problem solve through body movements everyday in practice and these individuals have been doing so for approximately 10 years by the time they are freshmen in college.

(2) This learner exhibits a high spatial intelligence. Basketball is inherently a spatial sport. These learners are required to think in pictures as they construct offensive plays (mental models) in their working memory as they execute play after play in practice and in games. These learners must judge distances accurately and remember the dynamically moving player positions on the court while in action.

(3) This individual can be considered to be a low-knowledge learners within the specific domain of college basketball. The transition from high school to college athletics requires a significant acquisition of knowledge in a short amount of time. The cognitive

demands of competing in college basketball are drastically higher than the demands of even the top high school programs in the country.

(4) This learner has a limited amount of time for on-court coach directed instruction where the instructional messages are delivered verbally by the coach and are physically acted out by the student-athletes on the court.

(5) This learner is of the digital age and has most likely been exposed to technology all of the learner's life. The learner most likely has a mobile device and readily uses such device.

The initial link that reveals itself is spatial intelligence. As mentioned, multimedia learning is most beneficial to individuals with a high spatial intelligence. Basketball demands high spatial intelligence in order to compete at a high level and basketball players exhibit that intelligence. Therefore, multimedia learning can be beneficial to these student-athletes.

The second link is low-knowledge learners. Freshmen student athletes can be considered low-knowledge learners of this specific domain due to the initial jump in cognitive demands of the sport from high school to college. Mayer states that multimedia instructional messages are most beneficial to low-knowledge learners. Therefore multimedia learning can be beneficial to these student-athletes.

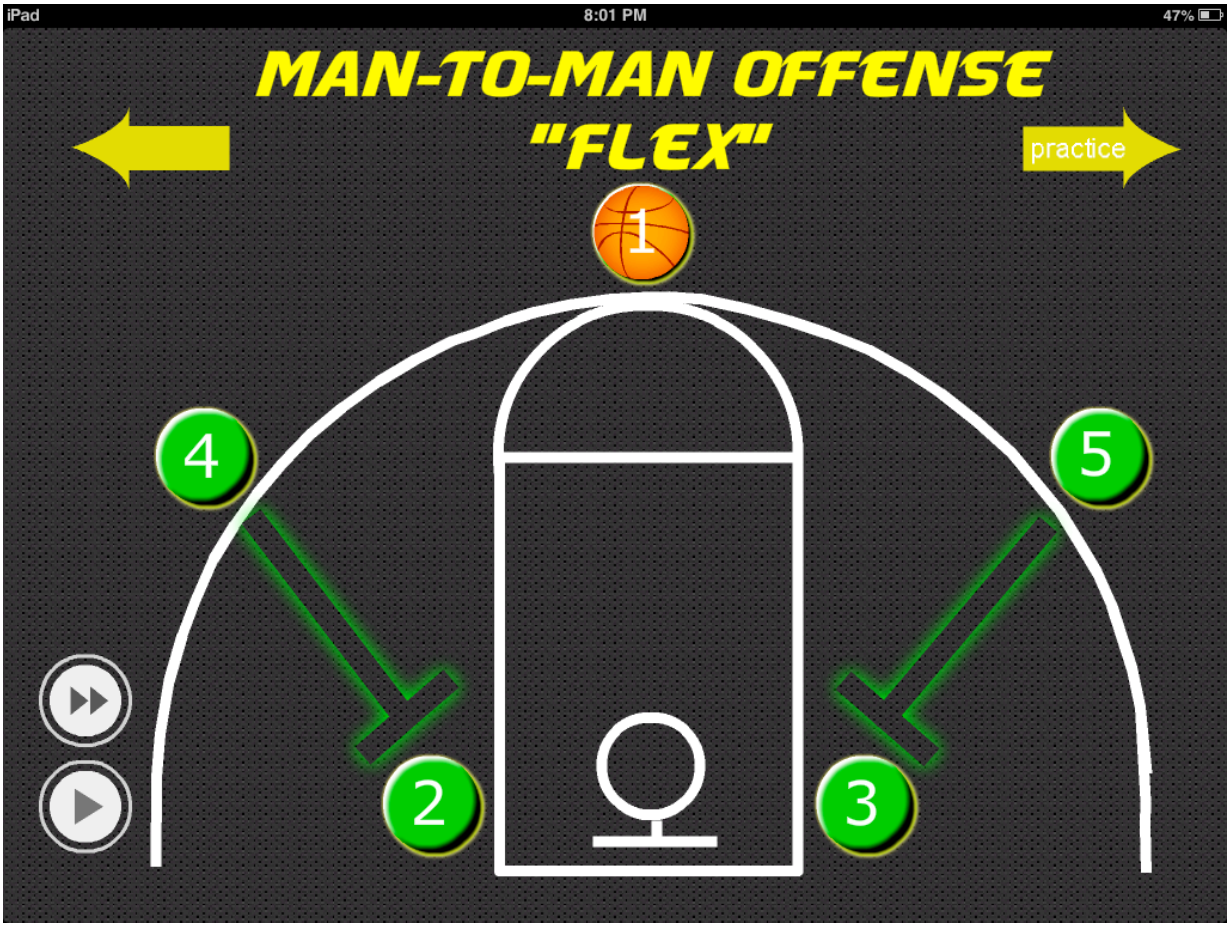
These two links show how multimedia learning can provide a rich environment for basketball student-athletes. Now the focus is on how to create this experience utilizing emerging mobile technology. Adobe Flash Professional is an interactive multimedia authoring software that supports deployment to multiple platforms including mobile devices. Sports instructional materials can be produced as downloadable apps by student athletes to their mobile devices.

Flash allows for the construction of mobile, self-paced multimedia learning within the sports education domain. Specifically, college basketball players can download these educational apps to their ipod, ipad and/or android device. The instructional material can include a digital playbook including concise narrated animations of all of the offensive/defensive plays that were initially learned via traditional teacher-directed on-court instruction during practice. The instructional messages can be designed utilizing Mayer's Multimedia Design Principles as previously outlined.

As mentioned, advanced basketball players tend exhibit high bodily-kinesthetic intelligence. Incorporating swipe gestures on ipads/iphones and tactile interactions to the multimedia learning experience can aid in learning of complex pattern recognitions and logical reasoning associated with being able to properly execute offensive and defensive plays during a competition.

Below are screenshots of an iPad app developed in Adobe Flash Professional utilizing AIR for iOS:


iPad
8:01 PM
47%
DIGITAL PLAYBOOK
OFFENSE
DEFENSE
POSITIONS
GAMES



Summary
A mobile multimedia educational app developed in Flash and based upon the frameworks of multimedia learning and multiple intelligence theories has the potential to significantly impact the performance of collegiate basketball student-athletes who have a high bodily-kinesthetic and high visual-spatial intelligence; especially incoming freshmen. Mayer states that multimedia learning is more effective with low knowledge learners rather than high knowledge learners of a specific sports domain. The transition from high school to college athletics requires a significant acquisition of knowledge in a short amount of time. Freshmen student-athletes who can acquire this new knowledge and transfer gained knowledge to practice and then competition succeed. Freshmen who are not able to grasp these new ideas tend to be left behind and is one source of a high attrition rate of freshmen student-athletes. A mobile app can aid basketball instruction as providing a tool that augments on-court instruction. Coaches have a limited amount of time for "offensive" and "defensive" review of plays on the court due to NCAA practice time restrictions. Student-athletes can benefit from being able to study these plays anytime, anywhere and at their own pace in an engaged and well designed app on their personal mobile device.

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