A CASE STUDY ON MOBILE MULTIMEDIA LEARNING AND BASKETBALL COACHING

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Master of Arts in Digital Media And Education

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Abstract.

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The purpose of the present study was to investigate the impact of Mobile Multimedia Learning, using Multimedia Content (Animation-Audio-Text) designed on the principles of Mayers Multimedia Learning Approach (1991), in a sports education domain. In particular for the learning of basketball plays, situational tactical tasks set by a coach , which in principle is a problem-based learning environment. The arrival of the twenty-first century has brought with it a new generation of young people who are no longer interested in being educated by traditional teaching methods. We live in an era where the net generation are searching to become part of the learning process by interactively getting involved with multimedia, simulation games, individual self-paced learning modules, problem solving computer games, interactive TV, on-line library, bulletin boards, search engines, distance learning, video conferencing and emails. With this in mind the present study aimed to provide selected basketball Coaches and Players with a number of multimedia animations to aid learning of team plays. The Plays were designed using Mayer's (1991) Multimedia Learning Theory and were delivered using the Apple iPod media device The thesis also investigates other relevant learning theories, the development and design implications of the use of digital media in a contemporary classroom and the function of the tool in reality to facilitate learning in accordance with traditional domain oriented learning approaches.

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CHAPTER 1. Introduction

1.1 Background to Research

From a cognitive psychology perspective, "learning is the act of deliberate study of a specific body of material, so that the material can be retrieved at will and used with skill" (Norman, 1982, p. 3). As a result learning can be perceived as the process of absorbing new information in the form of facts, procedures, or concepts. Learning is also an active process dependent on various learner attributes such as motivation, self-control and self-direction and it is one that takes place in definite situational contexts. Furthermore learning may apply an assortment of assessment paradigms. For instance, a free recall assessment determines the number of items a person can recall from a list or a problem-solving assessment measuring a person's ability to integrate prior knowledge in a new way.

Due to our inevitable association of learning with education in a conventional academic context we are inclined to neglect less traditional areas of education and also less traditional approaches to learning. For example, in contemporary physical education, there is an obvious emphasis, in particular, on the acquisition of motor skills and tactical expertise. This is a complex issue as the process of gaining expertise and storing skill knowledge involves many psychological as well as physical processes. However it is still the traditional learning theories of behaviourism and constructivism that continue to be influential in physical education pedagogy.

The underpinning philosophy of the traditional physical education pedagogy has, at its foundation, the belief that students need to master the technical skill aspects associated with a particular sport as a pre requisite for playing the actual sport. This behaviourist, teacher centred focus tends to follow a part-whole-part approach with students being told what to do and how to do it and then applying this knowledge. Research suggests that this approach reduces levels of student motivation, has an negative impact on overall levels of participation and can impact on the physical activity levels of students in post school years, especially for those who are less skilled (Mandigo & Holt, 2000). Other more learner-centred, inquiry-based approaches informed by or consistent with constructivist learning theory, such as Teaching Games

for Understanding (Bunker & Thorpe, 1982) or Games Sense(ASC, 1991), are consequently considered more progressive.

In general there are many other learning models particularly supportive of the learner-centered and collaborative approach but which have received less research consideration. Their principles often intersect closely with many of the key aptitudes and abilities of learners in the domain. These include Paivio's(1986) Dual-Coding Mental Representations, Siemen's Connectivism Theory (2005a) and Learning Development Cycle (Siemens, 2005b), as well as Gardner's (1999) work on multiple intelligences (MI). Mayers Multimedia Learning approach (1991) develops the dual-coding assumption with the attributes of Multimedia as a complementary learning tool. Multimedia can be thought of as the use of several media for the purpose of communicating information to a person. These media include text, graphics, pictures, animation, sound, and video. (Brown, Lewis, & Harclerod, 1973). Najjars' work on dual-coding and Multimedia Learning (1996) further develops the understanding of Multimedia learning and its delivery using digital media technologies.

Educational practice in general, and in the Sports Domain specifically, is also increasingly influenced by the profile of the Learner. Prensky (2001) surmises that today's students are no longer the people for whom our educational system was designed to teach. They are often referred to as the Net Generation (Oblinger 2005). The Net Generation students have grown up with technology and are being socialized in a way that is vastly different from their parents. A prevailing reliance on new technologies such as mobile phones, iPods, internet, blurs the boundaries between both their social and education experiences. It is also an indication of Mobile Learning becoming more a norm than an exception in the near future.

According to the Wikipedia (2006), "M-learning is the term given to the delivery of training by means of mobile devices, such as Mobile phones, PDAs and digital audio players." Compact personal learning devices, such as Apple iPod, and the ubiquitous cell phone, that store large amounts of data may be carried in a student's pocket (Engadget, 2006). An increasing number of educators (eg. Berkeley, MIT) are also using mobile learning applications, such as educational podcasts, in order to facilitate

and enhance students' learning. Ubiquitous mobile technologies are becoming more important in technology, sciences and healthcare training because of the ability of the technology to be used in a manner suited to modern learning patterns (video, audio, animation, image and text).

Interactive Multimedia Technologies are beginning to gain some traction in the sports research and development field. At the moment such Applications tend to focus on the Sports Analysis and Notation area. In effect as reinforcement tools. Research into the impact of Digital Multimedia on learning in sport education is less widespread. Antoniou (1998, 2006) examined whether Digital learning Environments (DLE), using interactive multimedia, could be suitable to support the development of motor creativity of some students. He found that a DLE, characterized by the digitisation of the course material, the content's delivery via Internet, digital forms of communication, digital tools of expression and social networking, could address the learning procedure and aid communication between students and teacher, and among students themselves. Other relevant research in the area is, as mentioned, rare.

1.2 Significance of Research

The pedagogic and psychological factors influencing sports coaching are well understood and researched yet, there is little established research into the impact of mobile and multimedia technology as an educational and learning tool in a sports context. It would appear to be an ideal field in which to apply these principles. The profile of learners and the content of lessons in Sports Learning / and Coaching environment indicates it could benefit from a multimedia learning approach. For example it is well known that basketball is a complex team game. The content of a basketball game is determined by the diversity of technical elements and the variety of tactical tasks and delivery modes (audio-visual). To achieve that objective the usual coaching scheme (coach–sportsperson) has to be complemented with a planned game environment (situational tactical tasks). In principle it is a problem-based learning environment. Solving the situations (plays) set by the coach in the varying game environment improves both the technical performance and tactical intuition and potential for success. (Bazanov 2007). Therefore effective Teaching and Learning of these principles is a fundamental issue in coaching.

1.3 Aims of the Research

The aim of this research is twofold.

1. To investigate if Mayers and Najjars concepts of Multimedia Learning Theory apply to a sports learning environment.
2. To investigate how the use of a Mobile Multimedia Learning Tool (podCoaching), designed on the principles of dual-coding and Multimedia Learning Theory, impacts on predominantly Net Generation learners and educators in a sports context (ie. Basketball). In particular does it contribute to an increase in Learning and Understanding of basketball tactical plays.

Establishing the veracity of the research aims will be accomplished using the following methods.

1. Completion and Analysis of a Case Study on the use of a Mobile Multimedia Learning Tool (podCoaching) for coaching basketball tactical plays.
2. By utilising secondary source data abstracted from relevant academic and industry Literature focusing on the subject area

1.4 Definition of podCoaching.

Since the term is central to the text it is advisable to confirm its exact definition. Therefore "podCoaching" is defined as a method for teaching/coaching tactical basketball plays using a Mobile Multimedia Learning Tool delivered through the Apple iPod (or similar device) medium. It is used in conjunction with Traditional Drill Coaching Practice which includes the use of hardcopy text/diagrams and Coach instructions. Conversely "Traditional Drill Coaching Practice" defines a method for teaching/coaching tactical basketball plays excluding use of podCoach.

1.5 Tangible issues

It is not the purpose of the thesis to investigate the design of the podCoaching content but rather to investigate if the inherent properties of Mobile Learning and Mayers Multimedia and Learning theory are effective in a sports learning context. Specific

questions to be addressed relate to this Mobile Multimedia Learning Approach. Such as:

- Does it contribute to the learning and understanding of basketball plays
- Does it complement or enhance existing coaching practices used in the learning environment.
- Does it apply to sports learning.

A secondary consideration is to evaluate the impact of PodLearning on the extrinsic issues relevant to the sports domain. Specific questions to be addressed are:

- Does podCoaching increase productivity in training and match environments
- Does podCoaching reduce time learning plays
- Does podCoaching improve player participation rate

1.6 Thesis Structure

This study is comprised of a number of different chapters. Chapter one is a review and analysis of previous literature relevant to the research. This includes a review of Learning Theory, with particular emphasis on Multimedia Learning. A review of socio-educational issues relevant to the Net Generation and also it considers current pedagogical and technological issues that arise in physical education. The chapter will finally review the design and presentation of multimedia software within and e-learning and mobile learning context and present considerations that must be adhered to if such content is to facilitate learning in a positive direction. Following the literature review, the methodology chapter outlines and explains the process involved in the planning and design of evaluation policies for integration, by coaches and players, of the podLearning content into their coaching structures and any limitations that exist. Chapter four will attempt to present the information gathered from the various methods of data collection employed. The information will be presented so that each issue from the research aims will be addressed. The final section of this study will consist of a discussion of the impact the content has had upon learners and educators in the chosen field. closely followed by the study's conclusion where recommendations for future studies will be made.

1.7 Scope and limitations

The thesis aims to focus on three focus groups involved in the field. Novice, Intermediate and Expert players. The Coaches will also play a significant role as their feedback is essential to determining the success of the learning approach (podLearning). The research carried out is limited to amateur teams so the significance on professional game/players is not addressed. Also the research was carried out over an intensive 4 week period. The data could be improved by allowing a year or season long intervention. The data however is still of significance.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Chapter two is a review and analysis of previous literature relevant to the research. This includes a review of Learning Theory, with particular emphasis on Multimedia Learning. A review of socio-educational issues relevant to the Net Generation and current pedagogical and technological issues that arise in physical education. Finally the chapter will review the design and presentation of multimedia software within and e-learning and mobile learning context and present considerations that must be adhered to if such content is to facilitate learning in a positive direction.

2.2 Learning Theories

2.2.1 Behaviourism

Behaviourism is a theory of animal and human learning that only focuses on objectively observable behaviours and discounts mental activities. Followers of this trail of thought consider learning as nothing more than the acquisition of new behaviour[1]. As one of the oldest theories of personality, behaviourism dates back to Descartes, who introduced the idea of a stimulus and called the person a machine dependent on external events whose soul was the ghost in the machine. Behaviourism takes this idea to another level.

Ivan Pavlov identified learning as an observable behaviour as a result of humans associating specific environmental stimuli with specific behavioural responses (O'Grady, 2001). The seminal work of Pavlov identified that such associations are built up through two processes, namely, classical conditioning and operant conditioning. (it is important to note that in the field of behaviourism learning is often termed conditioning). It was illustrated by Pavlov's classic research into the salivation process of a dog with the sight of food.

Edward Thorndike was leading the way forward with behaviourism in America. From his evolutionary research Thorndike (1989) questioned the work of Pavlov and suggested that learning was not as simple a process as Pavlov made out and he argued that more complicated behaviour was influenced by anticipated results, not by a

triggering stimulus as Pavlov had proposed (Naik, 2005). Thorndike categorised his thoughts of learning under the behaviourism umbrella under two hypotheses, which he termed the law of exercise and the law of effect (www.ship.edu/~cgboeree/beh.html).

Skinner's advancement in theoretical learning suggested that any behaviour followed by a reinforcing stimulus results in an increased probability of that behaviour occurring in the future. Similarly, it is suggested that any behaviour that is no longer followed by the reinforcing stimulus results in a decreased probability of that behaviour occurring in the future (Boeree, 2005). In this way humans acquire a repertoire of behaviour and knowledge, which is literally 'shaped' by the environment (Tennant, 1997).

In terms of teaching and learning, behaviourism has manifested itself in creating a systematic approach to teaching and it's foundations lie in the concept of reinforcement by way of repetition, instructional cues, drill and practise processes to strengthen the exhibition of desired behaviour.

To teach under behaviourist principles Tennant (1997) concludes that teachers and students should be clear about what it is that they are trying to learn. To learn, clear guidelines and specific learning outcomes for teachers and learners must be established using verbs that refer to observable behaviour in order to make learning intent unambiguous. Such terms include 'describe', 'distinguish' and 'explain'.

2.2.2 Constructivism.

Constructivism is a psychological theory based on a combination of a subset of research within cognitive psychology and a subset of research within social psychology (Huitt, 2003) that construes learning as an interpretive, recursive, building process by active learners interacting with the physical and social world (Fosnot, 1996). It is a philosophy of learning founded on the premise that, by reflecting on our own experiences, we construct our own understanding of the world we live in.

The growth in the theory of constructivism emerged during the mid 20th century when researchers became dissatisfied with the output and explanations of behaviourism

(www.cocc.edu/cbuell/theories/cognitivism.html). Two of the leading researchers to make competent indents in the understanding of learning under this theory were Jean Piaget and Lev Vygotsky both of whom emphasised the importance on two different components of constructivism which overall led to the establishment and development of two types of constructivism, namely cognitive constructivism and social constructivism (Huitt, 2003).

Cognitive constructivism is based on the work of developmental psychologist Jean Piaget who identified that learning occurs in different stages of human development. Piagetian epistemology of cognitive development suggests that humans cannot be given information that they automatically understand and use; they must in fact construct their own knowledge through experiences (Fosnot, 1996). In other words, children engage in qualitatively different kinds of thinking as they pass through various stages of development (Marsh, 2005).

The second type of constructivism, termed social constructivism, is a theory developed by psychologist Lev Vygotsky and is a theory similar to Piaget's theory of age related learning with the exception that Vygotsky places more emphasis on the social context of learning and places the role of the teacher in the learning process with greater esteem. According to Epstein (2002) Vygotsky's theory states that students can, with the help from others who are more advanced, grasp concepts and ideas that they cannot understand on their own. Overall, constructivism encourages learning through discovery but it does leave room for guidance from other people.

2.2.3 Multiple Intelligence Theory

Gardner (1999) defined intelligence as a "*biopsychological potential to process information that can be activated in a cultural setting to solve problems or create products that are of value in a cultural setting*" (p.34). In other words, Gardner (1999) suggests that intelligences are not things that can be seen or counted; they are potentials that will or will not be activated, depending on the values of a particular culture, the opportunities available in that culture and the personal decisions made by individuals, families, schoolteachers and others. According to Gardner (1999) there are seven different types of intelligence which accumulate to form the products of his

multiple intelligence theory and he points out that many of our schools and universities are missing some of these intelligences as a result of our traditional unidimensional teaching methods (Dickinson, 2005) that have scarcely changed in the past century (Hoerr, 2005). These various types of intelligences include linguistic intelligence, logical-mathematical intelligence, musical intelligence, bodily-kinaesthetic intelligence, spatial intelligence, interpersonal intelligence and intrapersonal intelligence.

2.2.4 Paivio's Dual Coding And Mental Representations

The dual coding theory proposed by Paivio (1986) attempts to give equal weight to verbal and non-verbal processing. The theory assumes that the first cognitive subsystems specializes in the representation and processing of nonverbal objects/events (i.e., imagery), and the latter specializes in dealing with language. Paivio found that shown a rapid sequence of pictures as well as a rapid sequence of words and later asked to recall the words and pictures, either in order of appearance, or in any order they wanted, students were better at recalling images when allowed to do so in any order. Participants, however, more readily recalled the sequential order of the words, rather than the sequence of pictures. These results supported Paivio's hypothesis that verbal information is processed differently than visual, information and that verbal information was superior to visual information when sequential order was also required for the memory task.

Each channel also has limitations. For example, humans have difficulty simultaneously attending to multiple auditory or visual cues, depending on expertise with the task or prior knowledge with the subject area. A multimedia presentation that shows multiple visuals such as an image of a speaker as well as the text that the speaker is reading, such as a series of bullet points, could overwhelm the viewer, depending on the person and the situation, because the viewer must now attend to two images. However a television documentary showing images of plant and animal life in a rain forest while also simultaneously providing descriptive narration could potentially provide for improved learning using the dual-code theory because the visual and verbal information do not compete with each other.

2.2.5 Siemen's Connectivism Theory and the Learning Development Cycle

"Our ability to learn what we need for tomorrow is more important than what we know today. A real challenge for any learning theory is to actuate known knowledge at the point of application." (Siemens 2005).

When knowledge, however, is needed, but not known, the ability to plug into sources to meet the requirements becomes a vital skill. As knowledge continues to grow and evolve, access to what is needed is more important than what the learner currently possesses.

Connectivism presents a model of learning that acknowledges the tectonic shifts in society where learning is no longer an internal, individualistic activity. How people work and function is altered when new tools are utilized. Connectivism provides insight into learning skills and tasks needed for learners to flourish in a digital era.

The limitations of Behaviorism, Cognitivism, and Constructivism are also of concern to Siemens. A central tenet of most learning theories is that learning occurs inside a person. These theories do not address learning that occurs outside of people (i.e. learning that is stored and manipulated by technology). Learning theories are concerned with the actual process of learning, not with the value of what is being learned. When knowledge is abundant, the rapid evaluation of knowledge is important. Additional concerns arise from the rapid increase in information. The ability to synthesize and recognize connections and patterns is a valuable skill.

Many important questions are raised when established learning theories are seen through technology. Siemens suggests that by including technology and connection making as learning activities begins to move learning theories into a digital age. We can no longer personally experience and acquire learning that we need to act. We derive our competence from forming connections.

The principal of Chaos is introduced as a new reality for knowledge workers. Chaos is the breakdown of predictability, evidenced in complicated arrangements that initially defy order. Unlike constructivism, which states that learners attempt to foster

understanding by meaning making tasks, chaos states that the meaning exists – the learner's challenge is to recognize the patterns which appear to be hidden. Decision making is indicative of this. If the underlying conditions used to make decisions change, the decision itself is no longer as correct as it was at the time it was made. The ability to recognize and adjust to pattern shifts is a key learning task.

2.2.6 Mayers Cognitive Theory of Multimedia Learning.

The term "multimedia" has been used for decades (Brown, Lewis, & Harclerod, 1973) and can be thought of as the use of several media for the purpose of communicating information to a person. Multimedia is being used increasingly for educational purposes, especially via computer. One reason for this increase is that a computer-based multimedia tutorial allows the instructional designer to use a variety of media to present the learning material. These media include text, graphics, pictures, animation, sound, and video.

For many reasons computer-based multimedia instruction has enormous potential for improving learning. Not only is it possible to use the most effective medium to communicate information, but, once created, multimedia instruction can be easily and cheaply copied. This allows the instructional developer to minimise the cost of development and to increase the available number of potential students. There is also a parallel between multimedia and the ‘natural’ way people learn, as explained by the Information Processing Theory. This is due mainly to the dual coding aspect of the information processing theory outlined by Paivio (1986). Dual coding refers to using more than one code in the learning process. Several studies have shown that two media improve learning better than one medium. Mayer delineates three views of “multimedia” for learning.

1) in terms of the medium of delivery,
2) in terms of its presentation modes, its re-presentational formats, and
3) in terms of the sensory modalities used to process the material.

The focus on the first view, the delivery media, is “technology-centered” rather than human-centered. The focus of the latter two views is human- or “learner-centered”.

Concern for the presentation modes and sensory modalities is based in cognitive theory on how people learn and this is what drives the design. Also, these two views take a constructivist learning ideology, i.e. that knowledge is actively constructed rather than transmitted and passively acquired.

Mayer's cognitive theory specifically ascribes to a "Dual Channel Assumption" which basically assumes that humans have separate information processing channels for verbal and pictorial information, or (to put it in terms of the sensory modalities) for auditory and visual stimulus. From a cognitive psychology perspective, "learning is the act of deliberate study of a specific body of material, so that the material can be retrieved at will and used with skill" (Norman, 1982, p. 3). So, learning can be thought of as the process of assimilating new information such as facts, procedures, or concepts.

With Multimedia Learning theory, Mayer is proposing that multimedia can be used to design material that optimizes learning, and that an optimal condition for learning (information processing) is a combination of auditory and visual, words and images, presented to minimize extraneous cognitive load and maximize learning in terms of retention and transfer of knowledge.

2.2.7 Najjars Multimedia Information and Learning.

Najjar (1996) investigated the assumption that multimedia information helps people learn. He examined how classroom lectures compared to multimedia instruction using a review of current research. For example: Over a wide range of students and topics, meta-analyses by (Bosco, 1986) found that learning was higher when the information was presented via computer-based multimedia systems rather than traditional classroom lectures. Another very significant finding was that learning appeared to take less time when multimedia instruction was used. A Study by Kulik, Bangert, and Williams, 1983, cited by Najjar (1996) , shows a 36% savings in learning time.

The core of Najjars findings addressed situations in which multimedia helps people learn. There is empirical support for concluding that multimedia information provides learning advantages in several specific situations.

1) When the Media Support Dual Coding of Information

According to dual coding theory (Paivio, 1971, 1986, 1991; Clark & Paivio, 1991), information is processed through one of two generally independent channels. One channel processes verbal information such as text or audio. The other channel processes nonverbal images such as illustrations and sounds in the environment. Information can be processed through both channels. This occurs, for example, when a person sees a picture of a dog and also processes the word "dog."

2) When the Media Support One Another

Levie and Lentz (1982) found that text accompanied by illustrations describing the text was understood better by children than text not accompanied by illustrations. Multimedia information seems to improve learning when the media show closely related, supportive information. Suppose a television documentary shows images of plant and animal life in a rain forest while also simultaneously providing narration that describes the animal life. This potentially provides for improved learning using the dual-code theory because the visual and verbal information does not compete with each other.

Support for this is demonstrated by Bransford and Johnson (1972). Short, ambiguous text passages were presented to high school students. Before seeing each passage, one group of students saw a picture that explained the ambiguous text. The researchers believed that this picture provided a context for understanding the ambiguous text. The students who saw the picture recalled more ideas from the text than the students who did not see the picture. It appears that the picture helped the students to interpret the meaning of the text.

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3) When Media Are Presented to Learners with Low Prior Knowledge or Aptitude in the Domain Being Learned

Multimedia information appears to be more effective for learners with low prior knowledge or aptitude in the domain being learned. Mayer (1993) believes that this is because the multimedia helps low domain knowledge

learners to connect the new knowledge to prior knowledge or, for learning systems such as bicycle tyre maintenance, to build a cognitive model of the system. Multimedia may also make more important information more obvious.

However, learners with high domain knowledge have a rich source of prior knowledge that can be connected to the new knowledge. These learners can make these connections or build cognitive models with text alone. Also, learners with high domain knowledge are more likely to know which information is important and on which information they should focus their attention.

Najjar has also significant observations on combining Media for Learning. There is empirical support for concluding that certain media combinations seem to be better than others for helping people to learn specific kinds of information. These combinations may encourage the information to be processed in a way that is easier to encode, store, retrieve, and use.

Multimedia may also improve learning by allowing instructional designers to use the most effective medium to present specific information. The relevant areas to this research are outlined in Table 2.1.

• Problem solving	Animation with explanatory verbal narration
• Spatial information	Pictures

Table 2.1: Effective Medium To Present Specific Information

The areas are defined in more detail as:

Problem-Solving Information

To absorb or learn problem-solving information, an animation with verbal narration was shown to be effective (Mayer 1991, 1992). People who saw an animation with verbal narration did better on a bicycle tyre maintenance problem-solving test than

people who got no training, saw the animation only, or heard the verbal description only.

Spatial Information

Illustrations are superior to text when learning spatial information. Research by Bartram (1980) arranged for college students to learn how to get from a starting point to a destination using a minimum number of buses. The study found that the students learned the bus route information more quickly when they used a map than when they used lists. Bartram believed that the students performed a spatial task, and the maps were superior to lists because the map presentation of information is consistent with people's preferred internal representation of spatial information.

2.3 Social Changes and the Net Generation.

It has been identified that children today are being socialized in a way that is vastly different from their parents (Prensky, 2001b). Prensky surmises that today's students are no longer the people for whom our educational system was designed to teach. They are often referred to as the Net Generation (Oblinger 2005).

2.3.1 Who are the Net Generation ?

The Net Gen students have grown up with technology. Considering College students born around the time the PC was introduced, 20 percent began using computers between the ages of 5 and 8. Virtually all Net Gen students were using computers by the time they were 16 to 18 years of age. Computer usage is even higher among today's children. Among children ages 8 to 18, 96 percent have gone online. Seventy-four percent have access at home, and 61 percent use the Internet on a typical day.

Individuals raised with the computer deal with information differently compared to previous cohorts: "they develop hypertext minds, they leap around." A linear thought process is much less common than bricolage,or the ability to or piece information together from multiple sources. Among other differences are their:

- Ability to read visual images—they are intuitive visual communicators
- Visual-spatial skills—perhaps because of their expertise with games they can integrate the virtual and physical
- Inductive discovery—they learn better through discovery than by being told
- Attentional deployment—they are able to shift their attention rapidly from one task to another, and may choose not to pay attention to things that don't interest them
- Fast response time—they are able to respond quickly and expect rapid responses in return.

2.3.2 Properties of NetGen Students

Although many observations can be made about the Net Generation, several merit special mention because of the potential impact on higher education..

2.3.3 Implications for Learning

Learning is participatory; knowing depends on practice and participation. Digital resources enable experiential learning—something in tune with Net Generation preferences. Rather than being told, Net Generation students would rather construct their own learning, assembling information, tools, and frameworks from a variety of sources.

Educating students is the primary goal of educators. However, reaching that goal depends on understanding those learners. Only by understanding the Net Generation can educators create learning environments that optimize their strengths and minimize their weaknesses. Technology has changed the Net Generation, just as it is now changing education.

2.4. E-learning and Mobile learning.

2.4.1 E-Learning

Information Communication and Technologies (ICTs) provide a window of opportunity for educational institutions and other organizations to harness and use technology to complement and support the teaching and learning process. E-learning is an example of the use of these ICT-supported teaching and learning methods whose use in educational institutions is gaining momentum with the passage of time (Omwenga, June 2004). In this regard the emerging and evolving changes in the teaching and learning requirements and needs will be addressed in this paper.

Educational systems around the world are under increasing pressure to use the new information and communication technologies (ICT) to teach students the knowledge and skills they need in the 21st century. Within the past decade, the new ICT tools have fundamentally changed the way people communicate and do business. They also have the potential to transform the nature of education: where and how learning takes place and the roles of students and teachers in the learning process.

2.4.2. The Constructivist Approach Vs. Intelligent Teaching and Methodologies

Duffy et al. (1993) has identified tools for building a Constructivist Learning Environment (CLE). In his article 'Designing constructivist learning environments', Duffy emphasises Problem/Task Representation Tools as being helpful in developing the Learners' mental models of objects, systems, or other phenomena that bring about visual/spatial capabilities. Visualization tools help learners to construct those mental images and visualize activities. Static and Dynamic Knowledge Modeling Tools on the other hand enable learners to use dynamic modelling tools for building simulations of those systems and processes and for testing them. Already, most e-learning environments take into consideration these new approaches to teaching and learning.

2.4.3 Mobile Learning

In 2008 the ISO undertook a study to review the definitions and gather information on mobile learning around the world. The Group recommended that the definition of

mobile learning should be:

> "Learning using mobile wireless technologies in a way to facilitate learner's mobility in different contexts" (ISO 2008)

The reasons commonly advanced for the adoption of mobile learning and teaching devices in education are usually economical, political and educational. Many scholars underline a link between the introduction of technologies in teaching and the budget constraints of North American universities (Broad & al., 2004; Campbell & Pargas, 2003). A number of educational institutions acclaim the unique advantages proposed by these technologies: together with e-learning programs, open distance education, mobile learning devices seem to be a solution to resolve main budget problems.

The ISO study also outlined the importance of underdtanding Learner Information.to determine how learning materials may be developed for mobile learning and the infrastructure and support required for the learner. This section on learner information for mobile learning is organized using the dimensions proposed by Joh and Kinshuk (2005).

2.4.4 Mobile Learning model

Designers tend to ignore the user of the devices when they develop multimedia materials for mobile devices. Different learners have different learning styles and some learners may be more visual while others may be verbal. Pictures and graphics can be used as overviews to give learners the big picture before they go into the details of the information. For the active learners, information can be presented on the mobile device and then give the user the opportunity to apply the information. For the creative users, there must be opportunities to apply the information in real life applications so that they go beyond what was presented.

- The learning should be self-directed where the learner controls the speed of the learning.
- Learning should be ubiquitous where learning can take place anywhere and at anytime.

- There should be instant connectivity with mobile devices.
- Learners should build a learning community for collaboration.

2.4.5 User preference

- The mobile learning system must take into account the learner-preferred mode of learning and prescribe learning materials based on the student learning style.
- Learning materials must be designed to cater for different learning styles and learner preferences. Mobile devices with multimedia capabilities allow for the delivery of learning materials in different mode to cater for the different learning styles. Mobile learning materials could include audio, video, animation, pictures, photographs, and texts.
- The mobile devices interface must adapt to the user rather than the user adapt to the interface. The interface can be graphical and should present limited information on the screen to prevent information overload in short-term memory.

2.4.6 Motivation

Learners must be motivated to learn in any situation. Hence, mobile learning materials must use strategies to continually motivate and engage the learners.

2.4.7 Multimedia

Mobile devices must have multimedia capabilities to meet the needs of those with different learning styles and accessibility requirements. Recent research studies have shown the benefits of the use of mobile phones with multimedia capabilities in language learning. Researchers are currently investigating the use of voice input for mobile devices to improve efficiency when inputting data into mobile devices. For example, voice input may be supportive for use in learning activities related to field work in engineering and science and in many learning situations, especially language learning.

2.4.8 Pedagogy

Mobile learning materials must be developed based on learning theories appropriate to the intended context and level of education, and must use content reflecting the learning situation.

2.5. Sports Coaching Pedagogy

2.5.1 Introduction.

This section outlines and discusses traditional role of behaviourism and constructivism as influences on contemporary educational approaches and the development of innovative practice and research in sport and physical education pedagogy over the past decade. This usually involves drills that are separate from the game and in which isolated technique is "mastered" as the players strive to imitate a model usually demonstrated by the coach. In this approach there is clearly defined and pre-determined knowledge that the coach strives to embed in the players. It also introduces the concept of Cognitivism as a key component in future educational approaches for the Net Generation.

2.5.2 Behaviourism in Sport .

Behaviourism is recognized as a Teacher-Centered approach and it is a common leadership style for many coaches. Coaches who pat their players on the back after making a good play or express disappointment or anger after an unwelcome performance are practicing behaviorism also referred to as behavior modification.

This approach is based on the contention that a human behavior is shaped or reinforced by its consequences. Reaching a goal or receiving a reward, then, is dependant on performing certain desirable behaviors. As a behaviorist you can cause certain behaviors that have a desirable outcome, or an increase of behaviors occurring in the future. Hence it is recognised as suiting the classic Motor/Skill Learning requirements of sports.

Contemporary writing in the sport and physical education pedagogy field is critical of this approach for a range of reasons. Among these is the lack of relevance to the game that techniques developed in isolation from game conditions suffer. The lack of intellectual development in the form of tactical and strategic understanding and decision-making ability, player independence from the coach. Player motivation at training, and the ways in which it discourages creativity and innovation. Critics argue that players do not need direct instruction on how to play. Instead, they need to

be placed in game-like environments structured to help players learn in context and to be able to solve the range of problems they are faced with in team games without having to turn to the coach (Light, 2007).

With the more student centered cognitive revolution came an associated interest in the processes responsible for learning new behaviours and concepts related to information processing.

2.5.3 Constructivism and Cognitivism in Sport

While the academic curriculum in most Western schools has been informed by constructivism for the past thirty to forty years, physical education and sport coaching have really only begun to draw on this learning theory over the past decade.

Contemporary views of learning reject the division between learner and learnt and the view of knowledge as an object. From as early as the 1960s and 1970s there have been some teaching approaches that are reasonably consistent with constructivist theory but, the rigorous application of learning theory to practice is a far more recent occurrence. Teaching and coaching approaches such as Teaching Games for Understanding ([TGfU], Bunker & Thorpe, 1982), Game Sense (Light, 2007) and Sport Education (Seidentop, 1994) are all student/player-centred, inquiry-based approaches informed by, or consistent with, constructivist learning theory.

2.5.4 Game Sense and TGfU

Game Sense and TGfU provide alternatives to traditional coaching approaches. TGfU is a pedagogical approach to teaching games that breaks from a traditional approach based upon the assumption that learners need to learn basic techniques used in games before learning the game. In contrast, TGfU views learning games as a holistic process to place all learning within modified games and uses questioning of learners in place of instructing them. It does not separate the learning of technique from the other aspects of game play. In TGfU the teacher designs a learning environment and encourages students to work together to solve the problems that typically arise in any game. He/she typically tends to guide learning through open-ended questioning rather than by using direct instruction.

Games Sense is an Australian variation developed for coaching. Research conducted in schools and universities over the past decade suggests that Game Sense, TGfU and similar approaches are significantly more engaging for students and more relevant to them (see for example, Chen & Light, 2006; Light, 2002). Owing to their effectiveness, approaches such as Game Sense and TGfU have also been applied to physical education teacher preparation programs in higher education settings (see for example, Light & Georgakis, 2005). Others have successfully applied a similar student-centred, problem-based approach to physical education teacher preparation programs (Macdonald, 2004).

2.5.5 Sport Education model

Siedentop (1994) suggests that the form of physical education currently dominating programs in North America, in Australia, and the UK too (e.g. Kirk & Macdonald, 1998), is the multi-activity curriculum.

The multi-activity curriculum typically offers students short sequential though unrelated units in a wide range of sports and other activities. Teaching specific sports techniques out of context may be less challenging than teaching skills and tactics in game contexts.

According to Siedentop (1994) “physical education...teaches only isolated sport skills and less-than-meaningful games.” (Siedentop, 1994, pp. 7-8)

He proposes that the key learning outcomes for Sport Education are the development of competent, literate, and enthusiastic sports persons. A competent sports person is someone one who has developed skills and strategies to the extent that he or she can participate successfully in a game. The educative goal, according to Siedentop, is concerned with the development of knowledge and skills in, about, and through the medium of organized physical activity.

2.5.6 Skill Acquisition

The question of how people acquire novel motor skills has long been a topic of interest. It is not the purpose of this paper to evaluate the learning approaches for

motor control. However it is relevant as it highlights the significant research emphasis on traditional learning approaches for motor learning.

Skill acquisition research dates back to the early work of the behaviourists (e.g. Thorndike, 1927; Skinner, 1953), when the outcome of the movement and the determination of environmental contingencies were of primary significance. With the cognitive revolution came an associated interest in the processes responsible for learning new behaviours and concepts related to information processing.

Hollier (2008) also defines skill as "Sports Sense". He states:

> "Execution of a particular motor function, kicking, throwing, catching is technique. Execution at the right time and place is skill" (Hollier 2008).

He goes on to question if there is an innate sense about the game some practitioners are born with or is it they have been taught at such an early age that they perform skills without thinking. Therefore there is an argument centered around the question of whether or not it is possible to teach skill or sports sense

Andre Joubert in a post-match interview in which he was asked what had been going through his mind as he made the decision to attack in a certain way. He replied;

> "I don't know, I don't think about it. It was there and I took it."

This example was offered in support of players having a natural intuition, or "Sport Sense", that just can not be taught. Some (Hollier 2008) argue , however, that it was precisely because he had been taught, and learned it so well that he could no longer put it into words.

Hollier argues that for the very best exponents of sports skills there are very Natural Processes that happen in the mind of an expert on the way to gaining that expertise. He maintains that skilled practitioners store their skill knowledge differently than storing the answer to a question. He uses the example of demonstrating how to tie a shoelace. The knowledge to explain this is stored in our memory in a way other than a

list of sentences. It is stored in Procedural Memory as a series of actions based on Visual Cues. So what are these natural processes ?

2.5.6.1 Non conscious behaviour

Intuition is merely learned behavior and decision making processes that have become so well learned that they have become automatic. The term for this is "non-conscious". Non-conscious behavior is just that: it is not available for conscious observation. If you have ever driven home and suddenly realized that you can not remember the last 20 kilometres, you have experienced this. You made decisions based on what you saw and you did not consciously observe the process. This automatization takes time and practice (repeated execution). Sports coaching can be said to deal with maximizing a players' ability to do this naturally, in a sports context, by giving players controlled situations in which to practice the behaviours. (Hollier 2008)

2.5.6.2 Perception

The sport of basketball would seem to require skill in perceiving as a component for successful performance. Many team sports (such as football, soccer, and hockey) involve strategies and tactics designed to gain points, yards, or space from opponents in an optimal and systematic fashion, not unlike chess. A comparative study ,(Allard,Graham, Paarsalu, 1980, demonstrated that the encoding of structure is an important element of skill in the "cerebral" games of chess and bridge.

Chess players are very good at recognizing patterns (meaningful patterns that is). Repeated exposure made them meaningful as the realization that valuable options came with these particular patterns. Rarely does the very next move win the game or take a valuable piece. It is a series of preliminary moves to get into position and then strike. This can be applied as a definition of the required goals of sports such as basketball.

2.5.6.3 Memory Chunking and Patterns

In 2009, Ron Brace began his career as a professional football player with the New England Patriots American Football team. He was handed a document and for a moment he wondered why he was being given a copy of the Manhattan telephone

directory. Then, to his horror, he realised he was holding the Patriot's playbook - and he had to memorise it.

> "It looked like a phone book with a binder around it. It's my job now. I don't have to worry about college lectures. I have to worry about the playbook. ". [2]

The importance of memory for sports practitioners is exemplified by this example. Cognitive psychological research highlights significant developments in the understanding of memory and pattern learning. It has been found that with repeated exposure to the same patterns, the behavioral responses become chunked. "Chunking" is simply a process of grouping smaller bits of information into a coherent larger "chunk" of information. This means that instead of seeing individual moves, the expert sees a whole set of moves. The expert does not necessarily see the next move, but actually sees the 5th or 6th move down the line. This is what lets an expert chess player play 12 people at a time. They do not remember the board, or the strategy of each board between moves. When they return to a board, they "see" the pattern and the set of moves, and continue the game (Chase, Simon, 1973). This is also central tenet to the dual coding theory proposed by Paivio giving equal weight to verbal and visual learning cues.

This is the same thing that a skilled basketball player does when s/he sees the attacking option or the best pass option or the dead end that will happen by the time the ball gets to the wing and the play clock runs to an end.

2.5.6.4 Decision-Making.

Coaching drills tend to focus on teaching individuals how to react in specific situations or, in other words, how to make decisions. Hollier suggests it is wrong to try to do so as the possible permutations make it impossible. Instead, he maintains coaches must help players internalize the process and learn to "see" the options. This is a gradual proccess. It starts with learning basic technique. This gives them a base behavior that they can internalize quickly. This is as far as a lot of coaches get and it relies on a traditional Behaviourist approach. Instead, Hollier encourages a more constructivist approach.. Learners, given a goal and drill examples, are asked to figure out how to achieve the goal. By adding variation to the tasks they learn to see faster

and to know what the situation looks like.

2.5.7. Mental Imagery And Simulation in Sport

The use of Mental Imagery and Simulation in sport to aid learning is well known. Although Mental Imagery is commonly treated as a single entity, its inherent components of imagery and simulation are two distinct psychological approaches to sport training and preparation. Imagery is a psychological technique where the athlete is conditioned to prepare for sport through the use of the mind. Imagery includes the development of set thought patterns, composed of often abstract words or images that the athlete finds helpful in reinforcing the focus on the activity.

Simulation is the mental companion to the physical training involved in sports practice. Simple simulations include the mental rehearsal of sport-specific techniques such as the mental review of all aspects of a foul shot in basketball, from the first approach to the foul line to the ball falling through the cylinder. The live drills used by teams to prepare for competition are the mirror to the mental training and psychological preparation of simulation.

As an example of its acceptance, a survey of Olympians attending the 1988 Seoul Games found that nearly all (over 95%) those surveyed had heard of Mental Practice or Imagery, and most of them understood the concept (Ungerleider, 2008, p5). Many researchers have documented the effects of mental practice and imagery on athletic performance. Investigating the subtle relationship between performance and psychological preparation is a common theme. Researchers such as Feltz and Landers have studied how and when mental practice best improves performance. Their work has highlighted four possible explanations behind why Mental practice and imagery work:

1) The Symbolic learning theory

Imagery may be part of a coding system that actually helps athletes understand movement. The theory says that every move made in life if first coded like a blueprint in our minds and nervous systems, so that if we mentally rehearse an athletic event, we are actually blueprinting each move, making the gestures symbolic and therefore

more familiar to our body chemistry. Mental practice therefore sets the stage for movement to become quite automatic and easy to recall.

2) The Psychoneuromuscalar theory

Mental practice works because even when sitting motionless we can actually produce very small muscular contractions similar to those involved in the actual sport. This has been tested and proved by having athletes mentally rehearse images and then measure the electrical activity in their arms and legs using an electromyography (EMG).

3) Bio-informational Theory

First brought about by doctors trying to explain the connection between imagery and anxiety disorders, staes that if we imagine how we might respond to a certain event, we can better prepare for it.

4) Dual Coding Theory

This theory by Paivio, detailed in section 2.2.4, suggests that athletes receive information by two independent channels or encoding systems. The verbal channel and the motor channel. Simply stated, this means the new skills are better learned if they are both explained to an athlete and then actualised through physical practice. The link between the two channels is known as the action-language bridge.

The bridge is the key to athletic learning. It makes it possible for athletes to describe an action, generate another action, and act on verbal cues

2.5.8 Measuring Learning and Performance in Sport

In technique-led approaches for games teaching the assessment focuses on the decision-making component and a motor execution component as it is believed without tactical awareness and understanding it is difficult if not impossible to play a game (Oslin, Mitchell, & Griffin (1998).

The Game Performance Assessment Instrument (GPAI; Mitchell, Oslin, & Griffin, 1995) provides teachers and researchers with a means of observing and coding performance behaviors that demonstrate the ability to solve tactical problems in games

by making decisions, moving appropriately, and executing skills.

A second procedure was developed by Gréhaigne, Godbout, and Bouthier (1997). This Team Sport Performance Assessment Procedure (TSPAP) provides information that quantifies an individual's overall offensive performance in selected invasion and net team sports, reflecting both technical and tactical aspects of game play.

The GPAI is an observation instrument developed to be used across game categories and it considers a decision-making component and a skill execution component of both offensive and defensive actions. Game performance and game involvement can be calculated after the observation. Its premise is that it recognizes that lower ability players, who may not make appropriate decisions or execute skills efficiently, can still be highly involved in a game (Griffin, Mitchell & Oslin, 1997).

With the TSPAP a player is observed in order to establish two complementary performance indices: the efficiency index and the volume of play. The TSPAP only considers the events or actions related either to the attack or to the offensive aspect of the game. The assessment relies on quantitative data based on the frequency of various events that occur during game play (Gréhaigne et al., 1997).

However the measurement of learning and understanding in sport is on balance an ambiguous and non-quantifiable task. It was noted by Thomas & Thomas (1994) that in sport a player can have an expert declarative knowledge base and yet be inept as a performer.

2.5.9 Basketball

The focus in physical education and especially in basketball, is on developing basic and complex skills, decision-making and adaptation in the team (Kioumourtzoglou and Goudas, 2003).These skills are acquired and mainly developed through practice as they are differentiated by the abilities (Schmidt, Wrisberg, & Wrisberg, 2000).

Technical and tactical aspects of basketball are mainly coached separately. The skilled melting of techniques and tactics into the effectively functioning game is one of the

most important tasks in the professional activity of the coach (Bazanov 2007).
Many believe basketball drills kill student interest and learning. But for others, it is fundamental to learning technique. Basketball coaching legend John Wooden of UCLA advocates the drill, when it is used properly within a balanced approach that also involves developing understanding and initiative. Drill for the coach is intended to achieve a mastery of fundamentals that open up opportunities for individual creativity and initiative. (Wooden 2002).

The continuous use of such practice brings us to the situation where some abilities "function" well in local exercises (dribble, passes, 1:1, 2:2 etc) but does not guarantee the effectiveness in more complex competitive situations. Research by Bazanov (2007) proposed a new holistic coaching system approach, coach–game environment–player. This approach modelled the possible game situations met in the real competition. His proposal states:

> "…One of the most important features of the new methodology is widening the possibility of the players' self-organization during the training process. In principle it is the problem-based learning where obtaining the knowledge, habits and skills put forward the higher demands to include the players' consciousness. Solving the situations set by the coach in the varying game environment improves both the technical performance and tactical intuition."

2.6 Technology And Learning in Sport.

Investment in research and development into technology for sport is prevalent. It is predominantly commercial driven with the main area of emphasis on equipment such as clothing, golf clubs, boots etc. Research into the use of technology and, in particular multimedia, for sports education is less common. However, Interactive Multimedia Technologies are beginning to find traction as sports education tools. At the moment these applications tend to find focus in the Sports Instruction or Sports Analysis and Notation areas. These systems are either instructional such as V1[4], or else enable production and analysis of match/player statistics, for example Dartfish[5], through review of video data. The technology is used for educational purposes but the approach remains behaviourist in tone. The "if you do X, then Y will happen" approach. It remains teacher-centered. Such systems also rely on data gathering and after-match review of performance to aid learning. The role of multimedia technologies and its ability to integrate audio, visual stimulation to aid learning is not investigated.

There are some practical examples of the implementation of Mobile Technologies to aid learning in the sport industry. For example, the Colorado Rockies baseball team in 2006 adopted the Apple iPod as a tool for players to browse useful information about their opponents and review plays before entering the field [3]. It is a prime example of how mobile multimedia can be adopted as an educational tool in a sporting context.

Every year brings new mobile technology products to the market exploiting the demands of sports practitioners. There are several training aid devices based on Global Positioning Satellie and Statistical/Notational Analysis services. The Nike and iPod Sport Kit , although not essentially categorised as a learning tool, does supervise user training programmes and provide useful feedback on user performance. [1]

In general it is thought that new technologies can positively influence a learning environment (Anand, Herrington, & Agostinho, 2008). Physical education, because of its form that includes instructional teaching, demonstration and movement activities' implementation, appeared to constitute a unique field where computers could be used as an instructive tool (Najjar 1996). They are frequently used for teaching cognitive

issues and motor skills in physical education and sports. Mohnsen (1998) identified a number of reasons for using Computer-Assisted Instruction (CAI) in health-related physical education. Among them there are suggestions that CAI provides students with the "why" behind health-related fitness, since it provides unlimited practice, review, and remediation and so students stay actively involved.

Previous studies in physical education have shown that Computer Assisted Instruction is not consistently superior to the traditional forms of instruction, (Skinsley & Brodie, 1990; Antoniou, 1998; Vernadakis, 1999) but most of these studies focused on secondary, high school and college students. It was found that groups using multimedia computer-assisted instruction had better results on the cognitive test but not on the motor skill test than the traditional instruction group.

CHAPTER 3: METHODOLOGY

3.1 Overview

It is the purpose of the thesis to investigate if Mayers and Najjars independent research into Dual Coding and Multimedia Learning, outlined in sections 2.2.6 and 2.2.7 respectively of the Literature review, are relevant in a sports learning context. For effective examination two specific questions will be addressed by this research.

1. Do Mayers and Najjars concepts of Multimedia Learning Theory apply to a sports learning environment.
2. Does the podCoach mobile application, designed using Multimedia Learning Theory, contribute to an increase in Learning and Understanding of basketball tactical plays

In order to answer these research goals, the researcher opted to obtain the views of a range of basketball players and coaches (from novice to advanced levels) in line with this topic. Selected participants used the chosen technology and software during a two month period July-August 2009.

Research data was then gathered through use of online survey questionnaires and interviews conducted by the researcher. Data gathered from this research instrument were then computed for interpretation. Along with primary data, the researcher also made use of secondary resources in the form of published articles and literatures to support the survey results.

3.2 Methodology Chosen

A case study research strategy was adopted for this study. A case study is an empirical inquiry that investigates a phenomenon within its real-life context (eg. basketball coaching) and it allows for both generating and testing hypotheses (eg. Multimedia Learning in Sports Education). Case study research can include single and multiple case studies, quantitative evidence and relies on multiple sources of evidence both quantitative and qualitative. It also benefits from the prior development of theoretical propositions. This is supported and well-formulated in (Lamnek, 2005):

> "The case study is a research approach, situated between concrete data taking techniques and methodologic paradigms."

The main point of the quantitative research method is that measurement (eg. questionnaire, empirical analysis) is valid, reliable and can be generalized with its clear anticipation of cause and effect (Cassell & Symon, 1994). Being particularistic and deductive in nature, quantitative method is dependent on the formulation of a research hypothesis and confirming them empirically using a specific data set (Frankfort-Nachmias & Nachmias, 1992).

The chosen sports environment of basketball and more specifically the predefined participant groups were deliberate choices of the researcher. Random samples emphasizing representativeness will seldom be able to produce accurate insight; it is more appropriate to select Cases chosen for their validity. It is in this context that the particular participant groups, Novices, Coaches and Experts, were selected.

The researcher also used traditional secondary sources with significance to the research area. These included relevant academic papers and journals as well as related internet based articles.

3.3 Participants

In order to determine whether ipod coaching technology (podCoaching) does play an important role in the development and education of basketball players, a total of 42 respondents were asked to participate. To achieve pertinent information, certain inclusion criteria were imposed. The participants qualified for sample selection were all competent basketball players or coaches. Some had not played organised basketball but were familiar with the sport in a recreational form. This qualification ensured that the participants understood the nature of the study and its use as a coaching analysis tool, making the tasks and survey items easy for them to accomplish. The respondents were selected from players and coaches in Ireland and the UK, thus, a total of 32 players (ranging from novice to expert) and 10 coaches (ranging from club to expert) were selected.

In order to conduct a valid sampling strategy three participant groups were chosen. Novice, Expert and Coach,. The properties of the groups are as shown in Table 3.1.

Type	Description
Experts	Players or Coaches above average ability currently playing or coaching at international level.
Novices	Players who have just taken up the sport and have not played representative basketball at any level.
Coach	Coaches between Club and Expert Level.

Table 3.1: Participant Groups

The researcher defined the player population first and selected appropriate participants for the sample groups. 20 Expert and 12 Novice level players were selected. Those selected for the Expert group were members of the Irish Womens u19 Basketball team. The 12 Novice players were selected from students attending Waterford Institute of Technology. The ten coaches sampled were a combination of Expert and Club level coaches. 2 were active as part of the Expert Player groups and 3 were associated with the Novice Player group supervised by the researcher. The remaining 5 were active as coaches in UK and Ireland college basketball

3.4 Research Instruments

All participants were provided with the necessary content to complete the case study. This ensured provision of meritorious data for analysis. The researcher used a combination of tools to create the multimedia drills, including: Adobe Premiere Standard Edition, Windows Movie Maker, 3DCoach, AVS Video Converter 4.3, Nokia 5800 Mobile Digital Voice Recorder.

The Expert group were provided with the podCoach content in both podCoach and supportive hardcopy text formats. The content was designed by the researcher in corporation with the team coaching staff. This content consisted of 3 Expert level basketball tactical plays (See Appendix B). Testing was carried out during the Irish u19 women's basketball tour to the United States in July 2009. The researcher

provided the 12 Novice players with podCoach content in both podCoach and supportive hardcopy text formats also. This content consisted of 3 Novice level basketball plays to learn and execute (See Appendix B). Testing was carried out over a one week period in September 2009 in Waterford Institute of Technology. The ten coaches sampled were provided either with all plays relevant to their participant group or with all 6 plays from both groups in podCoach and supportive hardcopy text formats. This allowed a more general opinion to be formed.

Participants accessed the PodCoaching content via two methods. The first method required users to subscribe to a Podcast made available through Apples proprietary digital media player application iTunes (http://www.apple.com/itunes/). In order to submit the podcasts, the researcher first created an iTunes account, logged in and then uploaded the content. Users subscribe to this podcast using a URL provided by the researcher (http://www.emcsports.com/mobile/Basketball/basketball1.xml), see Appendix A (A1). The URL was emailed to the participating coaches who in turn forwarded it to the players under their supervision. The users then accessed the podcast drills, see Appendix A (A2) and downloaded the video pod casts on to their Apple iPod devices. Six Video Podcast drills were provided. See Appendix B for detailed specification. Three of the podcasts were relevant only to Novice and Intermediate level players. These drills were created by the researcher under the guidance of skilled basketball coach familiar with the type of player involved. The remaining three podcasts were aimed at Expert players and as a result the respective coaches provided the source material for the drill content.

The Second method required users to simply download the video files from a website and they could then transfer the content onto a suitable mobile medium of their own choice. Eg. Laptop, Mobile Phone, iPod, etc. The researcher again provided individual coaches with a URL to access the online directory containing the files. (http://emcsports.com/mobile/Basketball/). This method did require more computing skill and knowledge.

3.5 Questionnaire Design:

The researcher followed approved guidelines for questionnaire design to ensure it provided a sound research tool [6] . The majority of these guidelines dealt with making the questionnaire understandable and free of bias. Eliciting relevant opinions and attitudes to research questions was the main concern. There is a difference between determining the nature of the attitude and determining the intensity of the attitude in a questionnaire. The group of questions that clearly measures a construct can then used as a entity and values or totals can be reported for the constructs. The two different scales that were used to gauge responses, apart from status and profile questions, will now be discussed.

1) Dichotomous scale:

In this case the answer to each question is analysed on its own. The answer to each question is important and must be reported separately. For example:

Do You own and iPod ? Yes No

2) Likert scales:

This type of scale is used to measure intensity of feelings. A specific theoretical construct is supposed and with the help of statistical techniques it can be determined whether the data confirms a research theory.

A number of questions that theoretically measure the construct must be included. Techniques like factor analysis must then be used to ascertain that this is proved in practice. For example:

	1	2	3	4	5
3D Animation helpful ?:	S-Agree	Agree	Unsure	Disagree	S-Disagree

3.5.1 Administering the Scale.

Each respondent is asked to rate each item on some response scale. For instance, they could rate each item on a 1-to-5 response scale where:

1. = strongly agree
2. = agree
3. = undecided
4. = disagree
5. = strongly disagree

All of these odd-numbered scales have a middle value is often labeled Neutral or Undecided. It is also possible to use a forced-choice response scale with an even number of responses and no middle neutral or undecided choice. In this situation, the respondent is forced to decide whether they lean more towards the agree or disagree end of the scale for each item.

The final score for the respondent on the scale is the sum of their ratings for all of the items (this is why this is sometimes called a "summated" scale).

The questionnaire was divided into two sections: a profile and the survey proper. The profile contains socio-demographic characteristics of the respondents such as age, gender, and the level of computer literacy or expertise. This was important as it could reflect user satisfaction. The survey proper explored the perceptions of participants on PodCoaching, particularly on its usability and reliability as a coaching and learning tool. This section also contains questions that identify the advantages and disadvantages of applying the dual coding theory of learning to sports coaching through the use of a specific mobile multimedia application. The questions were structured using a combination of Yes/No ,single sentence response, and Likert formats as outlined above.

The selected questionnaire type enabled the respondents to answer the survey easily. In addition, this research instrument allowed the research to carry out the quantitative approach effectively with the use of statistics for data interpretation. In order to test the validity of the questionnaire used for the study, the researcher tested the questionnaire

to five respondents. These respondents as well as their answers were not part of the actual study process and were only used for testing purposes. After the questions have been answered, the researcher asked the respondents for any suggestions or any necessary corrections to ensure further improvement and validity of the instrument. The researcher revised the survey questionnaire based on the suggestion of the respondents. The researcher then excluded irrelevant questions and changed vague or difficult terminologies into simpler ones in order to ensure comprehension.

3.6 Data Processing and Analysis

The questionnaires were completed online by the respondents, total responses for each item were obtained and tabulated. In order to use the Likert-scale for interpretation, weighted mean to represent each question was computed. Weighted mean is the average wherein every quantity to be averages has a corresponding weight. These weights represent the significance of each quantity to the average. To compute for the weighted mean, each value must be multiplied by its weight. Products should then be added to obtain the total value. The total weight should also be computed by adding all the weights. The total value is then divided by the total weight. Statistically, the weighted mean is calculated using the following formula: Total of Each Response Value/Total Responses. Five values should be returned using this approach.

The survey questionnaire form was hosted online by a commercial Internet Service Provider (hosting365.com). The form URL is: http://www.emcsports.com/form2.html. See Appendix C. All data submitted by participants was automatically forwarded to the researchers email. This allowed a wider range of participants to communicate and complete survey. The data was then retrieved from the researchers email and stored on a conventional Excel spreadsheet for statistical and graphical analysis. See Appendix D. It was then correlated for reponse analysis. See Appendix E.

3.7 Ethical Considerations and Limitations

As this study required the participation of human respondents, specifically human resource professionals, certain ethical issues were addressed. The consideration of these ethical issues was necessary for the purpose of ensuring the privacy as well as the safety of the participants. Among the significant ethical issues that were considered in the research process include consent and confidentiality. In order to secure the consent of the selected participants, the researcher relayed all important details of the study, including its aim and purpose. By explaining these important details, the respondents were able to understand the importance of their role in the completion of the research. The respondents were also advised that they could withdraw from the study even during the process. With this, the participants were not forced to participate in the research. The confidentiality of the participants was also ensured by not disclosing their names or personal information in the research. Only relevant details that helped in answering the research questions were included.

This thesis has some limitations. With respect to the analytical parts of this thesis scrutinizing the existing studies, the limitations are research methodological: one is to do with the reliability of the results of the analysis and another concerns the conceptual-analytical research strategy generally. As to the former issue, a limitation stems from the qualatative research strategy utilized, namely that the results are affected by:

- Opportunites for collecting data on the system were limited. The Novice and Expert groups were addressed but the intermediate groups were not available as the basketball playing season ended before analysis began. This group may be seen as the largest participation group.
- Time constraints again due to seasonal issues limited scope of the project so that results may not be generalisable
- Topics that are addressed may be of limited interest to other non-practical fields of education.
- The lack of comparative mobile learning multimedia applications in real-world practice. This led to a lack of empirical evidence on the usefulness and effectiveness of similar applications.

The structure of online surveys requires that users provide limited explanations to

survey questions. The traditional True/False question can be insufficient for some participants and for the researcher. For example “ Did pod learning reduce time learning plays ?” More data could be provided with a more detailed reply. However surveys can be off putting if too much detail is requested.

CHAPTER 4. FINDINGS

4.1 Introduction.

The purpose of this chapter is to attempt to present and review the information gathered from the various methods of data collection that were employed. I shall attempt to present the unambiguous information collated from participant responses so that each issue from the research aims is addressed in a separate section.

4.2 Review of Research Aims

It is the purpose of the thesis to investigate if Mayers and Najjars independent research into Dual Coding and Multimedia Learning, outlined in sections 2.2.6 and 2.2.7 respectively of the Literature review, are relevant in a sports learning context. For effective examination two specific questions will be addressed by this research.

1. Do Mayers and Najjars concepts of Multimedia Learning Theory apply to a sports learning environment.
2. Does the podCoach mobile application, designed using Multimedia Learning Theory, contribute to an increase in Learning and Understanding of basketball tactical plays

Establishing the veracity of the research questions will be accomplished using the following methods.

1. Analysis of primary source data in the form of the findings of the case study into the use of podCoaching for basketball . The findings are outlined in section A of Chapter 4
2. By utilising relevant secondary source data abstracted from the Literature review content in Chapter 2.

The findings are based on data gathered from the online survey and interviews carried out by the researcher. Overall results are reviewed first followed by a review of User Profile data. The researcher proceeds with an appraisal of results relating to the impact on the learning domain, such as productivity, participation, game and results

quality, followed by the analysis of the educative impact of Najjars Multimedia and learning approach in sports coaching. Finally more general user opinions are analysed with respect to the technologys' practical use and adoption.

4.3 Results

4.3.1 Overall Survey Results

The online survey data containing replies to 21 questions was imported to Microsoft Excel spreadsheet for analysis. Data from 42 respondents was summarised to gain a more consensus view. This resulted in the following data table. Table 4.1

Responses	ALL Values					CANVAS TOTAL	All Values %				
	1	2	3	4	5		SAgree	Agree	Undecid	Disagree	
	TRUE	FALSE					TRUE	FALSE			
	Never	SomeT	Always				Never	SomeT	Always		
	<3	3-5	>5				<3	3-5	>5		
	Fast	OK	Slow				Fast	OK	Slow		
	Coach	Novice	Expert	Null			Coach	Novice	Expert		
	Coach	Player					Coach	Player			
Survey Questions	Novice	Club	Expert				Novice	Club	Expert		None
	m	f					M	F			
Coach or Player ?	10	32				42	24%	76%			
iPod Ownership x Group?	8	10	15	9		42	19%	24%	38%	21%	
Average Age: 1:Coach, 2:Nov, 3:Exp, 4: Total	29	18	17	20							
Gender	13	29				42	31%	69%			
Playing Level ? 1:Novice, 2: Club, 3: Exp	12	5	25			42	29%	12%	60%		
1. Increase understanding	10	17	9	4	2	42	24%	40%	21%	10%	
2. Increase productivity	4	22	14	1	1	42	10%	52%	33%	2%	
3. Reduce time learning	11	22	7	2	0	42	26%	52%	17%	5%	
4. Improve participation	2	25	11	3	1	42	5%	60%	26%	7%	
5. Improve quality :	0	9	14	10	9	42	0%	21%	33%	24%	
6. Aid Interpretation of Drill Text Instructions	6	21	10	5	0	42	14%	50%	24%	12%	
7. 3D Animation helpful	11	16	10	5	0	42	26%	38%	24%	12%	
8. Audio Commentary helpful	6	28	6	2	0	42	14%	67%	14%	5%	
9. Did Audio Commentary Support Animation	8	26	5	2	1	42	19%	62%	12%	5%	
10. Used iPod immed before ?	25	10	7			42	60%	24%	17%		
11. Times to Understand	20	17	5			42	48%	40%	12%		
12. Times Used (Avg)	12	16	8				32%	45%	23%		
13. Learning pace	13	25	4			42	31.0%	59.5%	9.5%		
14. Complemented existing coaching ?	35	7				42	83%	17%	0%		
15. Prefer Traditional	13	29				42	31%	69%			
16. Managed adequately without	22	20				42	52%	48%			
17. General comments on coaching technology ?											

Table 4.1: Profile of Sample Group

4.3.2 User Profile Data

4.3.2.1 Participant Type

There were 42 valid Respondents in the case study. This consisted of 10 Coaches and 32 Players. 76% of sample were Players and 24% Coaches. A valid respondent will have used and evaluated the podLearning tool in practice. **See Figure 1a.**

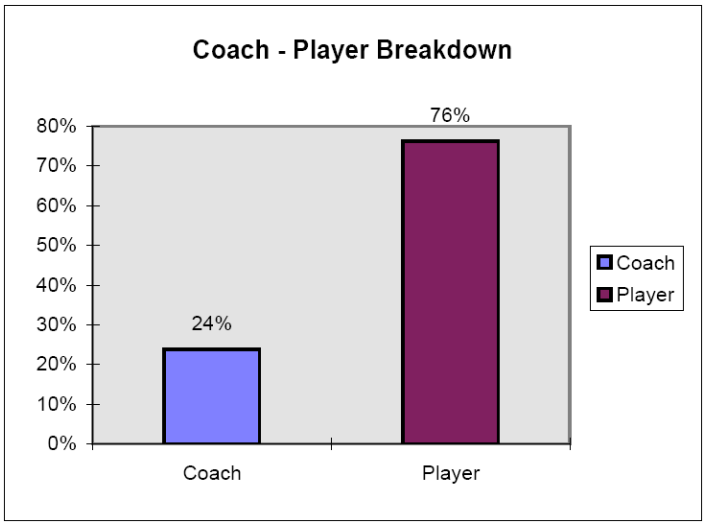


Figure 1a. Participant Type

4.3.2.2 Gender

The Gender breakdown was 69% Female and 31% Male across the range of respondents **See Figure 1b**. All 20 Expert Players were Female as were 3 Coaches and 6 Novice Players.

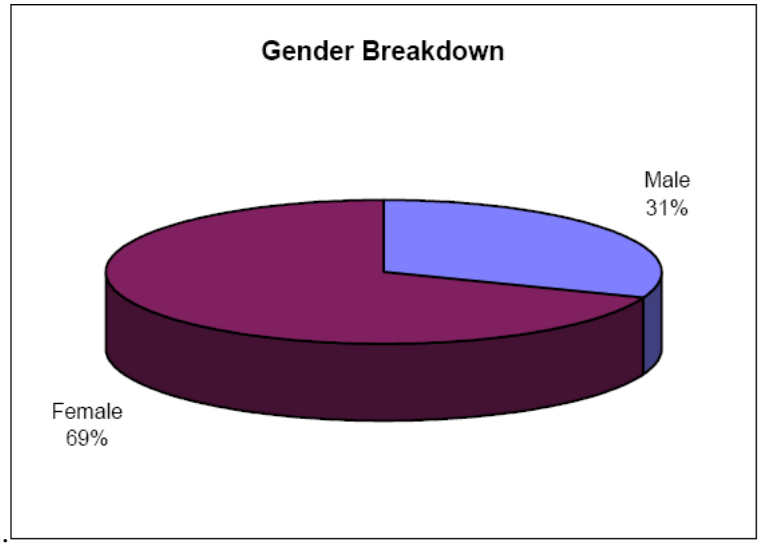


Figure 1b. Gender Breakdown

4.3.2.3 Expertise

Of the 42 survey respondents, 25 were graded as Expert, 12 as Novice and 5 as Club

level players. (**See Figure 1c**) This is a breakdown of 29% Novice, 16% Club and 55% Expert.

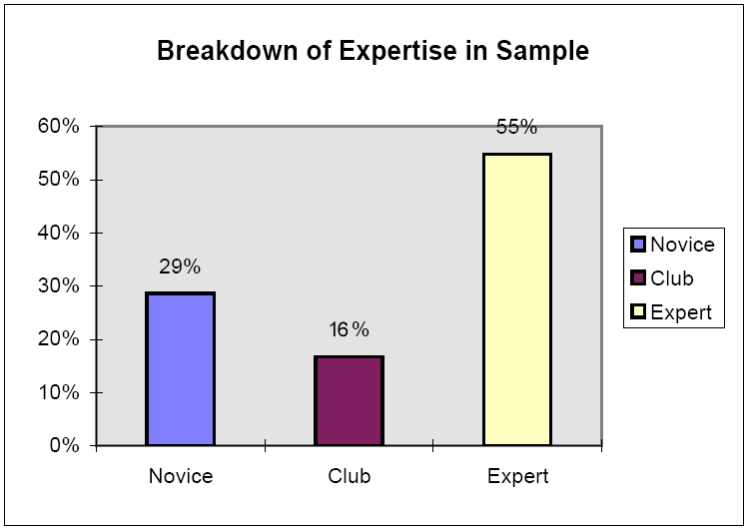


Figure 1c: Expertise Breakdown

Participants graded as Expert or Club could be either a Player or a Coach but not both. Participants graded as Novice could only be Players by definition. See Table 4.2

Type	Description	Comment
Experts	Players and Coaches above average ability currently playing at international level.	Can be either a Player or a Coach but not both
Novices	Players who have just taken up the sport and have not played representative basketball at any level.	Can be Players only by definition
Club	Players and Coaches between Novice and Expert Level. Players of average or above ability who have played representative basketball at a level lower	Can be either a Player or a Coach but not both

Table 4.2: Player and Coach Category

This provided a valid and satisfactory cross section of respondents for analysis. It allowed for a valid and realistic perspective across a range of users. Each unique group contributed significantly to the research. The Coach group provided an Educators Perspective. The Novice and Expert a Learners perspective. Also the learner perspective was enhanced by secondary source research which claimed that Multimedia for Learning benefited the Novice user above the Expert level. This will

be investigated in research discussion stage.

4.3.2.4 Age Profile

The Age profile varied across the Participant Type and Expertise. Expertise in Coaching may be defined differently for a Player. This is projected in the Age Profile. The average age across all participants was 21. Among the expert group it was 17, the Novice 18 and the Coaches 29. **See Figure 1d.**

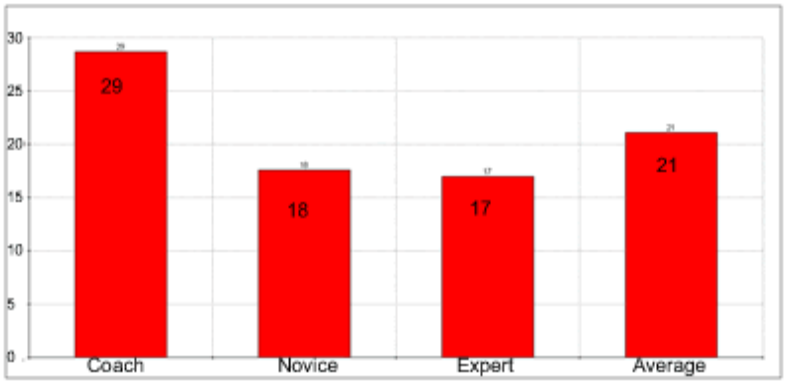


Figure 1d: Age Profile of Participants

4.3.2.5 iPod Ownership

The final criteria choses for survey and relevancy to research was the level of ownership of iPod (or similar Device). The Survey data returned 79% ownership across all sectors. **See Figure 1e**

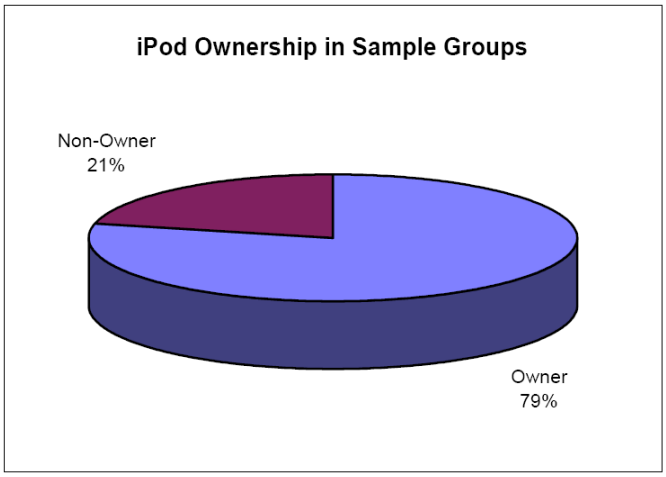


Figure 1e: iPod Ownership

4.3.3 Impact on the learning domain

The researcher proceeds with an appraisal of results relating to the impact of podCoaching on the learning domain, such as productivity, participation, game and results quality. These relate to extrinsic benefits, or otherwise of a Mobile Learning Application based on Multimedia Learning concepts.

4.3.3.1 Improve Coaching / Learner Productivity

Productivity may be defined as improving quantity of work completed during coaching sessions. Perhaps a coach may find that more/less work is accomplished with use of podCoach. 62% Agreed or Strongly Agreed with this issue, 33% were Undecided and 5% Disagreed or Strongly Disagreed. See Figure 2a.

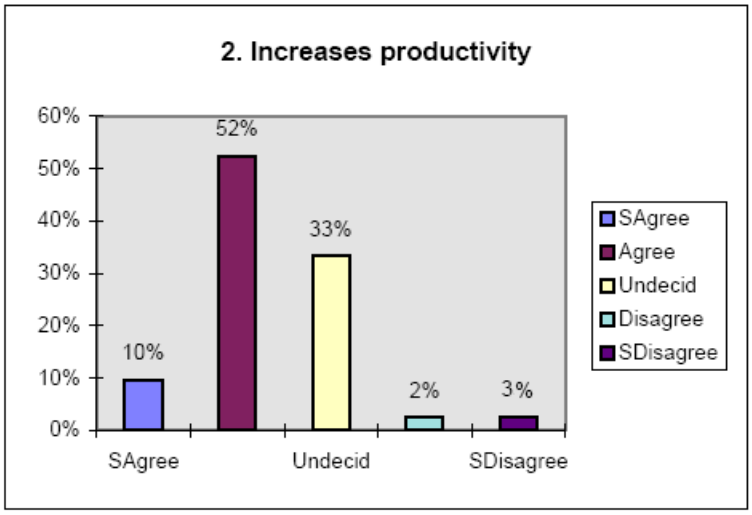


Figure 2a: Improved Productivity through podCoach use

4.3.3.2 Reduce Time Learning Plays

Research has found that learning time appears to be reduced, on average by 36%, when multimedia instruction is used (Kulik, Bangert, Williams, 1983). Therefore the following measure relates to this argument. Reducing Time learning Plays relates to individual plays as opposed to overall productivity in training. Survey shows that 78% of respondents Agreed or Strongly Agreed with the issue.

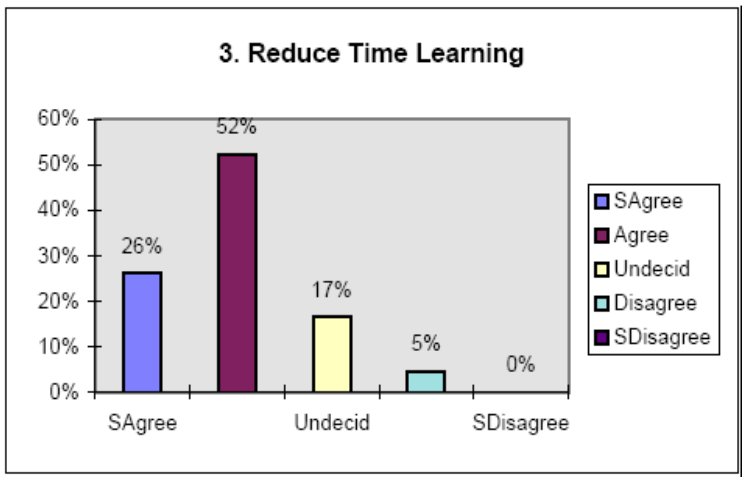


Figure 2b: Reduction in Time Learning Plays

4.3.3.3 Participation Rates

The study considered the effect of podCoach on attracting new players into, or encouraging existing players to remain involved with, the sport. The question targeted respondent opinion with reference to the ubiquitous nature of mobile computing and social trends. The response illustrates strong (60%) agreement on this topic. Fig 2c

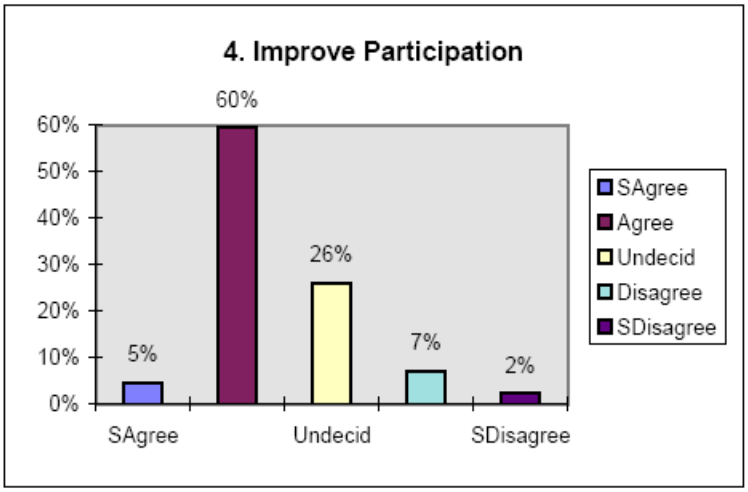


Fig 2c: podCoaching Improve Participation Rates

4.3.3.4 Quality of Practice and Play

This measure was aimed at addressing question if podCoaching improved the quality of the work of players and coaches. 21% Agreed, 33% were undecided and 46% either Strongly Disagreed or Disagreed. Fig 2d.

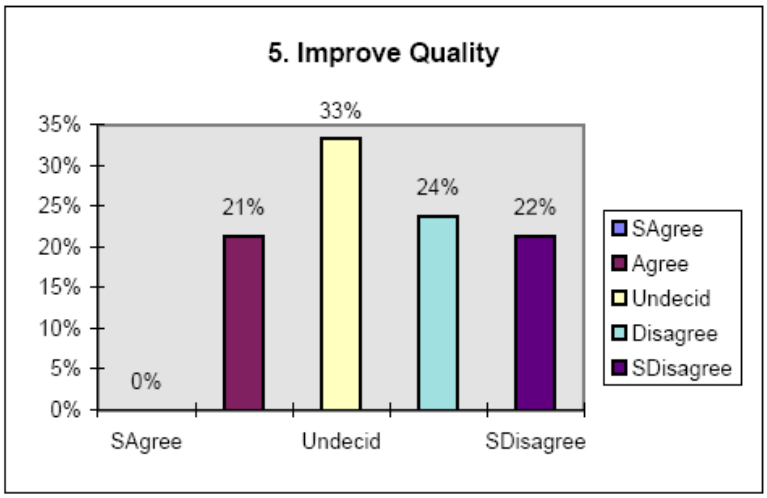


Fig 2d: Does podCoaching Improve Quality of Learners Practice and Play

4.3.4 The Impact of Multimedia Learning Theory

The primary goal of the thesis was to investigate how a Mobile Learning Application based on Mayers Cognitive Theory of Multimedia Learning, impacts on learners and educators in Sports Coaching environment. Therefore this section provides responses for related survey questions. Specific questions to be addressed are:

- Can it be effective by increasing learners understanding of basketball plays
- Can it complement or enhance existing coaching practices and resources used in the learning environment.
- Is Mayers Multimedia Learning Theory applicable to sports learning.
- What is the impact on Learners and Educators

4.3.4.1 Does Multimedia Animation Aid Understanding of Text Content

From the Literature review it was noted that Levie and Lentz (1982) found that text accompanied by illustrations describing the text was understood than text not accompanied by illustrations. Multimedia information seems to improve learning when the media uses closely related, supportive information. 50% of Respondents Agreed and 14% Strongly Agreed. 24% were Undecided and 12% Disagreed. **Fig 2e.**

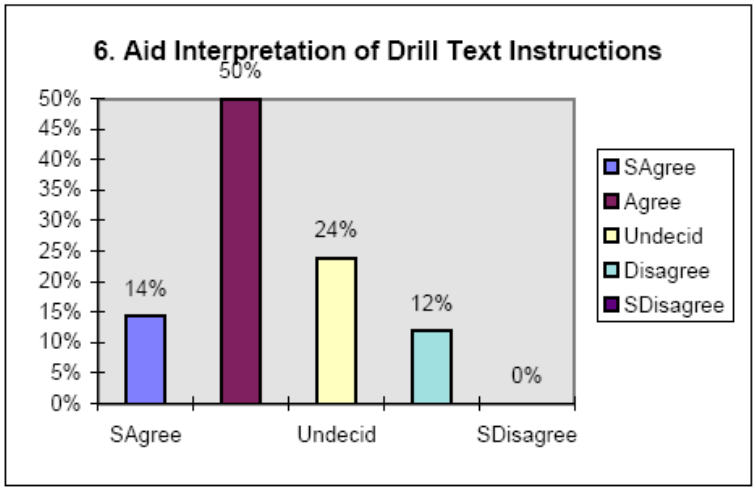


Fig 2e. Does Animation Aid Understanding of Text Content

4.3.4.2 Does Animation Aid Learning

This measure relates to the effectiveness of Multimedia as a Learning tool. 54% of respondents agreed while12% Disagreed. 38% were undecided. See Fig 2f.

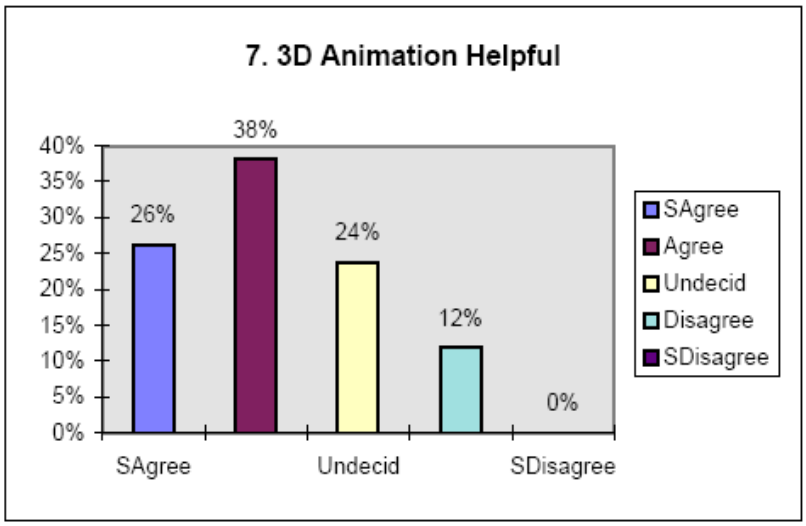


Fig 2f. Does Animation Content Aid Learning of Drills

4.3.4.3 Does Audio Aid Learning

Mayers cognitive theory states that multimedia learning uses a combination of auditory and visual, words and images, to aid retention and transfer of knowledge.

This measure relates to the effectiveness of Audio content. 71% of respondents agreed it aided their learning, while 5% Disagreed. 14% were undecided. See Fig 2g

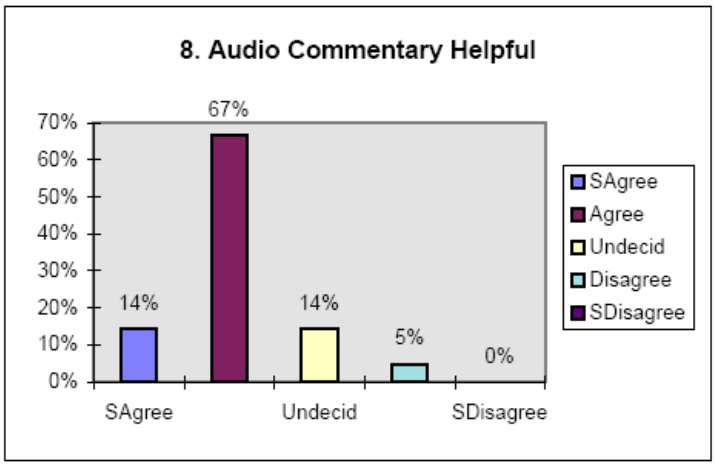


Fig 2g. Does Audio Commentary Aid Learning of Basketball Drills.

4.3.4.4 Does Audio, Text and Animation Support One Another

Najjar concludes that multimedia information provides learning advantages in several specific situations. For example, when the Media Support One Another. This survey question addressed the issue. 81% of Respondents Agreed that it did and so improved learning process. See Fig. 2h.

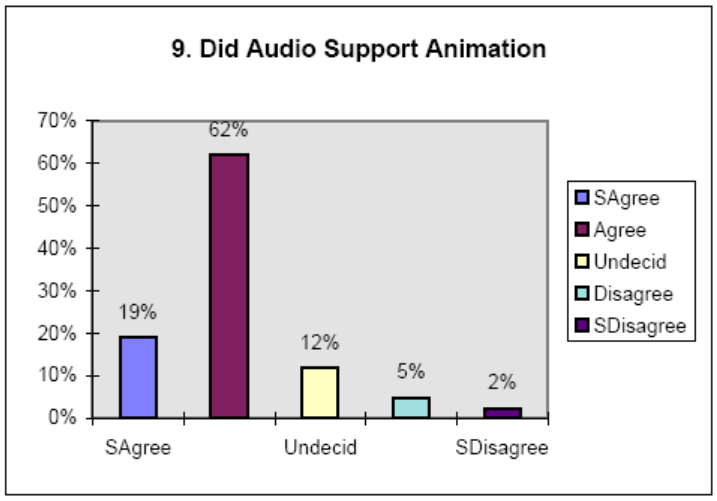


Fig 2h. Did Drill Audio, Text and Animation Support One Another.

4.3.4.5 Pace of Learning.

One issues highlighted by the Mobile Learning model was that learning should be self-directed where the learner controls the speed of the learning. The Participants were asked to reflect on this point. 90.5% were satisfied and 9.5% felt the process too slow. See Fig 2i.

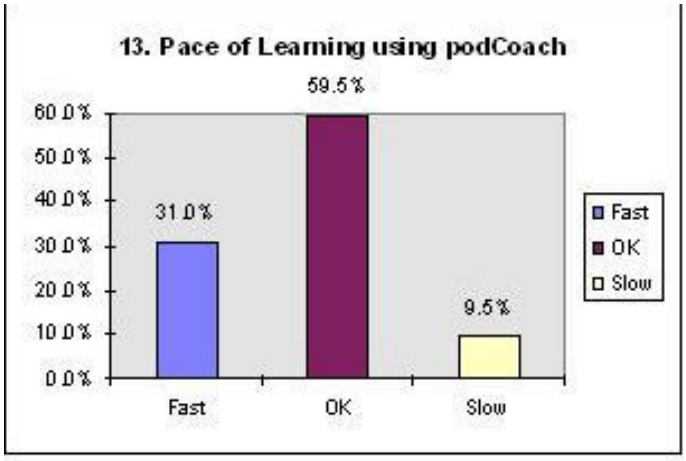
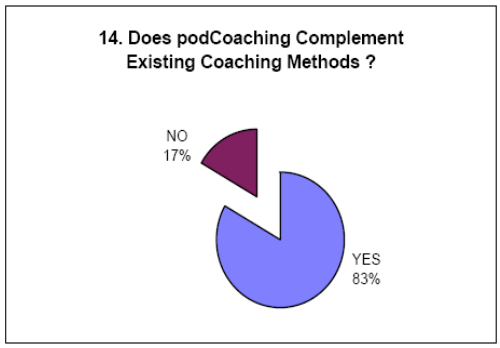


Fig. 2i : Learners views on Pace of Learning with podCoach

4.3.4.6 Complement Traditional Drill Coaching Methods.

This section relates to users opinions on how their experience with podCoaching relates to their experience of Traditional Drill Coaching approaches. This attitude may highlight significant issues with respect to learning and future use. 17% of Users intimitaed that podCoaching did not complement existing drill coaching approaches. 83% felt it was successful in complementing the approach See Fig. 2j. When asked if they preferred Traditional Drill Coaching methods, 64% replied No and 36% were in favour of Traditional Methods See Fig 2k



2j. podCoaching Complement Trad Drill Coaching Methods

2k. Do You Prefer Traditional Drill Coaching over podCoaching ?

4.3.4.7 Does podCoach help increase learners understanding.

The principle aim of the investigation is to find out if Mobile Multimedia Learning Technology can be used to increase learners understanding of basketball plays. This is

the user response. 64% of users Agreed or Strongly Agreed it did increase understanding and learning. 15% Disagreed to various levels and 21% were undecided. See Fig. 2j.

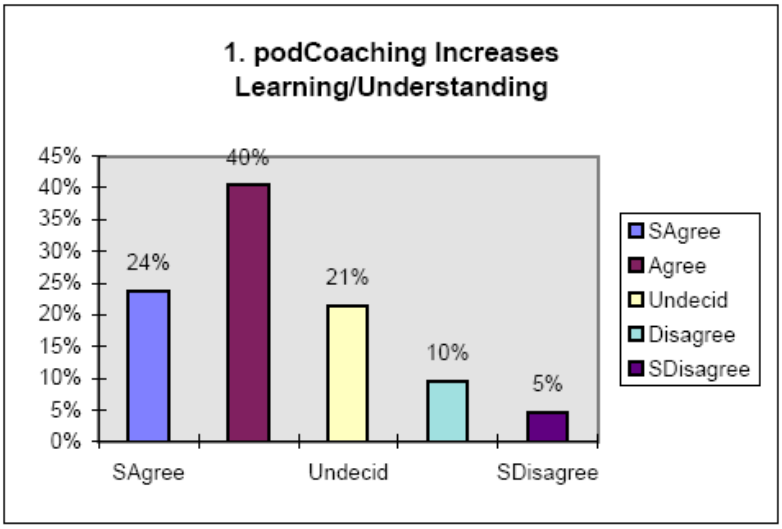


Fig. 2j: Does podCoaching increase learning and understanding (X Respondents)

When findings are divided into individual groups, 70% of coaches Strongly agree that podCoaching does increase learning. The Agree response is strongest for Novices (50%), followed by Experts (45%) and Coaches (20%). The highest undecided respondents are in the Experts Group (35%). See Fig 2k.

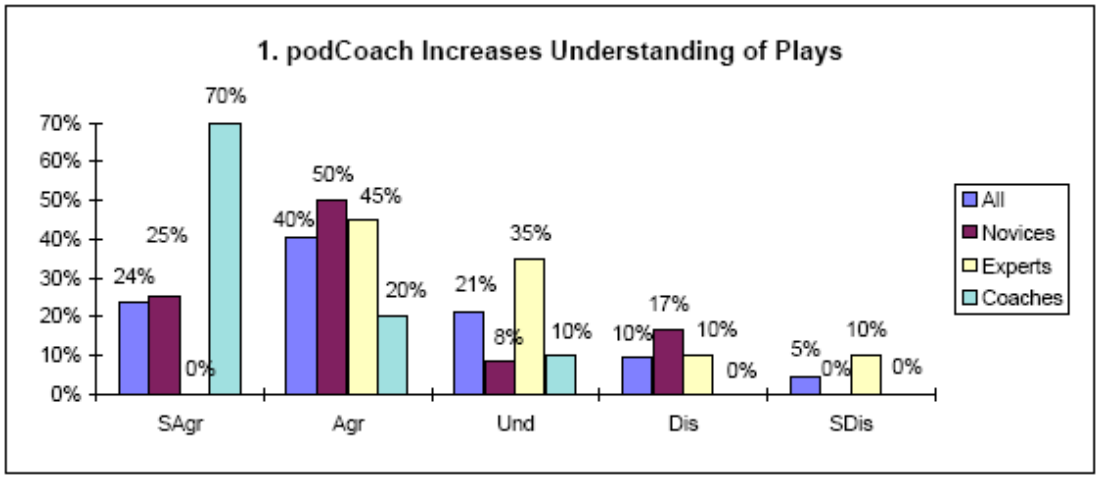


Fig 2k. Does podCoaching increase learning and understanding (X Groups)

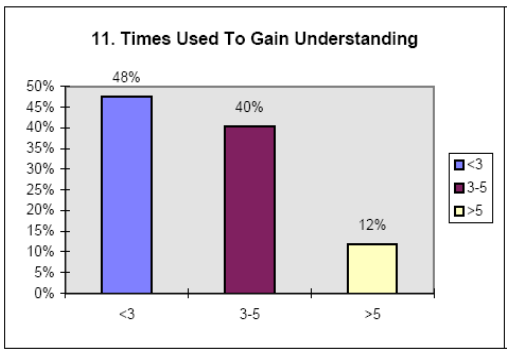
4.3.5 Usage Trends

4.3.5.1. Usage.

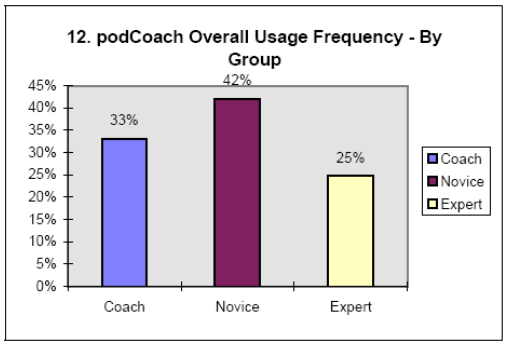
The research findings returned data which cast light on the usage trends of the mobile device and also users opinion on its relationship with traditional coaching. The usage trends may confirm other qualitative measures such as productivity and impact on learning. The attitude to traditional coaching may highlight its potential use in the future.

Figure 5a reveals the response to the number of times users needed to view content before content was learned and understood. Less than three times was the highest response (48%). Followed by between 3 and 5 (40%) and over 5 (12%).

Figure 5b reveals the overall usage frequency - by group. The Expert group were the lowest user group (25%), followed by the Coach group (33%). The highest User group were the Novice Users (42%).



3a. Required usage for understanding (%)



3b. Overall User Usage Frequency (%)

CHAPTER 5: DISCUSSION

5.1 Introduction

The purpose of this chapter is to attempt to analyse the findings outlined in Chapter 4: Findings in order to establish the veracity of the Research hypothesis

5.2 Review of Research Aims

It is the purpose of the thesis to investigate if Mayers and Najjars independent research into Dual Coding and Multimedia Learning, outlined in sections 2.2.6 and 2.2.7 respectively of the Literature review, are relevant in a sports learning context. For effective examination two specific questions will be addressed by this research.

1. Do Mayers and Najjars concepts of Multimedia Learning Theory apply to a sports learning environment.
2. Does the podCoach mobile application, designed using Multimedia Learning Theory, contribute to an increase in Learning and Understanding of basketball tactical plays

Establishing the veracity of the research questions will be accomplished using the following methods.

1. Analysis of primary source data in the form of the findings of the case study into the use of podCoaching for basketball . The findings are outlined in section A of Chapter 4
2. By utilising relevant secondary source data abstracted from the Literature review content in Chapter 2.

Primary source data was gathered through the case study. The case study focused on selected participants in the sport of basketball. The participants ranged from Novice to Expert in terms of skill and knowledge. The target group also consisted of Players and Coaches of varying levels of ability. It was felt that this cross section would allow sufficient scope to quantify and appraise the overall impact on learning..

Secondary sources are also significant in the analysis of findings. Fundamentally, with respect to sports learning, it has highlighted many attributes of sports practitioners, both learners and educators, that may have significance due to related characteristics with the pedagogic principles and theories of mobile, e-learning and multimedia learning.

The discussion will be logically structured. The first section will discuss Mayers Learning Theory and Najjars Multimedia Learning hypothesis as it applies to both secondary source data and primary sources obtained from the case study findings. A second section will address the impact of podCoaching on learning and understanding. Essentially the practitioners in the sports domain should generate and express the most relevant insights and views based on their experience as domain learners and educators.

The discussion begins with consideration of the findings relating to Mayers Learning Theory and Najjars views on Dual Coding and Multimedia Learning.

5.3 Is Multimedia Learning Theory applicable to sports learning environment.

5.3.1 Introduction

One of the principle aims of the investigation is to find out if Multimedia Learning Theory as proposed by Mayer(1991) and Najjar(1996) is applicable to a sports learning environment. The methodology chosen to deliver appropriate findings to measure or gauge this issue is the Case Study. In this research the case study took the form of providing learners, of basketball tactical drill content, with appropriate mobile multimedia learning tool and content, specifically designed for their sports domain, and monitoring the impact of this tool on their learning and understanding of the provided content though the use of a combination of quantitative and qualitative measures. It is the intention of this section to analyse the validity of the claims and theories of both Mayer and Najjar with respect to their implementation in a sports environment. This is particularly relevant as the content and medium of delivery, the Apple iPod or similar device, follows the design criteria outlined by both Mayer and Najjar.

5.3.2 Discussion of Secondary Source Data.

The Literature review revealed how Behaviorism (section 2.2.1) and constructivism (section 2.2.2) have influenced contemporary educational approaches and the development of innovative practice and research in sport and physical education pedagogy over the past decade. This usually involves drills that are separate from the game and in which isolated technique is “mastered” as the players strive to imitate a model usually demonstrated by the coach. In this approach there is clearly defined and pre-determined knowledge that the coach strives to embed in the players. However it is hypothesized by this research that sports learning can be addressed by other means. In particular through Mayers Multimedia Learning Theory (1991) and Najjars Multimedia And Learning Approach (1996). It is also clear that other non traditional learning theories have significant properties which may be influential with respect to Sports pedagogy.

According to Gardners multiple intelligence theory (1999), highlighted in literature review section 2.2.3, there are seven different types of intelligence. These various types of intelligences include linguistic intelligence, logical-mathematical intelligence, musical intelligence, bodily-kinaesthetic intelligence, spatial intelligence, interpersonal intelligence and intrapersonal intelligence. Of these various types of intelligences it is possible to assume that bodily-kinaesthetic intelligence and spatial intelligence would be the key attributes for learners in sports education. However Sport can initiate responses from several of the remaining intelligences. Interpersonal intelligence and intrapersonal intelligence are relevant with respect to team work and communication. Linguistic and logical-mathematical intelligences are also relevant. For example, a sports and fitness course could have a station with verbal text to help students understand the physiology and anatomy that govern bodily movement (linguistic intelligence). Station two could consist of graphical data and numerical fact sheets which display statistical information about training and strengthening the body (logical-mathematical intelligence). Therefore Sport knowledge and learning content has the potential to be delivered to its learners in a variety of modes.

The Dual Coding and Mental Representations theory proposed by Paivio (1986) attempts to give equal weight to verbal and non-verbal processing. The theory assumes that the first cognitive subsystems specializes in the representation and processing of nonverbal objects/events (i.e., Imagery), and the latter specializes in dealing with language (ie. Verbal). Mayer (1991) and Najjar (1996) develop this further by proposing that integrated multimedia technologies can help deliver this style of learning. The relevancy of these non-traditional learning approaches to the sports environment may be illuminated by referring to many common learning practices in sport.

For example consider the significance of Mental Imagery and Practice in Sport, highlighted in literature review section 2.5.7**.** Many sports scientists have spent their careers trying to understand this subtle relationship. (Ungerleider, 2008, p6). Ungerleider goes on to highlight four possible explanations behind why mental practice and imagery work. These are: Symbolic learning, Psycho neuromuscular theory, bio-informational theory and Dual Coding Theory. Of these, Dual Coding is

particularly significant to this research as it represents a key tenet of Multimedia Learning Theory and its impact on sports learning.

With respect to Sport this theory suggests that athletes receive information by two independent channels or encoding systems, the verbal and the motor channel. Simply stated, this means that new skills are better learned if they are both explained to the athlete and then actualized through physical practice. The link between the two channels is known as the action-language bridge. The bridge is the key to Athletic Learning. The bridge between Athletic Learning and Multimedia Learning Theory is Paivios Dual Coding theory, a key component in the subsequent research of both Mayer and Najjar.

Mayers Multimedia Learning Theory, based on Paivio (1986) Dual coding theory, delineates three views of "multimedia" for learning.

1) in terms of the medium of delivery,
2) in terms of its presentation modes, its re-presentational formats, and
3) in terms of the sensory modalities used to process the material.

Mayers Multimedia Learning Theory is defined as a Cognitivist theory of learning. All cognitive learning theories assume that reality is objective, but mediated through symbolic mental constructs. Students learn through mastering building blocks of knowledge based on preexisting relationships among content and skills. Instructors organize and sequence these building blocks to facilitate optimal mental processing.
An example of an extensively developed, empirically grounded Cognitivist theory is Richard Mayer's work on multimedia learning. As summarized by Mayer (1998):

> In multimedia learning, the learner engages in three important cognitive processes. The first cognitive progress, selecting, is applied to incoming verbal information to yield a text base and is applied to incoming visual information to yield an image base. The second cognitive process, organizing, is applied to the word base to create a verbally based model of the to-be-explained system and is applied to the image base to create a visually based model of the to be explained system. Finally, the third process, integrating, occurs when the learner builds connections between corresponding events (or states or parts) in

the verbally based model and the visually based model.

While performing its main task of delivering coaching data to learners podCoach also engages all three of the above cognitive processes. Connections are built between the visual (animation) and verbal (commentary) based models.

Mayer's theory illustrates goals for instruction characteristic of the Cognitivist school of thought, which include (National Research Council, 2005):

- Providing a deep foundation of factual knowledge and procedural skills
- Linking facts, skills, and ideas via conceptual frameworks – organizing domain knowledge as experts in that field do, in ways that facilitate retrieval and application
- Helping students develop skills that involve improving their own thinking processes, such as setting their own learning goals and monitoring progress in reaching these

Student motivation to achieve these goals is determined by a variety of intrinsic and extrinsic factors, such as satisfaction from achievement, contributing to others, and challenge and curiosity (Pintrich and Schunk, 2001). The goals for student achievemnet are also common objectives of sports coaches with respect to team building. Basanov (2007) states:

> One of the most important features of a coaching methodology is widening the possibility of the players' self-organization during the training process. In principle it is the problem-based learning where obtaining the knowledge, habits and skills put forward the higher demands to include the players' consciousness. Solving the situations set by the coach in the varying game environment improves both the technical performance and tactical intuition.

The core of Mayer's theory is that multimedia can be used to design material that optimizes learning, and that an optimal condition for learning (information processing) is a combination of auditory and visual, words and images, presented to minimize extraneous cognitive load and maximize learning in terms of retention and transfer of knowledge.

5.3.3 Discussion of Primary Source Data.

The hypothesis of Mayers Theory of Multimedia Learning is fully supported by many indicators in the research findings.

Mayers first view of multimedia for learning refers to “the medium of delivery“. This emphasises the“technology-centered” requirement of the approach. This is a prerequisite for the research carried out in this case study approach. PodCoaching is delivered entirely through use of mobile and internet technologies. 79% of participants responded to owning iPods or similar devices and so allowing content access. The Net Generation profile of 95% of participants also confirms their satisfaction and familiarity with the use and acceptance of the delivery medium. Computer usage among the Net Generation is supportive of this. Research shows that among children ages 8 to 18, 96% have gone online. 74% percent have access at home, and 61% use the Internet on a typical day (Oblinger, 2005)

Mayers remaining views refer to “presentation modes” and “sensory modalities“. The application of the research in respect to these issues is clear in view of the essential design ethos of the animated drills presented to participants during the study. All animated drills were in digital multimedia compliant formats (MP4). Each one consisted of Animations demonstrating the movement elements of the drill. Accompanying Audio commentary explained the drill movements. Finally Text content was provided with each drill outlining the drill name and basic functions. Along with the animated drills, each participant was also provided with traditional detailed Drill instructions in hardcopy format.

The results show that 64% of participants Agreed or Strongly Agreed that podCoach aided interpretation of traditional Drill Text Instructions, see Fig 2e Chapter 4. 24% were undecided. When asked to consider Animation and Audio, 64% strongly agreed Animation was helpful, 81% that Audio aided their learning. These results also support Paivio's hypothesis that verbal information is processed differently than visual, information and that verbal information was superior to visual information when sequential order was also required for the memory task.

Paivio identified limitations with dual coding theory. For example, humans have difficulty simultaneously attending to conflicting multiple auditory or visual cues. This is supported by interview and survey responses stating that 60% of players never used podCoaching immediately prior to a drill. Only 16% indicated always doing so. See Fig 5.1. This can be potentially explained by Paivios' hypothesis that user understanding decreases when the viewer must attend to two conflicting images. In the case study, both the animation representation of the basketball court and the physical court are presented to the user at the same time. A possible confirmation of Paivios limitation comments.

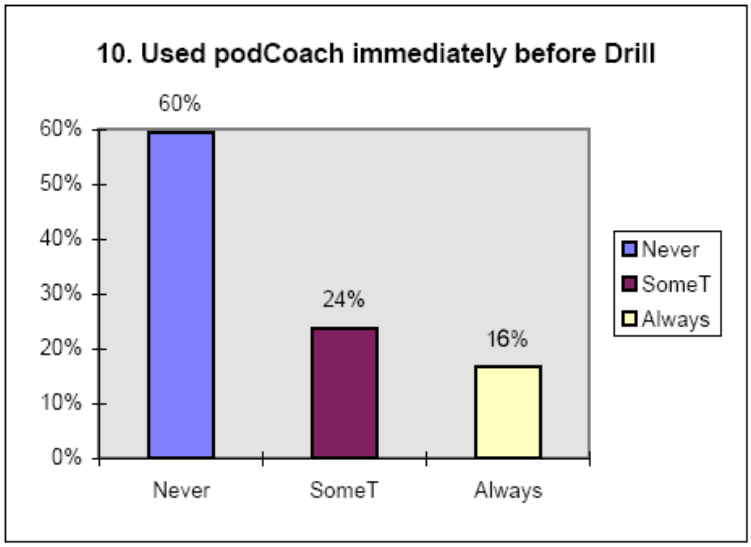


Fig 5.1. Usage of podCoach immediately before Drill

Therefore the research strongly agrees with Mayers Multimedia Learning Approach and Paivios dual coding hypothesis. Their basic contention is that a combination of auditory and visual, words and images, presented to minimize extraneous cognitive load does maximize learning in terms of retention and transfer of knowledge. PodCoach applied this combination. The case study highlighted the benefits of integrated animation, images, audio and text for learning delivered using a suitable medium or technology. It also highlights the significant support for audio description over visual representation and the practice of Users minimizing extra cognitive load to aid overall learning and retention of information.

The core of Najjars research relates to investigating situations in which multimedia

helps people learn. He concludes that multimedia information provides learning advantages in several specific situations. His hypothesis are also fully supported by many indicators in the research findings.

1) When the Media Support Dual Coding of Information

Overall research results indicate a satisfaction by participants with the podCoaching delivery and content, so supporting Najjars contention. The dual coding approach as outlined by Paivio and Mayer refers to using more than one code in the learning process. The codes are represented by Audio, Visual or Text based sources. The chosen delivery medium, Apple iPod or similar devices used, supports the dual coding of information. The Net Generation factor also confirms the attractiveness of this medium to learners in this particular case study. 95% of the group are classified as Net Generation. Therefore the medium of delivery supports dual coding, achieves widespread acceptance amongst the target group and therefore aids domain learning .

2) When the Media Support One Another

Multimedia information seems to improve learning when the media show closely related, supportive information. The research supports this hypothesis. 81% of respondents agreed or strongly agreed that the animation and audio supported each other, the media did not conflict with each other and so aided learning (see Fig 2f and 2g, Chapter 4). It is noticeable that 54% stated podCoaching supported interpretation of traditional drill text materials. The lower response may be an indication of two media conflicting. In this case the Text for Traditional Drills with the Text included in Animations. As 64% of respondents replied they did not prefer traditional coaching methods it is also fair to assume that the lower response indicates their attitudes to traditional coaching.

3) When Media Are Presented to Learners with Low Prior Knowledge or Aptitude in the Domain Being Learned

Multimedia information appears to be more effective for learners with low prior knowledge or aptitude in the domain being learned. Mayer (1993) believes that this is because the multimedia helps low domain knowledge learners to connect the new knowledge to prior knowledge or, for learning basic tasks such as bicycle

maintainence, to build a cognitive model of the solutions. Multimedia may also make more important information more obvious.

> However, learners with high domain knowledge have a rich source of prior knowledge that can be connected to the new knowledge. These learners can make these connections or build cognitive models with text alone. Also, learners with high domain knowledge are more likely to know which information is important and on which information they should focus their attention. (Mayer 1993)

Research results would appear to confirm this hypothesis. The case study represents the views of participants of three skill types: Novice, Club and Exp. See Table 5.1.

Type	Description	Comment
Experts	Players and Coaches above average ability currently playing at international level.	Can be either a Player or a Coach but not both
Novices	Players who have just taken up the sport and have not played representative basketball at any level.	Can be Players only by definition
Club	Players and Coaches between Novice and Expert Level. Players of average or above ability who have played representative basketball at a level lower than Expert.	Can be either a Player or a Coach but not both

Table 5.1: Player and Coach Category

The responses indicate that there is a definite difference in attitude to the overall learning properties of podCoaching. This attitude is significant when the responses of Experts and Novices are compared. Hence, Najjars hypothesis that Multimedia Learning favours Learners with Low Prior Knowledge is substantiated through the findings of this research. Two examples in particular highlight this.

For example 70% of Experts indicated requiring less than 3 views to understand content as opposed to only 8% of Novices .See Table 5.2. It implies, as Najjar suggests, that members of the Expert group possess high domain knowledge and have a rich source of prior knowledge that can be connected to the new knowledge.

	< 3	3-5	>5
Experts	**70%**	**30%**	**0%**
Novices	**8%**	**50%**	**42%**

Table 5.2. Number of Views before understanding Play Instruction

Another example also confirms the theory. 40% of the Expert group responded as favouring traditional coaching approaches. Only 8% of the Novice group indicated this. See Table 5.3. The Expert group prefer the more coach-person-coach interactive approach that traditional behaviourist coaching offers. Suggesting their high domain knowledge is not satisfied by the instruction and content provided by podCoaching.

	Y	N
Experts	**40%**	**60%**
Novices	**8%**	**92%**

Table 5.3. Prefer Traditional Coaching

Najjar (1996) also addressed situations in which multimedia helps people learn and specific domain concerns that may benefit from certain media. For example see Table 5.4 below for more details.

Domain Concern	Preferred Multimedia Solution
• Problem solving information	Animation with explanatory verbal narration
• Spatial information	Pictures

Table 5.4: Effective Medium To Present Specific Information

The sport of basketball can demand unique skills of the participants. Many team sports involve strategies and tactics designed to gain points, yards, or space from opponents in an optimal and systematic fashion, not unlike chess. Allard,Graham, Paarsalu, 1980, demonstrated that the encoding of structure is an important element of skill in the "cerebral" games of chess and bridge.

1. Problem-Solving Information. This relates to sports coaching pedagogy, TGFU and

Game Sense where problem-based learning is advanced. To learn problem-solving information, an animation with verbal narration was shown to be effective (Mayer & Anderson, 1991, 1992). 81% of users responded positively to the question if Audio complemented Animation in podCoaching content correlating with research literature views (see Fig 2h Chapter 4).

2. Spatial Information. Spatial Intelligence is one of the Multiple Intelligences identified by Gardner (1999) in his Multiple Intelligences theory. It is an appropraite skill demand from most sports. Basketball drills are effectively graphical map representations of situational tactical tasks set by the coach. Najjar notes that illustrations are superior to text when learning spatial information. Research by Bartram (1980) proposed graphical map presentation of information is consistent with people's preferred internal representation of spatial information. 64% of Users in the research findings felt graphical/animation representation of drill movement/spatial indicators was of benefit.

5.4 The impact of podCoaching on learning and understanding.

5.4.1 Introduction

One of the principle aims of the investigation is to investigate if Mobile Multimedia Learning Technology can be used to increase learning and understanding of basketball Plays. The methodology chosen to deliver appropriate findings to measure or gauge this issue is the Case Study. In this research the case study took the form of providing learners, of basketball tactical drill content, with appropriate mobile multimedia learning tool and content, specifically designed for their sports domain, and monitoring the impact of this tool on their learning and understanding of the provided content though the use of a combination of quantitative and qualitative measures. It is not the intention to analsyse the design of the multimedia learning tool but rather the effects of its use on learning and understanding in the specific sports domain.

5.4.2 Definition of Learning and Understanding in the Sports Domain.

A definition of Learning and Understanding in a sports domain should first be clarified. The goal of learning and understanding, in the context of this research, is the learning and understanding of tactical basketball Plays. A Play is defined as a situational tactical task set by a coach.

For many, the Drill or Play is fundamental to learning in sports. Basketball coaching legend John Wooden of UCLA advocates the drill, when it is used properly within a balanced approach that also involves developing understanding and initiative. Drill for the coach is intended to achieve a mastery of fundamentals that open up opportunities for individual creativity and initiative. (Wooden 2002). In this approach there is a clearly defined and pre-determined knowledge that the coach strives to embed in the players.

Siedentop (1994) proposes that the key learning outcomes for Sport Education are the development of competent, literate, and enthusiastic sports persons. A competent sports person is someone who has developed skills and strategies to the extent that he or she can participate successfully in a game.

The concern of this research is how to measure learning in a specific sports coaching context. And also in relation to how it is delivered using a Multimedia Learning Approach. By how much does learning increase ? What factors influence improved learning? Is there empirical evidence to back up a hypothesis that multimedia learning does increase learning and understanding ? The conventional approach to measuring learning is through written examination and practical assessment. The conventional approach to measuring learning and understanding of motor skills and tactical expertise in sports education is a much more ambiguous task. It is traditionally attempted through isolated skill tests or by ambiguous and uncorroboratable observation of individual performance by both the individual themselves and remote observers (eg. Coach). It is also open to interpretation and bias.

Specific measurement models do exist such as The Game Performance Assessment Instrument and the Team Sport Performance Assessment Procedure as outlined in the literature review section 2.5.9. Such measures are specific to motor skills and decision making and are devoid of references to more elusive influencing factors and outcomes such as Social Changes, Motivation, Learning Style, Content delivery, Quality of work produced, Productivity of work. All these, the researcher proposes, are equally significant in measuring learning and understanding in sport. For example a student may execute a task successfully but the quality of execution or the motivation to learn the task may be lacking. Perhaps other approaches, such as the adoption of the Multimedia Learning tool podCoach, can contribute.

Therefore in order to determine a more universal measure of improved learning and understanding of basketball plays in the context of a Multimedia Learning Approach the researcher aims to evaluate participant responses to some key questions. These relate to Improved Learning Method, Improved Quality of Work, Improved Productivity and Improved Motivation. The expectation is that an evaluation of these responses will imply an overall Improved Learning and Understanding measure.

The social factors mentioned will be discussed separately from this element. This is because its is a generational issue with particular relevance to the use of, and familiarity with , new technologies.

5.4.3 Discussion of Secondary Sources

Behaviourism as decribed in section 2.5.1 of the literature review is recognized as a Teacher-Centered approach commonly used by many coaches. Coaches who pat their players on the back after making a good play or express disappointment or anger after an unwelcome performance are practicing behaviorism also referred to as behavior modification.

Hollier (2008), confirms this opinion. See Literature review 2.5.6. With regard to skill acquisition, he states:

> "It starts with learning basic technique. This gives them a base behavior that they can internalize quickly. This is as far as a lot of coaches get and it relies on a traditional Behaviourist approach. "

Contemporary writing in the sport and physical education pedagogy field is critical of this approach for a range of reasons. Among these is the lack of relevance to the game that techniques developed in isolation from game conditions suffer. The lack of intellectual development in the form of tactical and strategic understanding and decision-making ability, player independence from the coach. Player motivation at training, and the ways in which it discourages creativity and innovation. Critics argue that players do not need direct instruction on how to play. Instead, they need to be placed in game-like environments structured to help players learn in context and to be able to solve the range of problems they are faced with in team games without having to turn to the coach (Kidman, 2001, 2005; Light, 2004).

Approaches that are reasonably consistent with constructivist theory are a far more recent occurrence. Teaching and coaching approaches such as Teaching Games for Understanding ([TGfU], Bunker & Thorpe, 1982), Game Sense (Light, 2004) and Sport Education (Seidentop, 1994) are all student/player-centred, inquiry-based approaches informed by, or consistent with, constructivist learning theory.

There is a notable lack of reference to many of the alternative learning theory approaches outlined in Literature review Chapter 2, such as Multiple Intelligences, Connectivism and Mayers Multimedia Learning Theory although Paivios Dual Coding

approach, see literature review 2.2.4, is referenced as a key component of Mental Practice for sports, see literature review 2.5.7. The conventional approaches still dominate learning in sports education yet research would indicate that the practical use of many of the alternative learning theory elements such as Gardners Multiple Intelligence (1999) , see literature review 2.2.3, may benefit sports learning

For example, incorporating the multiple intelligence theory into a classroom may be achieved through developing various workstations, where the students move from station to station developing a skill that is tailored to appeal to each of the intelligences individually. In a sports context, a sports and fitness course could have a station with verbal text to help students understand the physiology and anatomy that govern bodily movement (linguistic intelligence). Station two could consist of graphical data and numerical fact sheets which display statistical information about training and strengthening the body (logical-mathematical intelligence).

Another relevant approach may be Siemen's Connectivism Theory, see literature review 2.2.3. His theory includes reference to the significance of the principal of Chaos when it is introduced as a new reality for knowledge workers. Chaos is the breakdown of predictability, evidenced in complicated arrangements that initially defy order. Unlike constructivism, which states that learners attempt to foster understanding by meaning making tasks, chaos states that the meaning exists – the learner's challenge is to recognize the patterns which appear to be hidden. Decision making is indicative of this. If the underlying conditions used to make decisions change, the decision itself is no longer as correct as it was at the time it was made. The ability to recognize and adjust to pattern shifts is a key learning task.

A final example of how alternative learning approaches may be applied to a classroom situation is given using Paivios Dual Coding Approach. Research by (Ungerleider, 2008, p6) , see literature review 2.5.7, highlighted dual coding is a key element of Mental Practice in sports learning. Ungerleider goes on to explain how it could be applied directly to a classroom learning environment.

"If Tiger Woods were to go back to Stanford to give a lecture on how he

swings, he might first talk players through his mechanics (the verbal part) and then walk players through practicing his swing (the motor part) while describing it again. The players thus would be learning on two different levels and bridging between them through Woods's instruction. " Ungerleider, 2008, p8)

5.4.4 Discussion of Primary Sources

Due to the non-deterministic nature of learning measures for sports performance and the unique multimedia learning approach adopted, the researcher aims to evaluate participant responses to some key questions as mentioned in the definition of learning, section 5.3.2. Therefore an overall measure of improved learning of basketball plays, brought about by the use of podCoaching, will be gauged by evaluating improvements in the following areas:

- Productivity during Practice
- Motivation to Learn
- Learning Methods
- Quality of Work produced

The researcher highlights that it is significant only in the context of this research and the Multimedia Learning Approach adopted. Subsequently the survey questionnaire targeted directly these key issues using a range of specific questions.

Survey Question	Measurement
Does podCoaching Improve Coaching / Learner Productivity	Improved Productivity
Does podCoaching Reduce Time Learning Plays	Improved Productivity
Does podCoaching improve Pace of Learning.	Improved Productivity
Does podCoaching improve Participation Rates	Improved Motivation
Does podCoaching improve Quality of Practice and Play	Improved Quality

Evaluating improvements in Learning Methods, brought about by the use of podCoaching, is addressed by responses to the following survey questions:

Survey Question	Measurement
Respondent Profile Questions Eg. Age, iPod use, Gender,	Improved Learning Method
Does podCoaching increase learning and understanding	Improved Learning Method
Does podCoaching Complement Traditional Drill Coaching Methods	Improved Learning Method
Do You Prefer Traditional Drill Coaching over podCoaching	Improved Learning Method

5.4.5 User Profile Data

A study of responses to gauge attitudes to Improved Learning Method using podCoaching is obviously heavily influenced by participants perceptions of the use of new technologies. Therefore it is for this reason the questions relating to the social profile of participants are included. Overall analysis of results would suggest that podCoaching has a more positive effect on the Net Generation Learner as opposed to non-Net Generation participants. To confirm this, the researcher proceeds with an appraisal of results relating to the impact of podCoaching with respect to the generational profile of respondents. In other words the impact of the Net Generational Factor.

The case study respondent profile is varied. There were 42 valid Respondents consisting of 10 Coaches and 32 Players. 76% of the sample were Players and 24% Coaches. See Figure 1a., Chapter 4. The Gender breakdown was 69% Female and 31% Male across the range of respondents. See Figure 1b, Chapter 4. All 20 Expert Players were Female as were 3 Coaches and 6 Novice Players. Of the 42 survey respondents, 25 were graded as Expert, 12 as Novice and 5 as Club level players. (See Figure 1c, Chapter 4). This is a breakdown of 29% Novice, 16% Club and 55% Expert. Participants graded as Expert or Club could be either a Player or a Coach but not both. Participants graded as Novice could only be Players by definition. See Table 2, Chapter 4.

This provided a valid and satisfactory cross section of respondents for analysis of related attitudes to improvements in learning method brought about by the use of podCoaching. It allowed for a valid and realistic perspective across a range of users. Each unique group contributed significantly to the research. The Coach group provided an Educators Perspective. The Novice and Expert a Learners perspective.

5.4.6 The Net Generation Factor

The Age profile varied across the Participant Type and Expertise. Expertise in Coaching may be defined differently for a Player. This is projected in the Age Profile. The average age of across all participants was 21. Among the expert group it was 17, the Novice 18 and the Coaches 29. The average age of non net-gen user is 49 and they account for the 33% of the coaching participants. This is a significant factor and notable qualification for any measure involving the coach group. **See Table 5.5.**

Group	Average Age
All	**21**
Novices	**18**
Experts	**17**
Coaches	**29**
Non-NetGen	**49**

Table 5.5. Age Profile of Participants

The age profiles provided valid sample data to consider the issues of User satisfaction with podCoaching as a learning tool. It also supports research data on Net Gen attributes. Secondary research identifies Net Generation.as having good visual-spatial skills , being intuitive visual communicators and good at Inductive discovery. They also display fast response times. They are able to respond quickly and expect rapid responses in return.

This is noticeable in the results returned in respect to age. There were three users outside of the NetGen age range. All were coaches graded at expert level. Their responses differed on many issues compared to NetGen responses. The Survey data

returned overall 79% iPod ownership, however analysis of non-NetGen users indicates 33% ownership. Also the coach group percentage value must be qualified by its inclusion of the Non-Net Gen group. See Table 5.6.

Group	Percentage
All	79%
Novices	100%
Experts	75%
Coaches	80%
Non-Net Gen	33%

Table 5.6. iPod Ownership by Group

The attitude towards podCoach as a possible attractive tool for improving participation levels in basketball also indicates significant Net Generation attitudes. 75% of Novices and 65% of Expert users agreed with this issue. These groups account for 95% of the Net Gen participants. 40% of Coaches disagreed with the issue with the average age of this group being with this issue while none of the other participants indicated this. See Table 5.7

.

	S-Agree	Agree	Undecided	Disagree	S-Disagree
All	5%	60%	26%	7%	2%
Experts	17%	58%	25%	0%	0%
Novices	0%	75%	25%	0%	0%
Coaches	0%	30%	30%	30%	10%

Table 5.7: Does podCoach improve participation.

30% of experts felt they required between 3-5 views before understanding content. 70% of experts reported needing less than 3 views. This concurs with NetGen research indicating satisfaction using and understanding digital media. It also concurs with responses to interviews with coaches of the expert group who indicated that the expert users needed less time on instruction due to greater experience and knowledge base.

Digital resources enable experiential learning—something in tune with Net Gen preferences. Rather than being told, Net Geners would rather construct their own learning, assembling information, tools, and frameworks from a variety of sources. Furthermore, the net generation profile identifies the following group attributes.

- Inductive discovery—they learn better through discovery than by being told
- Attentional deployment—they are able to shift their attention rapidly from one task to another, and may choose not to pay attention to things that don't interest them
- Fast response time—they are able to respond quickly and expect rapid responses in return.

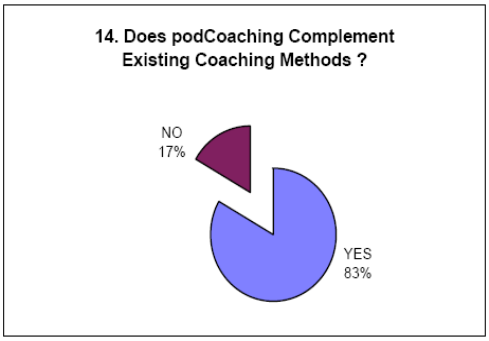
It is possible to substantiate these statements through the research findings. They are demonstrated through responses to key survey questions such as: Number of viewings required before understanding content, Preference for traditional methods, Attitude to Learning Pace and Preference not to use podCoach. The comparison of Non-Net Generation and Average User Responses clearly demonstrates the disparate views. See Table 5.8.

Survey Question	Non-Net Gen Users	Average Response
Views before Understanding Content	100% 3-5 Times	48% < 3 Times 40% 3-5 Times
PodCoach Learning pace ?	100 % Slow	90.5% Satisfied
Complements existing Coaching ?	100 % Disagree	83% Strongly Agree
Prefer Traditional Coaching Approach	67%	31%
Manage adequately without podCoach	100%	52%

Table 5.8. Comparison of Non-Net Generation and Average Responses

Further evidence that podCoaching does increase understanding is contained in survey and interview responses outlining attitudes to Traditional Drill Coaching Methods.

Users were asked for their opinions on using podCoaching and the Traditional Coaching approach. 83% of Respondents felt that podCoaching complemented the traditional approach, see Fig 5.2. 64% preferred the podCoaching approach over Traditional Drill Coaching approach, See Fig 5.3, or in other words they felt that podCoaching improved on Traditional Drill Coaching methods.



5.2. podCoaching Complement Trad Drill Coaching Methods

5.3. Do You Prefer Traditional Drill Coaching over podCoaching ?

This evidence receives some support from Users response to the question "Does podCoaching Aid Interpretation of Drill Text Instructions". From the Literature review it was noted that Levie and Lentz (1982) found that text accompanied by illustrations describing the text was understood than text not accompanied by illustrations. Multimedia information seems to improve learning when the media uses closely related, supportive information. 81% of Respondents Agreed or Strongly Agreed it aided understanding and learning of traditional Text/Diagram instructions. 19% were Undecided or Disagreed. See Fig 2h in Findings, Chapter 4.

Significant responses were returned in regard to the benefits, or otherwise, of Animation and Audio as aids to understanding and learning. These results support Paivio's (1991) hypothesis that verbal information is processed differently than visual, information and that verbal information was superior to visual information when sequential order was also required for the memory task. 64% of Respondents agreed or strongly agreed that Animation content aided their understanding. See Fig 2f, Chapter 4. 81% of respondents agreed that Audio aided their learning See Fig 2g,

Chapter 4. This is a significant observation and it is confirmed also by after use interviews with Coaches. Players indicated that audio was favoured, after initial viewings of drills, as it could be listened to at any point and in any location using iPods or similar devices. It acted as a reinforcement tool in this respect and it also observed attributes consistent with effective m-learning and multimedia learning properties. For example some of the attributes identified as conducive to effective learning in a mobile learning application have many characteristics in common with the opinions expressed by podCoach users:

- The learning should be self-directed where the learner controls the speed of the learning.
- Learning should be ubiquitous where learning can take place anywhere and at anytime.
- There should be instant connectivity with mobile devices.

5.4.7 Non-netGeneration Factors

The discussion continues with analyses of responses to the non-netGenerational issues relating to the Improved Learning Method questions. Such issues are Productivity, Quality and Motivation. To begin with, participants were asked specifically to state whether they agreed or not that podCoaching increased learning and understanding of basketball plays.

5.4.8 Increased learning and understanding of basketball plays

The response is out of context with the approach applied to measuring learning in this research, but it is a measure of overall satisfaction and may be used to balance and as comparative scale for satisfaction measures indicated. The results indicate that 64% of users agreed it did increase understanding and learning. 15% Disagreed to various levels. See Fig. 2j. Therefore the overall impact of podCoaching on learning is positive in this respect. As mentioned performance improvement measures are hard to quantify however this question was aimed at assessing Respondents general opinion on the impact of podCoaching.

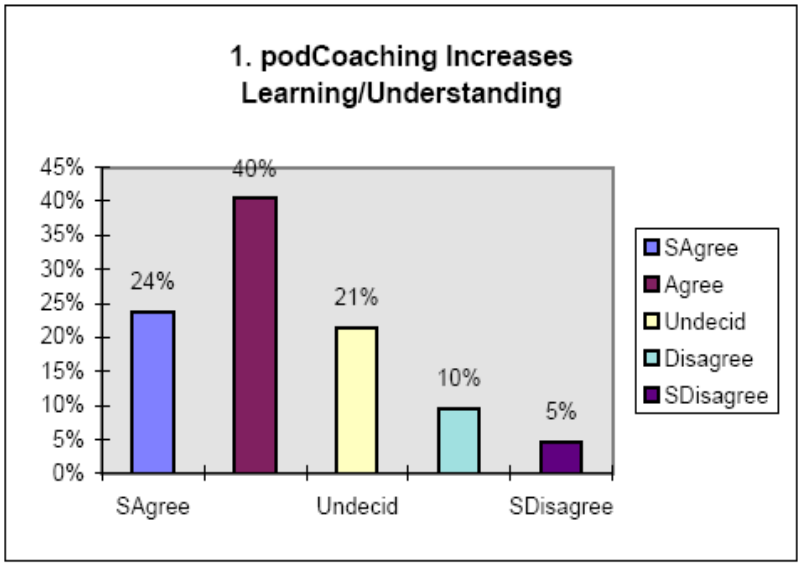


Fig. 2j: Does podCoaching increase learning and understanding

When findings are divided into individual groups, 70% of coaches Strongly agree that podCoaching does increase learning. This is a strong advocation for the use of podCoaching and is also indicative of the Net Generation profile of 70% of coaches. The Agree response is strongest for Novices (50%), followed by Experts (45%) and Coaches (20%). The highest undecided respondents are in the Experts Group (35%). This can be indicative of the experts views that the tool is more effective for learners of lower domain knowledge and expertise and therefore of the fact that they see learning at expert level of requiring more coach-player-coach and mental preparation inputs. See Fig 2k.

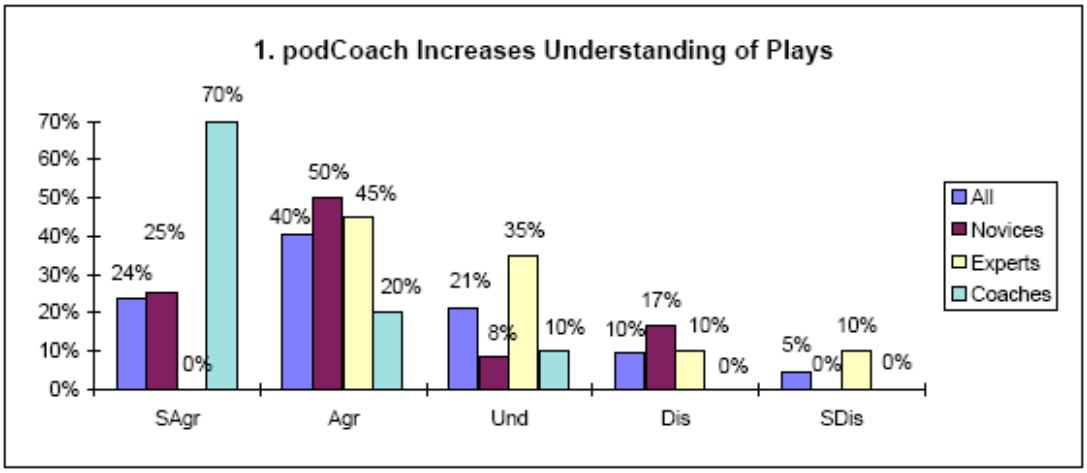


Fig 2k. Does podCoaching increase learning and understanding (X Groups)

5.4.9 Improve Coaching / Learner Productivity

Productivity may be defined as improving quantity of work completed during coaching sessions. Perhaps a coach may find that more/less work is accomplished with use of podCoach. 62% Agreed or Strongly Agreed with this issue, 33% were Undecided and 5% Disagreed or Strongly Disagreed. See Figure 2a. In Chapter 4. This is an indication that podCoaching does contibute to improved productivity in a coaching environment and therefor to improving the learning method.

5.4.10 Reduce Time Learning Plays

Research has found that learning time appears to be reduced, on average by 36%, when multimedia instruction is used (Kulik, Bangert, Williams, 1983). Therefore the following measure relates to this argument. Reducing Time learning Plays relates to individual plays as opposed to overall productivity in training. Survey shows that 78% of respondents Agreed or Strongly Agreed with the issue.

5.4.11 Participation Rates

The study considered the effect of podCoach on attracting new players into, or encouraging existing players to remain involved with, the sport. The question targeted respondent opinion with reference to the ubiquitous nature of mobile computing and social trends. A NetGen User accepts that learning is participatory; knowing depends on practice and participation. The response illustrates strong (60%) agreement on this topic.

Coach interview respondents emphasised that they felt podCoaching had a significant impact on attracting participants. It was felt that younger players especially with low domain knowledge would benefit as it is a medium in which they are familiar and used to using as a learning tool. See Appendix E

> *"... It is definitely something I would see younger novice players getting a lot of use from. They would see its use as part of basketball coaching as a fun element and something they could share with their friends afterwards"*

This is also backed up by definitions of the learning properties of Net Generation students, as outlined in section 2.3.1 of literature review.

- Ability to read visual images—they are intuitive visual communicators
- Inductive discovery—they learn better through discovery than by being told

And also by Mobile Learning model properties outlined in Literature review, section 2.4.4

- Learners should build a learning community for collaboration.

5.4.12 Quality of Practice and Play

This measure was aimed at addressing question if podCoaching improved the quality of the work of players and coaches. 21% Agreed but the remainder of respondents returned responses ranging from Undecided to Strongly Disagree. See Fig 2d, Chapter 4. This has a resonance in the secondary source data of the literature review.

Bazanov (2007) states that the continuous use of drill practice brings us to the situation where some abilities "function" well in local exercises (dribble, passes, 1:1, 2:2 etc) but does not guarantee the effectiveness in more complex competitive situations. He proposed a new holistic coaching system approach, coach–game environment–player. This approach modelled the possible game situations met in the real competition. His proposal states:

> "…Solving the situations set by the coach in the varying game environment improves both the technical performance and tactical intuition."

Therefore analysis of results would indicate that this is not an attribute of podCoaching and subsequently does not significantly improve the Learning Method. The problem solving aspect of podCoach is unique. It is not flexible enough to allow coach input. During interview, See Appendix E, coaches indicated that this was not something they would like to see in respect to Learning Method.

> *" ...This refocuses the application into more of a "Game" category where a player responds to unpredictable situations. This is not something I think that would complement working practice."*

5.4.13 Pace of Learning.

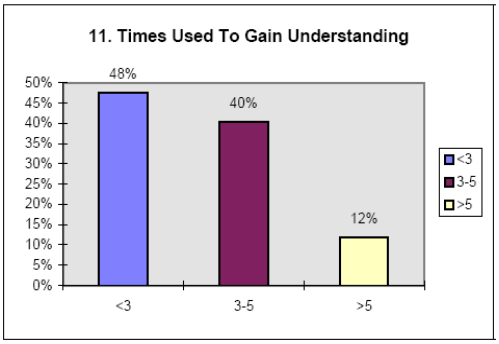
One issue highlighted by the Mobile Learning model (section 2.4.4) was that learning should be self-directed where the learner controls the speed of the learning. The Participants were asked to reflect on this point. 91.5 % were satisfied with the learning pace offered by podCoach (ie Fast or About Right) and only 9.5% felt the process too slow. See section 4.3.4.5 in Findings Chapter 4. Therefore the research findings would suggest that podCoaching does improve the pace of learning and hence improves the Learning Method.

It sheds light on the usage trends of the mobile device and also users opinion on its relationship with traditional coaching. The usage trends do confirm other qualitative measures such as productivity and impact on traditional learning practice in sports domain. The attitude to traditional coaching also highlight its potential use in the future.

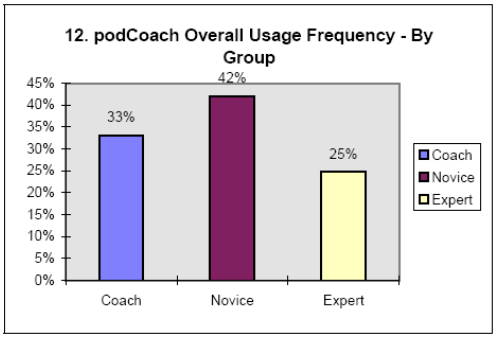
The Pace of Learning may also be judged by users response to Usage Frequency and Required Usage for Understanding questions respectively.

Figure 5a reveals the response to the number of times users needed to view content before content was learned and understood. Less than three times was the highest response (48%). Followed by between 3 and 5 (40%) and over 5 (12%). The results are not authoritative in this respect however the

Figure 5b reveals the overall usage frequency - by group. The Expert group were the lowest user group (25%), followed by the Coach group (33%). The highest User group were the Novice Users (42%).



5a. Required usage for understanding (%)



5b. Overall User Usage Frequency (%)

5.5 Summary

It is possible therefore to summarise podCoaching impact on learning and understanding as follows:

- Attitudes to Improved Learning Method using podCoaching is heavily influenced by participants perceptions of the use of new technologies. Overall analysis of results would suggest that podCoaching has a more positive effect on the Net Generation Learner as opposed to non-Net Generation participants.

- Based on case study findings, podCoaching results in Improved Productivity in the coaching environment and is therefore an indication of improved learning method.

- Respondents emphasised that podCoaching had a significant impact on learner Motivation and in attracting and maintaining participation levels. It was felt that younger players especially with low domain knowledge would benefit as it is a medium in which they are familiar and used to using as a learning tool.

- Analysis of results would indicate that Improving the Quality of Work is not an attribute of podCoaching and subsequently does not significantly improve the Learning Method.

- Research findings would also suggest that podCoaching does improve the pace of

learning and hence improves the Learning Method.

Finally as mentioned, performance improvement measures are hard to quantify but based on this research, Respondents general opinion on the overall impact of podCoaching on learning and understanding of basketball plays is positive.

Chapter 6: Conclusions

6.1 Introduction

The purpose of this chapter is to summarise the analysis of findings outlined in Chapter 5: Discussion, in order to clarify the basic aims of this research. Conclusions are based on reviews of both primary and secondary source findings. Secondary sources focused on relevant concerns such as Learning Theories, Socio-educational matters, Pedagogical and technological issues that arise in physical education and e-learning and mobile learning issues. The primary Sources focused on the outcomes of the Case Study into the application of a Mobile Multimedia Application (podCoach) in a Basketball Coaching environment. This chapter begins with a review of the research aims followed by a report of conclusions on the two key tenets of the investigation. This is followed by a section outlining overall conclusions and recommendations

6.2 Conclusion Structure

The conclusion structure order is based on addressing the two specific questions attended to by the main research investigation. These are:

1. Does Mayers and Najjars concepts of Multimedia Learning Theory apply to a sports learning environment.

2. Does the podCoach mobile application, designed using Multimedia Learning Theory, contribute to an increase in Learning and Understanding of basketball tactical plays

6.3 Do Mayers and Najjars concepts of Multimedia Learning Theory apply to a sports learning environment.

6.3.1 Introduction

The conclusions are ordered on the findings of the study on Mayer and Najjar respectively.

6.3.2 Mayers Multimedia Learning Theory

The hypothesis of Mayers Theory of Multimedia Learning is fully supported by many indicators in the research findings.

1) in terms of the medium of delivery,
2) in terms of its presentation modes, its re-presentational formats, and
3) in terms of the sensory modalities used to process the material.

PodCoaching is delivered entirely through use of mobile and internet technologies. 79% of participants responded to owning iPods or similar devices and so allowing content access. The Net Generation profile of 95% of participants also confirms their satisfaction and familiarity with the use and acceptance of the delivery medium. Computer usage among the Net Generation group is supportive of this.

The results show that 64% of participants Agreed or Strongly Agreed that podCoach aided interpretation of traditional Drill Text Instructions,. 24% were undecided. When asked to consider Animation and Audio, 64% strongly agreed Animation was helpful while 81% felt that Audio aided their learning. These results also support Paivio's hypothesis that verbal information is processed differently than visual, information and that verbal information was superior to visual information when sequential order was also required for the memory task.

The research strongly agrees with Mayers Multimedia Learning Approach and Paivios dual coding hypothesis. Their basic contention is that a combination of auditory and visual, words and images, presented to minimize extraneous cognitive load does maximize learning in terms of retention and transfer of knowledge. PodCoach applied this combination. The case study highlighted the benefits of integrated animation, images, audio and text for learning delivered using a suitable medium or technology. It also highlights the significant support for audio description over visual representation and the practice of Users minimizing extra cognitive load to aid overall learning and retention of information.

Suppoet for Paivios' hypothesis that user understanding decreases when the viewer

must attend to two conflicting images was also provided. In the case study, both the animation representation of the basketball court and the physical court are presented to the user at the same time. A possible confirmation of Paivios limitation comments.

6.3.3 Najjars research on the impact of dual coding on Multimedia Learning.

Najjars research findings were also in the main suppoeted by the sesearch. Najjars research relates to investigating situations in which multimedia helps people learn. He concludes that multimedia information provides learning advantages in several specific situations.

1) When the Media Support Dual Coding of Information

The chosen delivery medium, Apple iPod or similar devices used, supports the dual coding of information. The Net Generation factor also confirms the attractiveness of this medium to learners in this particular case study. Therefore the medium of delivery supports dual coding, achieves widespread acceptance and therefore aids domain learning .

2) When the Media Support One Another

Multimedia information seems to improve learning when the media show closely related, supportive information. The research supports this hypothesis. 81% of respondents agreed or strongly agreed that the animation and audio supported each other, the media did not conflict with each other and so aided learning

3) When Media Are Presented to Learners with Low Prior Knowledge or domain expertise.

Najjars hypothesis that Multimedia Learning favours Learners with Low Prior Knowledge is substantiated through the findings of this research. This attitude is significant when the responses of Experts and Novices are compared.

6.4 Does the podCoach mobile application, designed using Multimedia Learning Theory, contribute to an increase in Learning and Understanding of basketball tactical plays

6.4.1 Conclusions

An overall assessment of the benefits of podCoaching for learning and understanding are outlined in fig 6.1 below. It indicates that in general 64% Strongly Agreeing or Agreeing with this issue.

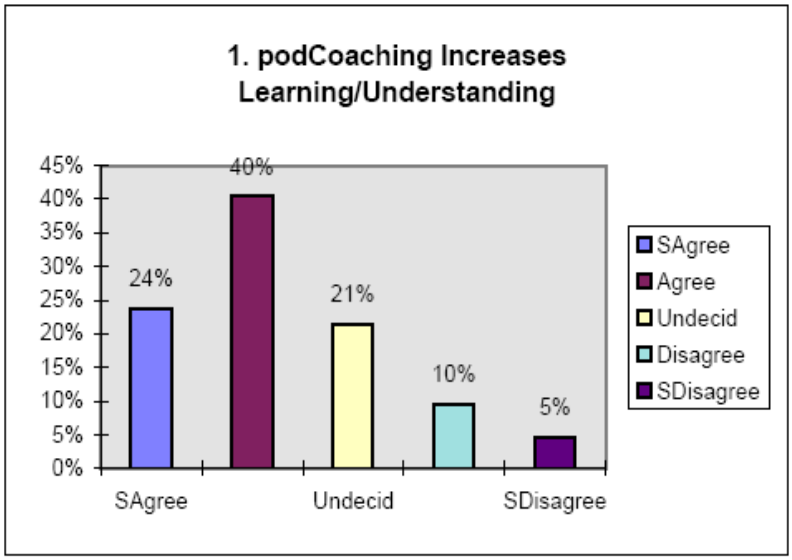


Fig. 6.1: Does podCoaching increase learning and understanding

This research suggests that in sports pedagogy there is a notable lack of reference to many of the alternative learning theory approaches, such as Multiple Intelligences, Connectivism, Mayers Multimedia Learning Theory and Paivios Dual Coding approach. The conventional approaches still dominate learning in sports education yet research would indicate that the practical use of many of the alternative learning theory elements may benefit sports learning and understanding.

The research also suggests that due to the non-deterministic nature of learning measures for sports performance and the unique multimedia learning approach adopted, an overall measure of improved learning of basketball plays, brought about by the use of podCoaching, may be a better evaluated by gauging improvements in the following areas:

- Productivity during Practice
- Motivation to Learn
- Learning Methods
- Quality of Work produced

The results of the investigation into these issues shed more light on the overall satisfaction conclusions suggested in Fig 6.1. Its suggest the following:

- Attitudes to Improved Learning Method using podCoaching is heavily influenced by participants perceptions of the use of new technologies.
- podCoaching results in Improved Productivity, an indication of improved learning method.
- Significant impact on learner Motivation and participation levels.
- Impact on Quality of Work is not an attribute of podCoaching and subsequently does not significantly improve the Learning Method.
- Suggests podCoaching improves the pace of learning and so improves the Learning Method.
- Overall impact of podCoaching on learning and understanding of basketball plays is positive.

6.5 Overall Conclusions.

It is the conclusion of this research that on the whole Mayers and Najjars theories of Multimedia Learning and the podCoaching approach to learning have had a positive impact on the sports education domain and on increasing learning and understanding in a sports context respectively. This conclusion was based on the results from two distinct processes.

1. The analyses of literature review content
2. The analysis of case study findings

The analysis of literature review highlights the opportunities offered by integration of less conventional learning theories such as Gardners Multiple Intelligences and

Mayers Multimedia Learning. And also how approaches common in sports pedagogy often overlap closely with these theories. The significance of the Net Generation of learners was pinpointed and how this issue needs to be considered with the use of Multimedia Learning approaches.

With respect to case study findings, the theories and concepts of Mayers and Najjars were supported fully by the research. Regarding podCoaching and learner improvement measurement, it was decided that a more in-depth analysis of participant opinions was required to confirm or deny this issue. Overall satisfaction measurement was therefore completed by evaluating a range of factors from productivity to motivation.

Finally an analysis of the overall satisfaction response indicated in fig 6.2 is even more significant when the detail is extrapolated. Individual user group opinion is then revealed. See Fig 6.2. 70% of coaches Strongly agree that podCoaching does increase learning. This is a strong advocation for the use of podCoaching. The wide range of participant skill, from novice to coach, was significant also. It supports research by Najjar and Primary Source data from case study that podCoaching is best suited to users of low-domain knowledge and expertise. The Novice users benefited most with 75% either Strongly Agreeing or Agreeing that podCoaching was beneficial. Whereas with the Expert group, 45% agreed, 35% were undecided and 20% Disagreed to some extent.

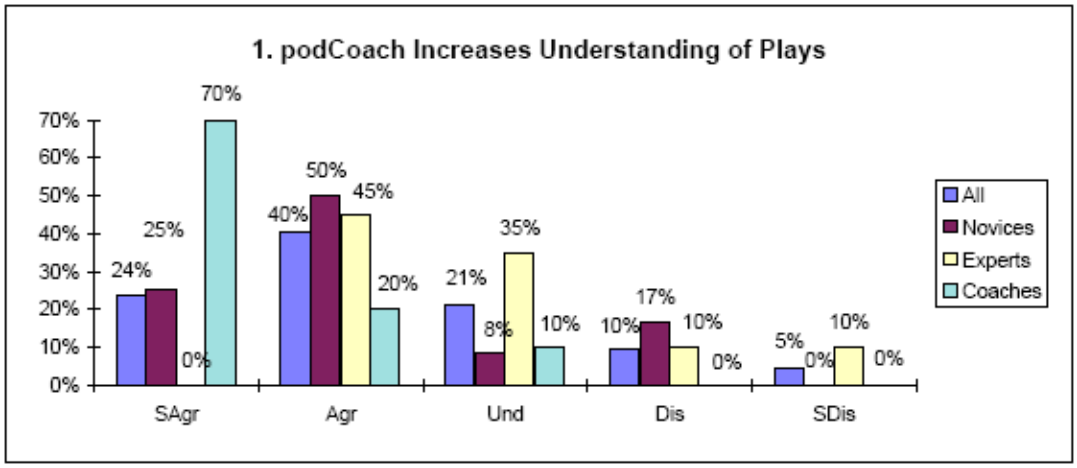


Fig 6.2. Does podCoaching increase learning and understanding (X Groups)

6.6 Recommendations

This study was an initial attempt to examine the use of Multimedia Learning for sports training education. Although the findings are limited to the use of an podCoaching in a basketball drill/play learning context ,it is believed that the descriptive data provided can be useful to all those who educate athletic training students, regardless of the sports application area. However, as noted by the participants of this study, further research is still needed to examine the effectiveness of this technology in athletic training education specifically.

As more athletic training/sports educators investigate new ways of improving teaching/learning methods, attracting and motivating participants this research challenges athletic training educators and researchers to seek answers to the following questions:

1) Can other non-traditional learning method approaches be adopted, similar to Multimedia Learning, in athletic training education specifically ?

2) Which types of athletic training students benefit most from technology-based instruction or Mobile Multimedia Learning (ie, Expert learners with high Domain Knowledge versus Novice learners with low-domain knowledge and expertise, students with one learning style versus students with another learning style, etc)?

3) Which athletic training content areas are best suited for the effective use of multimedia learning approach ?

4) Can alternative measurement of student learning and understanding in athletic training education be implemented with respect to extrinsic issues such as Motivation, Productivity and Quality of Learning ?

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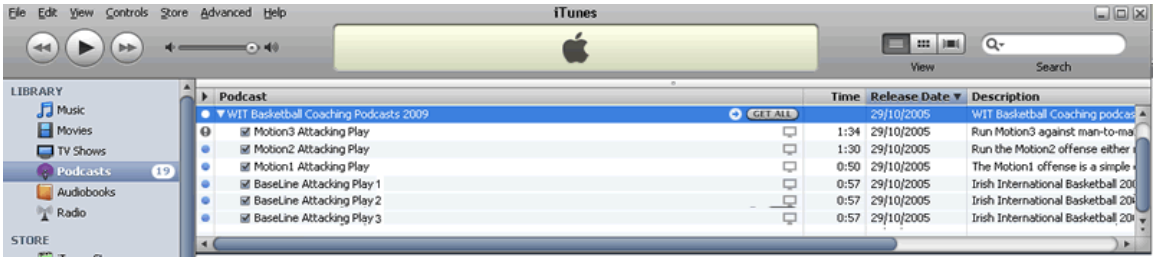
APPENDICES

Appendix A: iTunes Store and PodCoaching Podcasts



A1. The iTunes podCoaching Store

A2. A PodCoach podCast.

Appendix B: PodCoaching Drills Specification

The 1-3-1 offense is a simple offensive set, easy to learn, with good spacing, a high post and low post presence, and would be a good choice for youth and middle school teams. For attacking man-to-man defense, several simple motion patterns are presented below, and a few simple plays are referenced. We'll start with the most simple ("Motion-1") and end with a more detailed, advanced "Motion-3". Also read "Motion Offense Concepts".

The 1-3-1 set also works well in attacking 2-3 zone defenses, the most common zone defense that you will see. Having a single offense that will attack both man-to-man and zone defenses will certainly simplify things for younger teams, and teams that have limited practice time. Also see the simple 1-3-1 zone offense for attacking the 2-3 zone.

Motion 1

Using the 1-3-1 set, O1 is the point, O2 and O3 are the wings, O5 is high post and O4 is low block. O1 starts the play on either side by passing to either O3 or O2. O4 goes to the opposite block from the ball. O5 sets pick for O1. O1 cuts around the pick on the ball side. O3 can pass to the cutting O1 who can take it for the lay-up or shot.

If O1 does not get the pass, he/she continues through and sets pick for O4 (Diagram C). O4 then cuts to the ball-side block to post up.
Meanwhile, O5 drifts back to the free throw line, and O2 rotates out to the point. O3 tries to pass to O4. O4 then makes a post move for the shot. If O4 shoots, O1 should get into rebounding position on the opposite side. If the ball is passed out, O1 goes out to the right wing.

Options:
O3 can pass to the cutting O1, or to the posting O4, or to O5 at the free throw line, or back out to O2. Or O3 can take an open shot.

Motion 2.

Using the 1-3-1 set, O1 is the point, O2 and O3 are the wings, O5 is high post and O4 is low block. O1 starts the play on either side by passing to either O3 or O2.

If O1 does not get the return pass, he/she continues through and sets pick for O4. O4 then cuts to the ball-side block to post up.

Meanwhile, O5 drifts back to the free throw line, and O2 rotates out to the point. O3 tries to pass to O4. O4 then makes a post move for the shot. If O4 shoots, O1 should get into rebounding position on the opposite side. If the ball is passed out, O1 goes out to the right wing.

Options:

O3 can pass to the cutting O1, or to the posting O4, or to O5 at the free throw line, or back out to O2. Or O3 can take an open shot.

Motion-3

Run this against man-to-man defense. Useful because there are so many simple, effective options and plays that you can run from this play

These options use back-screens, screen-seal-roll moves, dribble-penetration with kick-out pass and "dump" pass options, ball-reversal, etc, all common and part of any motion offense. These things teach players how to "play the game", and when they get good at it, you won't even have to call plays, they'll just know what to do.

O1 at the point, passes to O2, and cuts around O4's screen. O2 passes to O1 for the lay-up. O4 seals the screened defender for inside position.

Endline Play 1

Starting spots

Player 4 and Player 2 start ball side. Player 4 on the block, Player 2 on the elbow. Player 5 on the opposite block. Player 3 on opposite elbow.

Player 4 screens away for Player 5 and rolls back to the ball. Player 2 screens for Player 3. Player 3 cuts out to the wing for the ball. Player 2 rolls back onto the three pt line.

Options :
Player 4 under the basket sealing her player. Player 5 coming off screen. Player 3 for shot or pass into 5 inside. Player 2 for jump shot or release pass

Side Line Play 2

Starting positions
Player 1 takes the ball out of bounds. Player 3 starts just below the FT line. Player 4 and Player 5 stacks up just outside the Player 3 pt line Player 2 stands just at the half way line

Appendix C: Online PodCoaching Survey

iPod Coaching Survey

Coach or Player ? (1:Coach; 2:Player):, *

Do you own an iPod ?, * ○ True ○ False

Age :, *

State Your Playing Level (1: novice; 2: club/college; 3: international);,

1. Did podLearning increase understanding of plays :, * ○SAgree○Agree ○Undecided ○SDisAgree ○ DisAgree
2. Did podLearning increase your productivity in training and match environments:, * ○SAgree○Agree ○Undecided ○SDisAgree ○ DisAgree
3. Did podLearning reduce time learning plays ;, * ○SAgree○Agree ○Undecided ○SDisAgree ○ DisAgree
4. Did podLearning improve yours and other player participation rate :, * ○SAgree○Agree ○Undecided ○SDisAgree ○ DisAgree
5. Did podLearning improve game and results quality :, * ○SAgree○Agree ○Undecided ○SDisAgree ○ DisAgree
6. Did podLearning aid your interpretation of Drill Text Instructions ?: ○SAgree○Agree ○Undecided ○SDisAgree ○ DisAgree
7. Did you think 3D Animation content was helpful as aid to learning Plays ?, ○SAgree○Agree ○Undecided ○SDisAgree ○ DisAgree
8. Did the Audio Commentary Support Animation Instructions and so aid learning ? ○SAgree○Agree ○Undecided ○SDisAgree ○ DisAgree

.

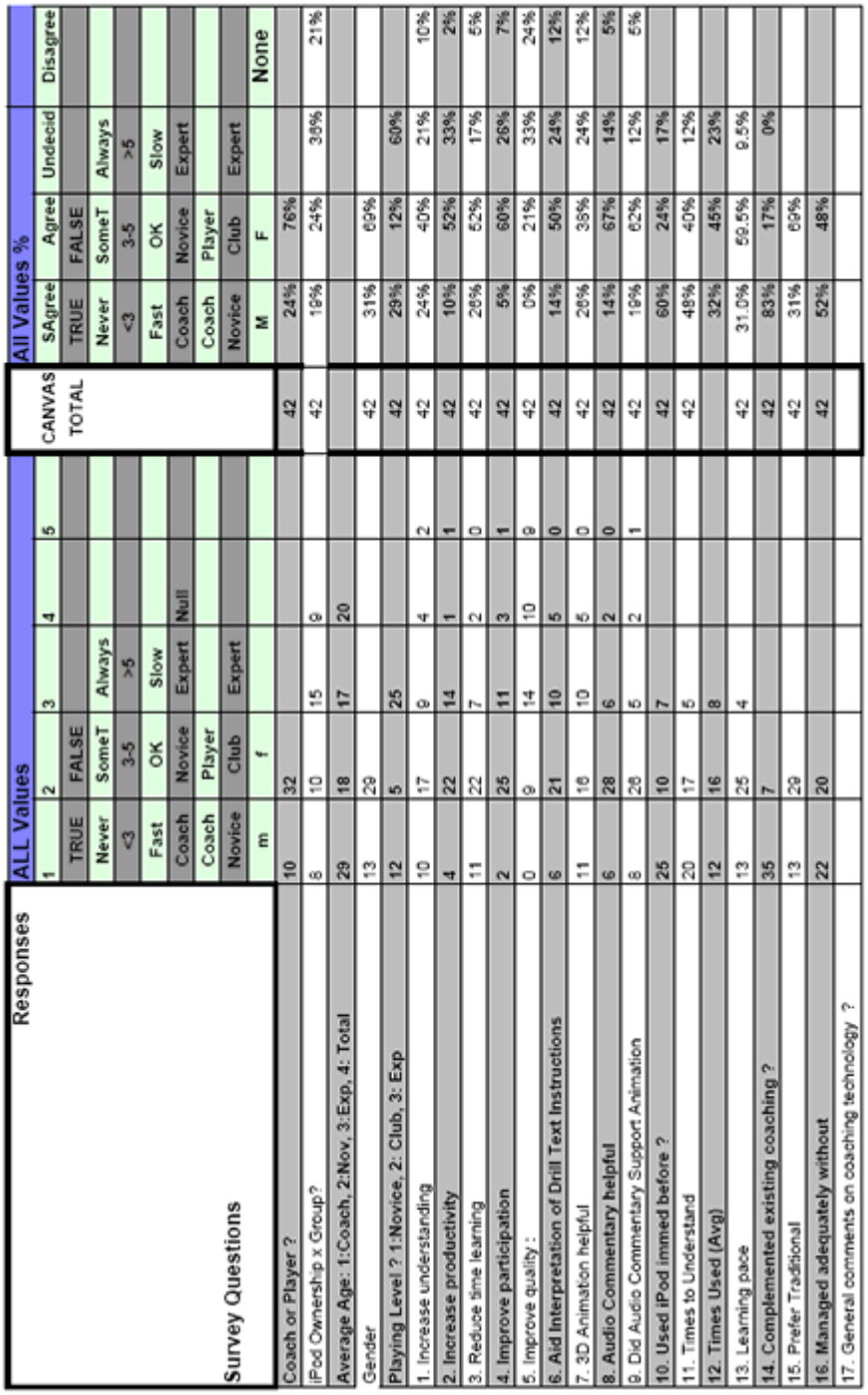
9. Did you use iPod Coach immediately before Play ? (1: never; 2: sometimes; 3: always),
10. How many times do you think you need to view iPod Coach data to obtain full understanding of content ? (1: less than 3 times; 2: between 3-5; 3: over 5 times):, *
11. How many times did you use the iPod Coach? Please state approximately how many:, *
12. How do you feel about the pace and workload of podLearning for Basketball Coaching ? Please enter the level most appropriate on the scale below: (1: too fast; 2: about right; 3: too slow):, *
13. Do you consider that iPod Coach tool complemented existing coaching ?, * ○ True ○ False
14. Would you prefer Traditional play learning approach (eg Rote & Practice) :, * ○ True ○ False
15. Could you could have managed adequately without iPod Coach?, * ○ True ○ False
16. Any general comments on use of coaching technology ?,

Submit Reset

Appendix D: Survey Analysis Spreadsheet

Response	1	2	3	4	5	6	7	8	9	10
Survey Questions	COACHES -->									
Coach(1) or Player(2) ?	1	1	1	1	1	1	1	1	1	1
Do you own an iPod ?	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE
Gender	m	m	m	f	f	m	f	m	m	m
Age	18	20	21	17	18	21	26	43	50	53
Playing Level	2	2	2	2	2	3	3	3	3	3
1. Increase understanding	1	1	1	1	1	1	2	2	1	3
2. Increase productivity	2	3	1	2	2	2	2	3	4	2
3. Reduce time learning	2	2	2	3	2	1	1	2	4	2
4. Improve participation	2	2	4	3	2	4	3	4	5	3
5. Improve quality :	4	4	4	3	2	4	3	3	5	5
6. Aid Interpretation of Drill Text Instructions	2	3	3	2	4	4	2	2	3	4
7. 3D Animation helpful	1	1	1	2	3	1	2	2	2	3
8. Audio Commentary Helpful	2	2	1	3	2	2	2	3	2	4
9. Did Audio Commentary Support Animation	2	2	2	2	2	2	2	1	2	2
10. Used iPod immed before ?	1	1	2	1	1	2	1	2	1	1
11. Times to Understand	2	2	1	1	1	1	1	2	2	2
12. Times Used	9	12	15	12	16	10	6	15	12	10
13. Learning pace	2	2	2	3	2	2	2	3	3	3
14. Complemented existing coaching ?	TRUE	TRUE	TRUE	FALSE	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE
15. Prefer Traditional	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	TRUE	FALSE	TRUE	TRUE
16. Managed adequately without	TRUE	FALSE	TRUE	FALSE	FALSE	TRUE	FALSE	TRUE	TRUE	TRUE
17. General comments on coaching technology ?	Useful Apr	Didnt use i	ok		like it		Ok for Nov	Ok for Nov	Ok for Nov	Ok for Novic

Appendix E: Survey Response Analysis Spreadsheet



Responses	ALL Values					CANVAS TOTAL	All Values %			
	1	2	3	4	5		SAgree	Agree	Undecid	Disagree
	TRUE	FALSE					TRUE	FALSE		
	Never	SomeT	Always				Never	SomeT	Always	
	<3	3-5	>5				<3	3-5	>5	
	Fast	OK	Slow				Fast	OK	Slow	
	Coach	Novice	Expert	Null			Coach	Novice	Expert	
	Coach	Player					Coach	Player		
Survey Questions	Novice	Club	Expert				Novice	Club	Expert	
	m	f					M	F		None
Coach or Player ?	10	32				42	24%	76%		
iPod Ownership x Group?	8	10	15	9		42	19%	24%	38%	21%
Average Age: 1:Coach, 2:Nov, 3:Exp, 4: Total	29	18	17	20						
Gender	13	29				42	31%	69%		
Playing Level ? 1:Novice, 2: Club, 3: Exp	12	5	25			42	29%	12%	60%	
1. Increase understanding	10	17	9	4	2	42	24%	40%	21%	10%
2. Increase productivity	4	22	14	1	1	42	10%	52%	33%	2%
3. Reduce time learning	11	22	7	2	0	42	26%	52%	17%	5%
4. Improve participation	2	25	11	3	1	42	5%	60%	26%	7%
5. Improve quality :	0	9	14	10	9	42	0%	21%	33%	24%
6. Aid Interpretation of Drill Text Instructions	6	21	10	5	0	42	14%	50%	24%	12%
7. 3D Animation helpful	11	16	10	5	0	42	26%	35%	24%	12%
8. Audio Commentary helpful	6	28	6	2	0	42	14%	67%	14%	5%
9. Did Audio Commentary Support Animation	8	26	5	2	1	42	19%	62%	12%	5%
10. Used iPod immed before ?	25	10	7			42	60%	24%	17%	
11. Times to Understand	20	17	5			42	48%	40%	12%	
12. Times Used (Avg)	12	16	8				32%	45%	23%	
13. Learning pace	13	25	4			42	31.0%	59.5%	9.5%	
14. Complemented existing coaching ?	35	7				42	83%	17%	0%	
15. Prefer Traditional	13	29				42	31%	69%		
16. Managed adequately without	22	20				42	52%	48%		
17. General comments on coaching technology ?										

Appendix F: Survey Interviews

Interviews carried out with Participants were either carried out face to face or via telephone.

Question	Player	Coach1	Coach2	Coach3
Would you lime more features on system. Like an Interaction element to allow for more problem solving.	*I dont believe the extra interaction option would be of benefit to our players. It then becomes more like a game and this is a distraction.*	*This refocuses the application into more of a "Game" category where a player responds to unpredictable situations. This is not something I think that would complement*	*Yes it could be interesting but it needs more investigation. We find it better to get students to problem solve by game playing on court practice*	*Never considered this option but I can see the benefits. It may be a littele difficult to use and implment as users would need more training. I think it would make it less easy to use which is one of its great benefits.*
Who is the application best designed or suited for in your opinion.	*I think the great thing about this is young novice players will like it.*	*It is definitely something I would see younger novice players getting a lot of use from. They would see its use as part of basketball coaching as a fun element and something they could share with their friends afterwards"*	*I think all levels could use it. Depending on the design of the drills I think it could target all levels. Also I think coaches could use it for creating content.*	*Both coaches and players definitely. Coaches can get their message across 24 hours a day. Players can learn at their own pace and in a way they are familiar with.*
When was podCoaching Tool most Used	*None of our players used the application immediately before matches. They had enough to focus on with the game about to commence. This time is for focus, dealing with nerves and thinking about the overall game. The iPod would be a distraction and none of our coaches would want that.*	*Almost every day players and coaches were viewing content. Especially as we were on an intensive 2 week trip. Everyone needed as much time to focus on plays as possible in order to be familiar with the plays.*	*On Trips usually. Times when players use their iPods generally. Never before a match though. I wouldn't allow it as it distracts from focusing.*	*I used it every day either to review content or else to demonstrate elements of plays to players. I think most players and coaches used it every day.*
What did youu think about the Audio commentary provided with each Play.	*The audio commentary was of great benefit. Players could follow the instructions closely and then either review the animation or watch the movement in practice. It was a great reinforcement tool. We could also use it when travelling. Take a rest, close our eyes and still take in the instruction. The Mental Image was sometimes enough.*	*Really good. It proved to be the best part of the application for me. Obviously it needs the animation content but once viewed the audio remained in my mind longer.*	*Yes very good. I think the commentary should come from the coach themselves and this means it takes on more meaning*	*Very helpful.. The simple coaching instructions were best and they followed the text and animations well*

What did you think about the Animation content provided with each play ?	*Animation was extremely helpful. It was interesting to be able to view plays from the 3d perspective and it could be manipulated by the players also. Slowed, Paused, Speeded up. Each player could review play at their own speed. Also again it was great to be able to recall the play when you were relaxing on the coach, plane or just sitting quietly.*	*Very helpful. Almost all players commented on its usefulness. Especiually for learning during off periods, in hotels, coaches and travelling generally*	*Some players had problems with screen size and the animation could be hard to see. But generally it was good. The concept is great.*	*Perhaps on my iPod they were a little small. I don't own an iPod touch which was better I believe.*
Can you identify any specific Benefits of the podCoach Tool during your time using it ?	*Productivity in training increased I think. The players came in much better prepared. The mental imagery and instruction from podCoach meant we understood the task quicker*	*The audio reinforcement of the play content. I also like the link between the text instructions, the audio and the animation.*	*New technologies and especially iPods are all the rage. All our players have one or access to one. And they are always with them which means the coaching content is always with them*	*Easy to use and players or coaches can learn at their own pace*
Any Disadvantages ?	*This was difficult to say The system is good at helping understanding and learning so perhaps it is more useful for novice players.*	*It did not improve quality. This is about skill, expertise and experience. Different requirements from learning. Which i think podcoaching is good at.*	*As I mentioned the screen size could be a problem. But once this is addressed perhaps by improved animation then it would be ok. I cant think of anything else that concerned me.*	*Nothing specific. Perhaps more detail on the plays might be good.*