Multimedia Case-Based Learning in Athletic Training Education

Literature Review

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Health professional education programs use multifaceted pedagogical strategies and a variety of educational tools to teach students in this modern world. This review will focus on the research detailing the use of multimedia technology and case-based learning (CBL) within athletic therapy/training (AT) classrooms. The review will begin by describing the AT profession and its education process to set the context for this study. Next, the review will introduce some of the commonly used pedagogical strategies within AT education programs. The review will then explore the use of CBL (a specific pedagogical strategy) activities and demonstrate how multimedia technology can potentially impact AT education. Finally, a discussion of some of the important theoretical frameworks and learning theories will be presented to explain how to improve instructional design/strategies in AT education and how to incorporate multimedia technology into these educational programs.

The Profession of Athletic Therapy

The terms ‘athletic therapy’ as it is referred to in Canada, and ‘athletic training’ as it is referred to in the United States, will be used interchangeably throughout this review because of the similarities between the two professions and affiliations between national associations. Both healthcare professions dedicated to the health, well-being, and rehabilitation of physically active individuals (Canadian Athletic Therapists Association, 2008a). The only significant difference between the two professions is in the name. The first members of the Canadian national association were originally labelled as ‘athletic trainers’ to coincide with their American colleagues. However, these Canadian members felt that it was necessary to change the name of their profession to develop a more professional attitude and image before attempting to increase awareness of the profession throughout Canada (De Conde, 1990). These individuals felt the title “trainer” was inappropriate for their health profession because it was often confused with
other less qualified groups (e.g., someone who had a basic first aid course and worked with a hockey team would also be a called a trainer). Therefore, the Canadian association proposed a professional name change and henceforth athletic trainers became known as athletic therapists in Canada (De Conde, 1990).

The AT profession first emerged in the United States in the early 1900s, with the majority of trainers of the time being employed by either professional sports teams or as a part of the military ranks (Delforge & Behnke, 1999). Early accounts of the first athletic trainers portrayed these individuals as those on the team who carried water bottles and passed out towels, not as qualified health professionals who specialized in orthopedic rehabilitation (De Conde, 1990). Since that time, the AT profession has exponentially grown (currently there are approximately 2,500 members in the Canadian Athletic Therapists Association [CATA] and 40,000 members in the United States’ National Athletic Trainers’ Association [NATA]) and has evolved to now being considered a respectable and recognized paramedical healthcare profession throughout North America (CATA, 2013a). AT is also gaining more international exposure and recognition with the expansion of professional associations into the United Kingdom, South Africa, Japan, Taiwan, Italy, Korea, Spain, and Georgia (World Federation of Athletic Training & Therapy, 2013). Certified athletic therapists can be found working in many diverse employment settings including professional sports, private rehabilitation clinics, hospitals, college/university settings, within the arts (e.g., Cirque de Soleil or dance companies), research institutions, and even national or international sporting organizations (CATA, 2013a).

**What is Included in the Athletic Therapy Education Process?**

To achieve the status of certified athletic therapist from the CATA, a candidate is required to meet the academic requirements as set by a CATA-approved AT curriculum, leading
to a Bachelor’s degree from an accredited post-secondary institution. In Canada, there are currently only seven accredited AT institutions – Sheridan College (Brampton, Ontario), York University (North York, ON), Concordia University (Montreal, QC), University of Winnipeg (Winnipeg, MB), University of Manitoba (Winnipeg, MB), Mount Royal University (Calgary, AB), and Camosun College (Camosun, BC). Each candidate is also required to hold a valid First Responder certification (an advanced first aid designation) and complete an internship of at least 1200 hours of practical training under the supervision of a certified athletic therapist. Once these criteria have been met, a candidate is qualified to attempt the comprehensive written certification exam and then a practical exam that covers all required components of the AT scope of practice. These components include: on-field management procedures; taping/bracing procedures; clinical evaluation and management; and modality applications (CATA, 2013b).

A certification candidate in the NATA follows a similar process to the one just described for the CATA. A NATA candidate must also graduate from an accredited athletic training program with a Bachelor’s or Master’s degree before attempting the national certification exam (consisting of a written and practical exam). However, there are currently 360 accredited athletic training programs in the United States which explains why the NATA membership is much larger than the CATA (Myer, Kreiswirth, Kahanov, & Martin, 2009).

Accredited AT education programs in both the CATA and NATA are designed to prepare students with the essential content knowledge and practical skills from a variety of specific domains to better understand the human body, how it works, and how injury affects it (Mazerolle & Yeargin, 2010). The CATA divides the expected competencies of athletic therapists into six broad domains: 1) prevention, 2) recognition and evaluation, 3) management, treatment, and disposition, 4) rehabilitation, 5) organization and administration, and 6) education and
counseling (CATA, 2008b). Each area is further subdivided to form three separate domains (cognitive, psychomotor, and affective) with suggestions for topics/activities/strategies that demonstrate the specific knowledge, tasks, and intellectual skills required from each particular domain (CATA, 2008b). Accredited programs must ensure that each domain and its subdivisions are covered within their curriculum. In the USA, the National Athletic Trainers’ Association Board of Certification (NATABOC) outlines five main domains which are expected to be covered in all accredited AT educational programs: 1) injury/illness prevention and wellness protection, 2) clinical evaluation and diagnosis, 3) immediate and emergency care, 4) treatment and rehabilitation, and 5) organizational and professional health and well-being (BOC, 2011). For accredited education programs in both the CATA and NATA, each student is expected to demonstrate the necessary skill-sets, domains, and competencies as outlined above before being considered for examination to become a qualified, certified health professional.

The Education of an Athletic Therapy Student

The education of an AT student involves finding a balance between theory (content knowledge) and application (practical skills) because of expectations for the student to perform in both classroom and clinical environments (Carr & Drummond, 2002). For example, each student within an AT program will simultaneously complete courses in a classroom or laboratory setting, as well as in diverse practical settings (e.g., acting as a student therapist in a private clinic or as a first responder while covering a live athletic event). Because there are numerous settings, domains, and competencies expected of AT students, educators are required to use a variety of pedagogical strategies to ensure student learning in its multiple types, forms, and styles. One classification system that can be used to describe different pedagogical methods is to consider these strategies as being either teacher-centred or learner-centred (Carr et al., 2002).
Table 1 provides a comparison of the main differences between the teacher-centred and learner-centred teaching paradigms as described by Huba and Freed (2000).

Table 1. Comparison of Teacher-Centred and Learner-Centred Teaching Paradigms

<table>
<thead>
<tr>
<th>Teacher-Centred Paradigm</th>
<th>Learner-Centred Paradigm</th>
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<tr>
<td>Knowledge is transmitted directly from teacher to students</td>
<td>Students construct their own knowledge through gathering and synthesizing information; this is then integrated with other general skills of inquiry, communication, critical thinking, and problem-solving</td>
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<tr>
<td>Students passively receive information</td>
<td>Students are actively involved</td>
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<tr>
<td>Focus is often placed on a single discipline</td>
<td>This approach is compatible with interdisciplinary investigation</td>
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<tr>
<td>Emphasis is placed on the acquisition of knowledge outside the context in which it will be used</td>
<td>Emphasis is placed on using and communication knowledge effectively to address emerging issues and problems with real-life contexts</td>
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<tr>
<td>Teacher’s role is to be the primary information giver and evaluator</td>
<td>Teacher’s role is to coach and facilitate; Teacher and student evaluate learning together</td>
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<td>Class culture is competitive and individualistic</td>
<td>Class culture is cooperative, collaborative, and supportive</td>
</tr>
<tr>
<td>Teaching and assessing are separate</td>
<td>Teaching and assessing are intertwined</td>
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Teacher-centred learning strategies place students in a passive, receptive role where the teacher must accept a more active part at the centre of the learning process (Weimer, 2002). In this type of learning, the teacher chooses what the students will learn, how the students will learn, and how they will be assessed. Examples of teacher-centred strategies include traditional lectures, teacher demonstrations, and structured individual assignments. These traditional teaching strategies are still commonly used in AT education programs (Potteiger, Brown, &
Kahanov 2012). Therefore it is important to review the literature to show advantages and disadvantages of these instructional techniques in AT education.

The benefits of using traditional teacher-centred instructional strategies include: 1) an orderly classroom – by using these strategies, the teacher is in full control of the classroom and the type of activities that students are engaging in, 2) independent learning – because students learn on their own, they will learn to become independent learners and make their own decisions, 3) organized learning – the teacher is in control of directing the learning process and able to plan how the course should proceed, 4) ease of assessment – by using these strategies, it is easier for the teacher to assess student progress, and 5) all students will be presented the same material so the teacher does not have to worry that they will miss out on important topics or concepts (Gredler, 2009; Hughes, 2013).

Even though these methods are commonly used in AT education, it is also important to discuss the possible disadvantages associated with using teacher-centred instructional strategies. Espeland and Shanta (2001) proposed that instructors, who predominately use lecture formats, organize and present essential information without any forum for student input. This type of instructional strategy eliminates the opportunity for students to decide for themselves what information is important to know and has a possible negative effect on their ability to critically think and to make decisions (Espeland et al., 2001). Furthermore, Paul and Elder (2001) posited that many health professional educators ask their students to learn a body of knowledge in a sequence of lectures and then request them to internalize the knowledge outside of the classroom on their own time. However, these researchers also suggest that not every student possesses the necessary cognitive skills to analyze and synthesize information without the opportunity for
practice, further demonstrating the need for supplementary learner-centred instructional approaches.

Recent studies have shown a paradigm shift of moving from predominately using teacher-centred methods to using more learner-centred instructional methods in the higher education, medical education, and adult learning education literature (Bryan, Kreuter, & Brownson, 2009; McLean & Gibbs, 2009). Learner-centred learning strategies place the teacher role as a facilitator of learning and an increased focus is placed upon each student’s interests, abilities, and learning styles (Weimer, 2002). Examples of learner-centred strategies include active learning, collaborative learning, and various types of problem-based learning (PBL). This type of learning allows students to be more autonomous and in control of their own learning. When using these innovative and specifically designed instructional strategies, an educator should be expected to use techniques, tools, or strategies to help guide student autonomy (Heinerichs, Vela, & Drouin, 2013).

AT educational researchers suggest that a variety of instructional strategies (both teacher-centred and learner-centred) should be used in accredited AT programs to help develop a combination of theoretical understanding, clinical reasoning, and practical skills (Doherty-Restrepo, Hughes, Del Rossi & Pitney, 2009; Wright, Stewart, Wright, & Barker, 2002). However, traditional teacher-centred strategies still dominate the AT curriculum in many accredited programs (Walker, 2013). Nevertheless, there is an increasing amount of supportive evidence in the literature that strongly recommends the use of more learner-centred activities within the AT curriculum (Heinerichs et al., 2013; Walker, 2003).
The main reason for this shift towards using more learner-centred learning strategies in AT education is that these innovative learning strategies are thought to enhance the development of critical thinking skills when compared to other “traditional” teacher-centred approaches (Leaver-Dunn, Harrelson, Martin, & Wyatt, 2002; Walker, 2003). John Dewey was one of the original educational researchers to write about the importance of reflective, or critical, thinking. According to Dewey (1933), reflective thinking consists of constantly turning a subject over in the mind and giving it careful and consecutive consideration. Dr. Richard Paul, the Director of Research and Profession Development at the Center for Critical Thinking in California, defines critical thinking as, “purposeful thinking in which individuals systematically and habitually impose criteria and intellectual standards upon their thought” (p. 5). Critical thinking skills are very important for certified athletic therapists who must consider a number of injury options while performing an orthopedic assessment, as well as make difficult decisions between effective rehabilitation techniques and possible harmful ones. In addition, the therapist has to be able to react calmly during emergency situations and requires the critical skills to handle these stressful environments (e.g., dealing with an athlete with a possible spinal fracture in a hockey game).

Therefore, pedagogical strategies that allow for students to practice critical thinking skills in and out of the classroom should, in theory, be useful to AT education programs.

Heinerichs et al. (2013) investigated the effect of a specific learner-centred instruction strategy on clinical reasoning skills in a sample of AT students. The instructional strategy explored in this study was entitled SNAPPS - summarizing the history and findings, narrowing the differential (e.g., suspected injuries), analyzing the differential, probing the instructor about uncertainties, plan management, and selecting the issue for self-directed study. The results from this study showed that the SNAPPS instructional strategy can help students to effectively and
efficiently verbalize higher-level thinking skills, critical thinking ability, and also improve technical skills.

Additionally, Radtke (2008) developed a model for AT clinical education with the main goal of improving learning and promoting the transfer of knowledge from the didactic classroom to real world settings. This author posited five important strategies an AT educator should use to promote critical thinking: 1) effective higher-order questioning, 2) regular debriefing (student/teacher interaction), 3) reflective journaling, 4) process recording of observations (student/patient interaction), and 5) the facilitation of student self-evaluation (students should learn how to self-evaluate their own decision-making skills). These strategies should be included in the design and development of AT related learner-centred instructional methods.

In summary, AT education programs need to be designed to help foster the development of classroom, clinical and emergency care decision-making and critical thinking skills. There are several learner-centred instructional strategies that have been shown to be effective in developing these abilities including: journal writing, peer coaching, PBL, and CBL. When reviewing the AT literature, PBL and CBL appear to be the most documented learner-centred strategies and will therefore be the focus of this review.

**Introduction to Problem-Based Learning**

PBL instructional approaches have been successfully used in education programs since the early 1900s and continue to gain acceptance in multiple disciplines, especially within various health professional fields (Polyzois, Claffey, & Mattheos, 2010; Setia et al., 2011; Thistlethwaite et al., 2013). PBL consists of specific learner-centred approaches that empower the learner to
integrate both content knowledge theory and practical skills while attempting to construct a viable solution to a defined problem (Savery, 2006).

Through PBL instruction, students experience a collaborative/cooperative learning environment while working through the problem-solving process of realistic situations. PBL was originally designed to help students: 1) construct an extensive and flexible knowledge base, 2) develop effective problem-solving skills, 3) become intrinsically motivated to learn, 4) become effective collaborators, and 5) develop self-directed, lifelong learning skills (Barrows & Kelson, 1995). This type of instruction focuses on self-directed learning from the student. Knowles (1975) defines self-directed learning as the process in which learners take the initiative to define their learning needs, formulate goals, identify needed resources for learning, select and implement learning strategies, and evaluate the results. An AT student requires self-directed learning skills to be able to solve PBL problems effectively.

Although the evidence base is limited, previous research suggests that PBL has the potential to have a positive effect on learning for numerous student aged groups: from pre-school children (Zumbach, Kumpf, & Koch, 2004) to adult learners (Alexander et al., 2002; Vermette, Harper, & DiMillo, 2004). The focus of this review will be on literature from higher adult education because of the specific context for this study (i.e., post-secondary AT programs).

Throughout the literature, many different examples of learning strategies and activities fit under the PBL ‘umbrella’ (e.g., CBL, inquiry-based, problem-based) and these terms are often used interchangeably. According to Barrows (1986), PBL does not refer to a single, specific educational method because it can have many different meanings depending upon the design of the educational method and the skills/experiences of the teacher. Some of the different types of
PBL include CBL, inquiry-based learning, project-based learning, discovery learning, partial problem simulation, and full problem simulation (Barrows, 1986; Prince & Felder, 2006; Savery, 2006). This literature review will focus on CBL because of its frequent use in medical professions such as AT education (Heinrichs, 2002; Thistlethwaite et al., 2012).

**Introduction to Case-Based Learning**

Berry et al. (2011), posited that CBL is a particular method of teaching based on the principles of PBL but places more emphasis on learning specific skills that will be transferable to a practical clinical setting. These skills are very important to develop in the education of AT students. CBL, also known as case-based instruction (CBI), directly places the student into an active problem, centred on finding a solution to a real-life simulation or hypothetical situation. To successfully complete any CBL activity, the student needs to partake in a situated learning environment that emphasizes the need to find associations between content, context, understanding, meaning, and the construction of knowledge (Kim & Hannafin, 2009). For example, in AT education, a CBL activity could provide a student with a simulation of an athletic injury (e.g., ankle sprain scenario) and have the student work through the case to ultimately find a solution, or more specifically, use the information within the scenario to develop an index of suspicion of the type and degree of simulated injury.

The formal adoption of CBL as a pedagogical strategy first emerged in 1870 under the guidance of Dean Christopher Columbus Langdell at Harvard Law School (Merseth, 1991). The main objective of this innovative type of instruction was to emphasize the importance of analyzing and discussing individual cases to learn how to become a lawyer. Although this method was initially met with skepticism from other law schools in the United States, by 1915
CBL was implemented in most of the well-known law schools throughout the country (Culbertson, Jacobson, & Reller, 1959). With supportive anecdotal and empirical evidence being presented in the literature (Culbertson et al., 1959; Merseth, 1991), CBL soon became a commonly used instructional strategy and was adopted by other professional programs in business, medical, and teacher education. This type of instruction remains in frequent use in many professional programs throughout the world, especially within health professional education programs (Levett-Jones, Gilligan, Lapkin & Hoffman, 2012).

**Potential Benefits of Case-Based Learning**

Initially established as a pedagogical strategy to facilitate active learning in the classroom, CBL has many proposed benefits. Case studies can be used by an educator to improve areas such as critical thinking, problem solving ability, ability to integrate both process and content knowledge, and the required judgment to make real life decisions (Levett-Jones et al., 2012). Kumar and Sherwood (2007) suggested that CBL use in the classroom can also result in increased engagement, improved understanding, and provide students with a forum to make more meaningful connections with the course material. Furthermore, Prince and Felder (2006) posited that providing students with real-world problems in a situated learning context motivates them to learn by making the course material more relevant and engaging when compared to traditional lectures or readings.

The use of case studies for learning also has many potential benefits for teachers and instructors. According to Kunselman and Johnson (2004), CBL can potentially create a higher level of enthusiasm in instructors (which can then be transmitted on to the students), renew the instructors’ interest in the course material and activities, and help instructors rethink (or further
develop) their approaches to teaching. Popil (2011) augments these benefits for educators by stating, “Teaching the same topics in a lecture format can become redundant and lose its freshness. Developing case studies and discussing them with students brings freshness, innovation, and food for thought to the table” (p. 205).

**Limitations of Case-Based Learning**

While the benefits for CBL use are well documented in the literature, this type of learning is not without its difficulties. Billings and Halstead (2005) posited that CBL can become a frustrating activity for less prepared students or students who prefer more traditional methods of learning. Research by Popil (2011) adds that case studies are useful in working through complex situations that require problem solving, but are not the most effective type of instruction to teach concrete facts or content knowledge. These limitations suggest that CBL should be only used as a supplemental activity within AT educational curriculum instead of completely replacing the traditional lecture instructional format with learner-centred activities.

Further, Yadav et al. (2007) postulated some major obstacles that an educator needs to overcome to successfully use CBL within the curriculum. These authors offered that CBL activities require additional, careful preparation and educators should be informed of how to implement cases within an established instructional model. Inadequate preparation of AT educators, or ignorance of well-established instructional models, can be considered as potential significant barriers for using CBL effectively. AT educators often use some form of CBL activity in the classroom but many are unaware of specific instructional design models or have little knowledge about the amount of material/preparation to put into the design of each case scenario (Nath, 2005). This ignorance can potentially have a negative effect on student
motivation and attitudes towards learning, by causing student resistance towards using these learner-centred activities (Yadav et al., 2007). These barriers and limitations should be explored and understood in more detail before suggesting whether or not to use CBL exclusively as an instructional method within AT classrooms.

**Case-Based Learning in Athletic Therapy Education Programs**

A pedagogical strategy regularly used in medical professions, such as athletic therapy, CBL provides a safe, dynamic, and simulated learning environment for students to acquire, analyze, learn, and judge the appropriate clinical decision-making skills to properly handle an injury situation (Berry et al., 2011). According to Herreid (1998), case activities should focus on real life scenarios and explore the actual performance and ability of health professionals in managing these cases. These activities could possibly enhance the overall learning experience for the student and make the subject matter more relevant to them.

Most of the cases used in CBL activities are based on actual patient scenarios and are presented in one of the following formats: 1) simulated (people are acting as a patient with specific problems), 2) real (the student is working in an actual healthcare setting under the direct supervision of a certified professional), 3) text-based (text is used to describe the patient’s problems), or 4) virtual (using multimedia technology to simulate a patient with specific problems) (Thistlethwaite et al., 2012).

Barrows (2000) posited that CBL activities can be valuable to medical professional educators because this type of instructional method encourages students to: 1) become independent and critical thinkers, 2) reason their way through realistic patient problems, 3) recall and apply what they have been previously taught to help in the care of their patients, 4) recognize
when their skills/knowledge are not adequate to the particular clinical task, and 5) keeping contemporary in knowledge and skill development.

Also in many AT education programs, the variability in student clinical education experiences is difficult for an accredited program to control (Speicher, Bell, Kehrhahn & Casa, 2012). For example, one student could work in a particular clinical setting and assess/treat only ankle and knee injuries (this clinic could have a reputation for being ‘experts’ in these areas of rehabilitation), whereas another student could be in a different clinical setting and end up with the opportunity to practice assessments and treatments of every joint in the body. Using a CBL approach to learning would help to create consistency in clinical experiences to ensure that all students have the same opportunity to learn how to assess and treat the same simulated injuries or situations.

Although there are many AT researchers and educators who consider CBL to be a more effective learning and teaching method when compared to other traditional approaches, there is very little evidence that support these claims in the literature (Thistlethwaite et al., 2012). However, as AT educator Kristinn Heinrichs (2002) proposed, “[as AT educators, we should] shift the focus from ‘which technique is the best?’ to ‘which teaching strategies are best used to develop an instructional program?’” (p. S189). AT educators face great challenges and have expectations to produce competent professionals who demonstrate independent and critical thinking, who sequentially analyze and solve dynamic problems, who commit to lifelong learning, who can rapidly process problems to make critical decisions on the field and in the clinic, and who can work as part of a team (Heinrichs, 2002). Therefore, these educators should explore various instructional strategies in great depth to better understand when, and how, to use
these specific methods. Educators need to also learn how to use these multifaceted, innovative teaching techniques and educational tools to keep current with the new generation of students.

Lecture-based methods, skills-based methods (e.g., lab settings for teaching psychomotor skills), inquiry-based methods (e.g., CBL, PBL), peer-group methods (e.g., collaborative/cooperative learning), and technology-enhanced methods (e.g., computer simulations) all have the potential to develop critical thinking ability and decision-making skills in AT students. Therefore, future research should explore the development of improved instructional models for using these diverse strategies and attempt to answer the question, “Which teaching strategies are best used to develop the required competencies in an AT instructional program?”

**Multimedia Case-Based Learning**

As discussed in the previous section, CBL activities can be used in AT classrooms to provide a simulation of actual injury situations and to create an enhanced contextual environment to demonstrate how complex injury assessments and rehabilitation can be (Han, Eom, & Shin, 2013). Several researchers have posited that multimedia technology can be combined with CBL principles to present learners with a more complete and accurate depiction of the necessary complexities that are required to work through a case scenario process (Han et al., 2013; Kurz & Batarelo, 2010; Moreno & Ortegano-Layne, 2008). According to Bolz (2002), “Taking the strengths of the case study learning method and recommendations of constructivist learning support the design and development of using multimedia case studies” (p. 1362). The findings from Bolz’s research also suggest that multimedia technology can be used to create more authentic, realistic, and complex case scenarios which can have a positive effect on factors such
as cognitive learning objectives, student motivation, and attitudes towards learning (Bolz, 2002). These proposed benefits of multimedia CBL warrant its use in AT education programs to help build the foundation for a better understanding of the context for performing in actual environments (e.g., what it is like to do an assessment while on a football field) while also allowing for more effective application of theory and principles in real life contexts.

In AT education programs, various forms of multimedia technology are often combined with other common pedagogical strategies (such as CBL) to create more realistic injury simulations, to provide the student with additional resources (e.g., pictures, videos), and to increase student engagement, motivation, and critical thinking ability (Chien & Chang, 2012). For example, mechanism of injury videos, which show the exact incident of injury, can be added to a text-based case scenario to provide students with a more accurate depiction of the case in question. For this proposed research project a multimedia sports injury assessment DVD was designed by the researcher to explore the impact of using multimedia CBL on student learning in an orthopedic injury assessment course. This educational tool used various forms of media and text to simulate athletic injuries, while attempting to replicate a realistic injury assessment experience for the student. These case scenarios were embedded on the DVD so students could access them outside the classroom, from any computer, without being dependent upon a high quality internet connection.

**Multimedia Technology in Athletic Therapy Education**

As described in other health professional disciplines, AT education has the potential to benefit from a re-evaluation of instructional strategies because of the technological revolution, the advancement of the Internet, availability of information to students, and changes to the entire
educational cultural environment (Heinrichs, 2002). Constant scientific, medical, and technologic advances seemingly exceed the ability of the student mind to integrate all available knowledge within the present paradigm. This raises the question, “Are the ways that students are taught now the most appropriate way to learn in today’s society?”

According to Heinrichs (2002), traditional teaching methods (e.g., lecture format) may no longer be the most effective method to use in current AT classrooms. Payne, Berry and Lowry (2012) agree with this statement by suggesting that AT educators should be free to research and use innovative teaching strategies without feeling pressured to “teach to the test” by providing only the skills and competencies that are required for the certification exam. Additionally, researching or thinking about innovative instructional strategies that may further develop additional skills and knowledge will ultimately make the student a better health professional (Payne et al., 2012).

The potential of technology for education to help make improvements to traditional methods and change the way in which students learn, should be considered to be, arguably, a valuable pedagogical tool because of the number of students who are accustomed to creating, learning, and communicating via technology in this digital age (Courts & Tucker, 2012). For example according to the web research firm comScore, the average Canadian spends 43.5 hours a month on the Internet, which is almost twice the worldwide average (23.1 hours/month) (El Akkad, 2011). Therefore, educational researchers should explore how various forms of technology can be used effectively within Canadian educational settings. Future research should also explore the impact that technology has on student learning (e.g., does it change how knowledge is constructed?)
Potential Benefits of Multimedia Technology for Athletic Therapy Education

Various forms of multimedia technology have been suggested to be valuable supplemental instructional tools in AT education programs (Rehberg, Gazzillo-Diaz, & Middlemas, 2009; Wiksten, Spanier, & LaMaster, 2002). Proposed advantages of using technology for educational purposes within this population include: 1) increasing student engagement, 2) providing instant access to high-quality videos and images, 3) providing realistic injury simulations (compared to text-based scenarios with no technology), 4) providing an active learning environment, 5) assisting in the development of higher-order thinking skills, 6) providing opportunities to review and revise, and 7) allowing for flexibility so that students have the opportunity to learn at their own pace (LaRoche & Flanigan, 2013; Selwyn, 2011; Wiksten et al., 2002). Multimedia technology such as animations, videos, and pictures can also be used to create accurate simulations of sports injuries to allow for students to learn and practice in a “safe” environment, at any time, and in any place. If the student was working with a real patient (e.g., in an actual clinical setting) then there is a risk that the patient could be harmed by the student if they use an incorrect procedure/technique. A safe, simulated environment eliminates this risk by allowing the student to use technology to practice theory, concepts, and skills before working with an actual patient.

There is a considerable amount of research on the impact of using multimedia technology in medical education and nursing education but few studies have specifically focused on the fields of AT. Wikstein et al. (2002) examined the effectiveness of using a multimedia platform in AT students as a supplemental tool to traditional lecture instruction. The results of this small sample study (26 students in total) suggested there was no significant quantitative difference in performance between the lecture group and the group who used a combination of lectures with
multimedia technology supplements. However, qualitative data suggested the use of multimedia technology significantly increased student motivation, engagement, and access to course material. Another study by Davie (2009) evaluated the use of technology and mobile learning in AT classrooms. This author posited that today’s AT students are digital natives by growing up with a variety of digital technologies as a natural part of their daily lives. Therefore, teaching and learning methods that incorporate multimedia technology integration may be useful in engaging and motivating the newer generation of students that are familiar with learning in an evolving educational environment.

**Limitations of Multimedia Technology in Athletic Therapy Education**

While there are many proposed benefits for using multimedia technology for AT education, there are also numerous potential disadvantages that are well described in the literature. One of the foremost limitations for using educational technology is related to the concept of a “digital divide” that presently exists in various populations. According to Warschauer (2004), the term “digital divide” can be used to describe the discrepancies between nations, cultures, or socio-economic groups and their corresponding access to technologies. Waycott, Bennett, Kennedy, Dalgarno and Gray (2009) suggested that there is a generational digital divide between young people who have grown up with the internet and have a natural affinity with technology (“digital natives”) and older people who encountered technologies later in life (“digital immigrants”). If an educator decides to use technology in the classroom, then insurances must be provided so that each and every student has equal access to the necessary social and organizational resources required to use that type of technology effectively (Warschauer, 2004).
Another limitation of using educational technology is the increased opportunity for student distractions. La Roche and Flanigan (2013) showed that many post-secondary pedagogical strategies using technology required direct access to a computer or tablet (e.g., iPad). However, with this increased access, it is easier for them to become distracted and go on social media sites, surf the internet, email, play games, or online shop. In larger classes, it also becomes more challenging for the instructor to monitor students and to differentiate between those students who are using the computer for the required in-class activity and those who are just using it to update their social media pages.

Other studies suggest that even though there are many potential benefits for using multimedia technology for educational purposes, it should never fully replace the “hands-on” face-to-face learning (Heinerichs et al., 2013; Waycott et al., 2010). For example, in an AT assessment course, multimedia technology, such as videos or animations, could be used to demonstrate orthopedic special tests of a specific joint (e.g., the ankle). But this technology should not replace the type of active learning that asks for the student to actually practice the special test techniques on a partner. Therefore, these researchers suggested that multimedia technology should be used as a supplemental instructional tool as opposed to being considered an alternative to replace the more traditional instructional methods (Heinerichs et al., 2013; Heinrichs, 2002).

**Using Multimedia Technology Effectively for Athletic Therapy Education**

It would seem that various types of multimedia technology are bound to be a part of the social and possibly educational landscape of present and future AT students (Harman, 2010). But are educators prepared for this challenge and ready to teach in this digital age? According to
Mishra and Koehler (2006), many educators are not prepared to teach with modern technology because of the general tendency to focus only on the particular piece of technology being implemented and not on how it should be used in the classroom. Bate (2010) has suggested that educators struggle to integrate technology in meaningful ways due to a lack of understanding of the complex interplay between technological, pedagogical, and content knowledge. This lack of understanding is problematic because according to LaRoche et al. (2013), effective technology integration can be used to: deepen and enhance the learning process, increase critical thinking abilities, allow for active student engagement, increase student motivation, allow for collaborative learning, and provide a platform to connect with real-life experts.

Challenges such as the ones just discussed led to the development of a conceptual framework called Technological Pedagogical and Content Knowledge (TPACK), which extended on the original ideas of Lee Shulman’s pedagogical content knowledge (PCK) framework (Shulman, 1986). The developers of this TPACK framework suggested that it should be used to gain a better understanding of how to integrate technology into various educational settings (Mishra et al., 2006). Based on these suggestions, it appears that the TPACK conceptual framework has the potential to benefit AT educators, especially those attempting to develop specific instructional models and strategies to explain how to use technology within AT education programs.

**The Technological Pedagogical and Content Knowledge Conceptual Framework**

Teaching is a highly complex activity that often occurs in an ill-structured, dynamic environment and it often draws on many different kinds of knowledge (Abbitt, 2011). The TPACK conceptual framework emphasizes an emergent form of acquiring knowledge that describes the complex interplay between three primary domains of knowledge – content,
pedagogy, and technology. According to these researchers, effective teaching requires an understanding of each type of knowledge by itself while also being able to relate to, and integrate with, the rest of the primary domains (Koehler et al., 2009). For example, AT teaching should require the educator to have the necessary content knowledge to deliver the course content while also having an understanding of various pedagogical/instructional strategies to effectively teach the material. This combination of content and pedagogical knowledge is often absent in health professional educators and is considered a problem in many health professional programs (Walsh, 2013). McLeod et al. (2009) agrees by suggesting that numerous health professional educators are regarded as being competent practitioners within their respective profession (adequate content knowledge) but few have actually studied the art and science of medical education (little to no pedagogical knowledge). Most of these educators develop teaching behaviours that are based on their own learning experiences (e.g., teach how they were taught) and from general conceptions of teaching which are derived from their own personal experiences and observations (McLeod et al., 2009). The same can be said for AT educators that attempt to use technology for educational purposes. According to Abbitt (2011), many teachers focus only on learning how to use a specific type of technology (technological knowledge) without thinking about how it relates to content knowledge or specific pedagogical strategies.

To be able to use this TPACK approach to improve instructional strategies goes far beyond seeing the three forms of knowledge as separate entities. Figure 1 illustrates the multifaceted relationships between the three primary domains of knowledge - content, pedagogy, and technology. The figure includes a circle that represents each domain by itself, the three mixed domains that demonstrate the various intersections of the primary domains (pedagogical content knowledge, technological pedagogical knowledge, and technological content
knowledge), and then the important interaction that occurs between all three primary domains as they overlap (technological pedagogical and content knowledge).

![Figure 1. The Technological Pedagogical and Content Knowledge Conceptual Framework (Mishra & Koehler, 2006, p. 1025).](image)

By itself, content knowledge (CK) can be defined as the knowledge of concepts, theories, ideas, organizational frameworks, knowledge of evidence and proof, as well as established practices and approaches toward developing such knowledge (Koehler & Mishra, 2009). Pedagogical knowledge (PK) is composed of the processes and methods of teaching and learning including understanding how students learn, general classroom management skills, lesson planning, and student assessment (Koehler et al., 2009). Technological knowledge (TK) consists of specific ways of thinking about, and working with, technology, tools, and resources (Koehler
et al., 2009). Table 2 provides a summary of each possible domain construct within the TPACK conceptual framework, complete with succinct definitions and examples from AT education.

**Table 2. Definitions and Examples of TPACK Dimensions (Adapted from Mishra & Koehler, 2006)**

<table>
<thead>
<tr>
<th>TPACK Constructs</th>
<th>Definition</th>
<th>Example</th>
</tr>
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<tbody>
<tr>
<td>TK</td>
<td>Knowledge about how to use technological hardware and software</td>
<td>Knowledge about how to use a particular piece of AT software (e.g., Assessment CD-ROM)</td>
</tr>
<tr>
<td>PK</td>
<td>Knowledge about the students’ learning, instructional methods, educational theories, learning assessment</td>
<td>Knowledge about how to use PBL or CBL in teaching</td>
</tr>
<tr>
<td>CK</td>
<td>Knowledge about the subject matter without consideration about teaching the subject</td>
<td>Knowledge about human anatomy (or other subjects)</td>
</tr>
<tr>
<td>PCK</td>
<td>Knowledge of representing content knowledge and adopting specific pedagogical strategies to make the topic more understandable for learners</td>
<td>Knowledge of using analogies to teach orthopedic injury assessments</td>
</tr>
<tr>
<td>TPK</td>
<td>Knowledge of the existence and specifications of various technologies to enable teaching approaches without reference towards course content</td>
<td>Knowledge of computer-supported collaborative learning</td>
</tr>
<tr>
<td>TCK</td>
<td>Knowledge about how to use technology to create course content in different ways without consideration about teaching methods</td>
<td>Knowledge about Primal Anatomy Software</td>
</tr>
<tr>
<td>TPACK</td>
<td>Knowledge of using various technologies to teach and to facilitate knowledge creation of specific course content</td>
<td>Knowledge about how to use an assessment CD-ROM to enhance collaborative learning in AT classrooms</td>
</tr>
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</table>

The emergent knowledge found in a TPACK conceptual framework describes the necessary foundation that is required for effective teaching practices while using technology in an educational program. It requires: 1) an understanding of the representation of concepts using
technology, 2) pedagogical techniques that use technology in constructive ways to teach course content, 3) knowledge of what makes concepts difficult or easy to learn, 4) knowledge of how technology can be used to address some of the problems that students face, 5) knowledge of students’ previous knowledge and theories of epistemology, 6) knowledge of how technology can be used to build upon existing knowledge, and 7) knowledge of how technology can be used to develop new epistemologies (Mishra et al., 2006). Even though this is a relatively new framework, there are some examples within the educational literature that show how TPACK can be used to effectively integrate technology into a classroom.

Chai, Koh, and Tsai (2013) completed a systematic review of the literature to find journal articles that investigated various forms of information and communications technology (ICT) using the TPACK framework. These authors found a total of 82 journal articles from the Web of Science database, Scopus database, Education Resources Information Center (ERIC), and the Education Research Complete database, that contained one or more of the following keywords – “technological pedagogical content knowledge”, “TPACK”, or “TPCK”. The results from this systematic review indicate that many studies yielded positive findings to enhance teachers’ capability to integrate technology for instructional practice (Cox & Graham, 2009; Pierson & Borthwick, 2010). More specifically, TPACK was shown to: 1) guide educators’ to deal with the challenges of teaching and learning that are brought on by rapidly changing technologies (Cox et al., 2009), 2) enhance instruction from both student and teacher perspectives (Harris, Mishra, & Koehler, 2009), 3) be a useful framework for software development (Wu, Chen, Wang, & Su, 2008), and 4) enhance student learning using technology (Khan, 2011).

However, there are still many potential gaps within the TPACK literature. For example, a literature search of the same educational databases, produce no hits for studies that have
attempted to describe the use of this framework for technology integration within AT education programs (or other health professions for that matter). Chai et al. (2013) posited that TPACK concepts can be used to design a study to show how medical educators employ technology for the teaching and learning of various pathologies, but at the time of the writing of this review, there are no known studies that have investigated this topic.

According to the main concepts of the TPACK framework, knowledge within all three primary domains is required to be able to develop an effective multimedia educational tool and to create specific instructional strategies to explain how to use it in AT educational programs. However, before attempting to develop effective instructional and learning strategies to explain how to use multimedia technology in AT education, an educator would also need to become familiar with the common forms of learning and theories related to how students construct knowledge. There are several key learning theories that attempt to explain how knowledge is constructed in the human brain. The most common learning theories used in AT education include behaviourism, cognitivism, constructivism, and sociocultural psychology (Selwyn, 2011). Each of these theories will be presented in subsequent sections as well as a discussion of the contributions that these theories have made in exploring the use of multimedia technology to support the learning process.

**Behaviourist Learning Theory**

The theory of behaviourism is concerned with describing the effects of learning rather than exploring the actual processes that occur within a student’s head (Selwyn, 2011). According to Good and Brophy (1990), behaviourist researchers view the mind as being a type of “black box” which can be observed quantitatively, ignoring the exploration of thought
processes that exist in the human mind. Some of the key theorists who were instrumental in the development of these behaviourist theories include Ivan Pavlov, John B. Watson, Edward Thorndike, and B. F. Skinner (Ertmer & Newby, 1993).

Behaviourists consider learning to be represented by conditioned student behaviours in response to particular stimuli (Selwyn, 2011). This approach suggests that a student will respond (behave) in a specific way when faced with a certain stimulus. What happens after the stimulus (either a reward or punishment) will influence how the student responds when faced with the same stimulus in the future (Ertmer et al., 1993). Classic examples of behaviourist learning theory include Pavlov’s dog experiments and Skinner’s operant conditioning of rats, pigeons, and dogs (Good et al., 1990).

Many researchers consider behaviourism to primarily be a teaching theory instead of an actual theory of learning (Ormrod, 2011). This theory promotes sequential learning where students learn each step in a systematic order until the entire sequence is learned (Selwyn, 2011). Sequential instructional methods are commonly used in AT education, especially in injury assessment courses which teach the logical steps required to complete an orthopedic injury assessment (Coker, 2000). In these courses, it is important for the student to learn each step in order so they end up completing a comprehensive and organized evaluation of the injured individual. However, since this behaviourist learning theory focuses only on observable student behaviour, it does not try to understand any of the cognitive processes that are taking place within the student mind during learning. When attempting to develop effective pedagogical strategies and technological educational tools, a researcher should not just focus on measureable, observable behaviour (Selwyn, 2011). They should also use other theories and frameworks in an
attempt to find out how learning actually takes place, what factors affect it, and how knowledge is constructed within the student mind.

Another limitation of the behaviourist learning theory is its inability to explain certain social behaviours (Kaakinen & Arwood, 2009). For example, a child does not imitate every single behaviour that has been reinforced (either positively or negatively). In addition, a child may demonstrate a new behaviour days or weeks after the initial observation without being reinforced for that particular behaviour (Kaakinen et al., 2009). These proposed limitations led to the development of other learning theories which attempt to show that a student does not require reinforcement to be able to learn or to demonstrate learning.

**Cognitivist Learning Theory**

Cognitive psychology contains many learning theories that accentuate the role of the student in knowledge construction and offer a completely different perspective from the behaviourist accounts of empirical, observable behaviours (Peer & McClendon, 2002). Cognitive theorists attempt to understand the thought processes that lie behind the observable behaviour or the mental processes that underpin the act of learning within the human mind. These theorists also believe that the learner’s mental processes are the major factor in explaining learning. According to Good and Brophy (1990):

Cognitive theorists recognize that much learning involves associations established through contiguity and repetition. They also acknowledge the importance of reinforcement, although they stress its role in providing feedback about the correctness of responses over its role as a motivation. However, even while accepting such behavioristic concepts, cognitive theorists
view learning as involving the acquisition or reorganization of the cognitive structures through which humans process and store information. (p. 187)

Jean Piaget was one of the most notable theorists who first explored cognitive learning theory, with his innovative concept of schema (Halpenny & Pettersen, 2014). Piaget defined schema as being a form of internal knowledge structure. When an individual experienced some new information, Piaget suggested that this information would be compared to existing cognitive structures (or schema) to be combined, extended, or altered in order to construct new knowledge (Halpenny et al., 2014). This computational orientation of cognitive psychology led to the development of computer-like models of the mind (Selwyn, 2011). Because of these similarities between human cognition and computers, cognitivist learning theories were used to develop and design many technology-based learning tools. One of the classic examples of a cognitivist based educational tool is the intelligent tutoring system (Selwyn, 2011). This type of system is designed to respond to a particular model of what the learner should ideally be doing during a certain task and provide feedback to allow for learner reflection. These educational tools were, and still are, commonly used in industrial and military settings to train professionals from airline pilots to surgeons (Selwyn, 2011).

One of the main critiques of cognitivist learning theory is that it also encourages an individualistic approach to learning and knowing (Selwyn, 2011). By promoting individualistic learning, these theorists ignore the potential impact that various sociocultural factors have on human learning. Because learning does not occur in isolation in most AT classrooms and therapists are expected to work in many diverse social environments, it is also important to consider the impact of constructivist and sociocultural learning theories.
Constructivist Learning Theory

Constructivist theories describe learning as being a process that is based upon the learner’s previous experience and knowledge (Gordon, 2009). Constructivist theories portray learning as a much more active process when compared to behaviourist and cognitivist interpretations. Selwyn (2011) states that, “The constructivist learner is not solely receiving and acting upon information that is transmitted to them from others. Instead learners are seen as constructing their own perspective of the world through individual experiences” (p. 73). According to this learning theory, new knowledge construction is based upon previous learning experiences and is built upon the process of individual exploration.

Constructivist learning theories tend to support pedagogical strategies that are mainly activity based and learner-centred when compared to behaviourist and cognitivist models (Gordon, 2009). These activities often take the form of a CBL or PBL and allow for the problem in question to be answered in many different ways according the individual’s particular approach (Selwyn, 2011). This approach will differ depending upon their existing knowledge and how they filter the current problem through their previous experiences. For example, if two students attempted to complete an orthopedic assessment CBL activity on a knee injury then each student may approach the assessment differently. This will be dependent upon their previous experiences with performing knee assessments. One student may have more experience in completing knee assessments and be able to compare all the tests to their previous experiences (e.g., comparing the strength of the ligament to tests in past assessments). Whereas the other student, who has never completed an actual knee assessment before, may be only able to use their previous content knowledge about knee assessments because they have no previous experiences to compare the assessment to (e.g., they have only practiced on healthy knees and
never felt ligament laxity before). There are many educational strategies that have been developed to improve student learning through the use of constructivist instructional methods. However, these strategies are also related to sociocultural learning theory and will therefore be discussed in the next section.

According to constructivist principles, educational technology (e.g., multimedia CBL) can be used to help facilitate learning exploration and the construction of knowledge. Duffy and Jonassen (1994) postulated some significant principles that they considered to be most important when attempting to integrate technology and constructivist principles. These principles include: 1) providing representations of real-world settings, 2) emphasizing authentic tasks in meaningful contexts, 3) avoiding oversimplification while representing the complexity of the real world, 4) providing multiple representations of reality to be explored, 5) emphasizing knowledge construction instead of knowledge reproduction, 6) supporting collaborative construction, and 7) encouraging thoughtful reflection. Gruba and Lynch (1997) agree by suggesting that technological constructivist environments can be developed to get the student to explore the areas that motivate them to learn. These authors posited that motivational factors are created through: interaction with the technological environment, cognitive puzzles that stimulate and organize learning, and knowledge that develops through the activities and reflection upon individual practices (Gruba et al., 1997).

One of the aims of this proposed research project is to explore the impact of using multimedia technology integrated into a predetermined learner-centred teaching and learning model (CBL) through an interpretivist framework. For this project, a multimedia CBL educational tool was designed using a specific type of constructivist design called the Recursive Reflective Design and Development (R2D2) model. This developmental model was first
introduced by Jerry Willis in 1995 and is recommended for designing technology models and educational tools that are based on constructivist theory and interpretivist epistemologies (Willis, 2009).

This R2D2 model was built upon the following key principles: 1) the design model is an iterative process (recursive) – this allows the developer to make refinements and revisions at any time, 2) reflection is based on feedback and ideas from many different sources, not just the developer, 3) the design is non-linear – meaning the tool was not created using a linear sequence of steps, and 4) the model is developed by a group of individuals (participatory design) and not just the developer (Richey, Klein, & Tracey, 2011).

Many forms of AT education follow the same basic guiding principles as outlined in the R2D2 model. For example, even though orthopedic injury assessments follow a systematic approach, they can still be considered to be an iterative process that is based on therapist reflection. During an assessment, the therapist is always able to ask more history questions, do more observations, or perform more special tests once further information has been uncovered, even if they have already completed those portions of the assessment. Therefore, educational tools for these assessment courses should be designed using similar instructional models.

Within the instructional design literature, the R2D2 model is often critiqued by theorists who work from a behaviourist or cognitivist paradigm. According to Merrill (1996),

Those persons who claim that knowledge is founded on collaboration rather than empirical science, are not instructional designers. They have disassociated themselves from the technology of instructional design. We don’t want to cast anyone out of the discipline of instructional science; however, those who decry scientific method, and who
deride instructional strategies, don’t need to be cast off; they have exited on their own. (p. 57)

However, these theorists are working from a pure positivistic or postpositivistic epistemology and end up disagreeing with the general tenets of most other research paradigms anyways.

As described, constructivist learning emphasizes the importance of learner-centred instructional strategies such as CBL in the construction of student knowledge. However, this type of learning theory can still be considered to be individualistic because it does not attempt to directly understand the influence of various social and cultural environments that surround an individual’s learning and cognitive development (Selwyn, 2011). Many educational researchers and practitioners posit that learning is in fact a social process, especially within AT educational programs (McLeod et al., 2009; Peer et al., 2002). AT students have to learn how to interact with other individual’s in and out of the classroom because of the expectation to assess and treat actual human patients. These students need to learn in a variety of social settings to learn the necessary skills and mannerisms of how to become a competent health professional. Therefore, before providing suggestions of how to improve AT instructional strategies based on constructivist principles, one should also explore the impact of various sociocultural learning theories on AT education.

**Sociocultural Learning Theory**

Sociocultural learning theories accentuate the importance of the role of social interaction in the construction of student knowledge (Peer et al., 2002). The original social theorists (e.g., Albert Bandura, Noam Chomsky) were critical of both behavioural and cognitive learning theories. These theorists decided to integrate ideas from both of these theories to provide a more
comprehensive model that would account for the wide range of learning experiences that actually occur in various social settings within the real world (Bandura & Walters, 1963). According to Bandura (1977), the key tenets of social learning theory include: 1) learning is not completely behavioural; it is a cognitive process that takes place in a social context, 2) learning can only occur by observing a behaviour and the consequences of that behaviour, 3) learning involves observation, extraction of information from those observations, and making decisions about the performance of the particular behaviour, 4) reinforcement plays a role in learning but is not entirely responsible for it, and 5) the learner is not a passive recipient – behaviour, cognition, and environmental factors all influence one another.

Currently, many educational researchers consider learning to be a profound and complicated social process (Peer et al., 2002; Polyzois et al., 2010; Selwyn, 2011; Strauss, 1996). A growing number of researchers and theorists have turned their attention to exploring the influence of various social and cultural factors that have an effect on individual learning and cognitive development (Selwyn, 2011). This also holds true within the profession of AT, as current educators and researchers attempt to develop effective instructional strategies that reflect upon the way in which students organize knowledge while interacting within various social environments. Strauss (1996) suggested that AT students are not simply “blank slates” that need to be filled with information. Furthermore, he adds that thinking is not just a logical sequence of stimulus-response connections. AT students are educated in many different environments (classroom, field, and clinical) and these individuals are expected to learn and perform within these multiple social settings. Therefore, AT educators should become familiarized with some of the pedagogical strategies and evaluation techniques that consider the significance of sociocultural learning theories. Peer et al. (2002) posited that the most essential sociocultural
Theories for AT educators to consider are Vygotsky’s zone of proximal development (ZPD) and scaffolding.

Psychologist Lev Vygotsky provided much of the foundation for sociocultural learning theory by exploring the dynamic interaction between social and individual processes of learning (Harland, 2003). The major thematic results from Vygotsky’s work suggest that: 1) cognitive development is engrained in social interactions, 2) social interactions are mediated by tools (also known as abstract symbols); these tools are not created in isolation but rather are products of sociocultural evolution, and 3) learning is a genetic process of cultural development that emphasizes the importance of concentrating on the specific process by which higher functioning is created (Vygotsky, 1978). These important themes led to the development of Vygotsky’s concept of the zone of proximal development (ZPD). Figure 2 illustrates the three zones of Vygotsky’s ZPD model. The inner zone shows what the student can do alone without the help of any peers or teachers. The middle zone shows what the student can do with the help and guidance of more capable others. While the outer zone represents what the student cannot do.

![Figure 2. Vygotsky’s Zone of Proximal Development (Adapted from Vygotsky, 1978)](image)
Harland (2003) defines ZPD as the distance between what a student can achieve all alone and what the same student can achieve with help from others who are more capable. This concept suggests that a student will develop higher-level cognitive skills when their gaps in thinking and problem-solving are supported by adults, teachers, and/or peers. ZPD encourages the use of pedagogical strategies that allow a student to work in an active learning environment while searching for further explanations. The student is also expected to speculate between the new learning experience while comparing it to previous knowledge and experiences. Vygotsky stressed the importance of using structured activities and strategies that allow the student to interact with other students and instructors while directing the student towards the higher levels of the ZPD (Vygotsky, 1978).

These concepts and theoretical underpinnings of ZPD can be used to facilitate learning and develop effective practical implications to explain how to use multimedia CBL within AT education programs. Previous studies recommend AT educators to use specific pedagogical strategies that allow for interaction with other students and instructors while using multimedia CBL. A study by Wiksten, Patterson, Antonio, De La Cruz and Buxton (1998) showed how AT students preferred a more social environment of learning with increased interaction between students and faculty. These authors also concluded that when using innovative technology, educators should still promote active learning principles and higher-order learning within the classroom. Mensch and Ennis (2001) found that peer-group activities and the formation of positive relationships between faculty and students were viewed as being the most important factors for facilitating learning within AT education programs. Finally, Harland (2003) posited that PBL activities should allow for peer interaction. Each student should have the opportunity to discuss what they know about the problem and what they need to find out. This will allow the
student to be active in their own learning by setting their own objectives while being critically reflective about what they need to learn.

Scaffolding is another sociocultural learning strategy that is closely related to the concept of ZPD. Scaffolding is a specific learning process that is designed to promote a deeper level of thinking by creating supportive situations in which students extend their current level of skills and knowledge (Peer et al., 2002). More specifically, during the scaffolding process, teachers give additional support that is tailored to the needs of each individual student with the ultimate objective of helping the student achieve his/her specific learning goals (Sawyer, 2006).

There are many different types of scaffolding strategies that can be used in various educational settings. Simons and Klein (2007) describe two levels of scaffolding and categorized them as being either soft or hard. An example of a soft scaffolding strategy would be a teacher who moves around the classroom and has individual conversations with each student. This teacher may question the students approach to answering a particular problem and then provide constructive feedback. An example of a hard scaffolding strategy is when a teacher uses a more structured approach to giving hints and/or cues to help students reach a higher-level of thinking. This technique is thought to be effective when students are working on more difficult problems. Holton and Clarke (2006) proposed another type of scaffolding that does not depend on teacher/student interaction. These authors coined the term reciprocal scaffolding as being specific peer activities that help to improve higher-level thinking. This method involves class activities within a peer-group, where two or more students are working together collaboratively and sharing each other’s experiences and knowledge. These students will learn from one another and be able to reflect critically on the knowledge exchange, especially if the students share different perspectives. More recently, Yelland and Masters (2007) discussed a
newer type called technical scaffolding. In this innovative approach, technology (e.g., educational software) replaces teachers and peer groups to help guide students through the learning process.

Scaffolding strategies have been shown to: help students make connections between old and new information in a social environment (Peer et al., 2002); stimulate student interest while motivating students to pursue individualized goals (Pea, 2004); and to help students make connections with real-life situations by using structured activities that emphasize elaboration, analysis, and inference (Rosser, 1994). The proposed benefits of scaffolding are also similar within AT educational research. Mensch et al. (2001) posited that student motivation is enhanced in these scaffolding environments that foster the development of student autonomy, responsibility and confidence (e.g., CBL). Additionally, Weidner & August (1997) suggested that integrating skills from previous tasks and experiences helped to promote skill mastery within CBL activities in AT students.

There are many pedagogical strategies that encourage the use of scaffolding techniques including case studies, simulations, demonstrations, cooperative learning, and peer-group activities (Selwyn, 2011). According to Lajoie (2005), all PBL and CBL activities should include careful scaffolding planning and preparation by the course instructor. Teachers using these methods should identify the specific content that requires scaffolding, choose the appropriate time to implement the support, decide upon the correct method, and determine when the scaffold can be removed (Lajoie, 2005). Based on these advantages, scaffolding techniques could be used by AT educators to help develop instructional strategies that explain how to integrate multimedia technology into CBL.
**Research Questions**

Based on the gaps that were presented and discussed in this literature review, my proposed research project will have two main purposes: 1) to develop an effective multimedia CBL educational tool (designed on constructivist principles in an iterative process) that can be used within AT education programs, and 2) to develop improved instructional strategies for AT education using a TPACK conceptual framework and constructivist and sociocultural learning theories. More specifically, my main research question is what impact does the multimedia CBL educational tool have on the nature of student learning and instruction in AT education?
References


