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Learning Theories and Technology: a Qualitative Inquiry
ทฤษฎีการเรียนรู้และเทคโนโลยี: กระบวนการตรวจสอบเชิงคุณภาพ

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บทคัดย่อ

ดิจิทัลเทคโนโลยีกำลังมีอิทธิพลต่อผู้คนในสังคมด้านวิธีการสื่อสาร การทำงาน การศึกษาและการรับความรู้ การเปลี่ยนแปลงอย่างเหลือเชื่อและรวดเร็วของเทคโนโลยีกำลังท้าทายมหาวิทยาลัยให้คิดทบทวนกระบวนการเรียนการสอนและรวมเอานวัตกรรมล่าสุดเข้ามามีส่วนร่วมในการถ่ายทอดความรู้ในระดับอุดมศึกษา นักศึกษาในปัจจุบันนี้มีชีวิตที่เชื่อมโยงกับการสื่อสาร การเข้าสังคม และการเรียนรู้ออนไลน์มากขึ้น ดังนั้นบทความนี้จึงเน้นการพิจารณาวิธีการถ่ายทอดความรู้ที่ได้รับการยอมรับสองวิธี ได้แก่ วิธีที่เน้นด้านพฤติกรรมศาสตร์นิยม และด้านการสร้างสังคมนิยม รวมทั้งความเชื่อใหม่ด้านการเชื่อมโยงทางเทคโนโลยีเข้ากับกระบวนการเรียนรู้ พฤติกรรมศาสตร์นิยมคือระบบการเรียนรู้ตามพฤติกรรมตอบสนองต่อสิ่งเร้าทางกายภาพ การสร้างสังคมนิยมคือ การเรียนรู้ที่ใช้ห้องเรียนเป็นแหล่งที่จัดกิจกรรมและแลกเปลี่ยนความรู้ความคิดเห็นระหว่างผู้เรียนด้วยกัน (มากกว่าครู) มีความรับผิดชอบต่อการพิสูจน์ การปกป้องและการสื่อสารในห้องเรียนชุมชน ส่วนนักวิชาการที่เชื่อมั่นกับการเชื่อมโยงทางเทคโนโลยีอ้างว่าการได้มาซึ่งความรู้ที่ดีที่สุดจะเกิดขึ้นจากประสบการณ์การเรียนรู้แบบเครือข่ายในกลุ่มนักเรียนขนาดใหญ่โดยใช้เทคโนโลยีสารสนเทศ โดยเชื่อว่าเทคโนโลยีจะช่วยปรับปรุงวิธีการสอนทั้งสามนี้ แต่การพึ่งพาเทคโนโลยีมากเกินไปทำให้เกิดข้อได้เปรียบและความท้าทายในการเรียนการสอน

คำสำคัญ: *เทคโนโลยีในการเรียนรู้ พฤติกรรมศาสตร์นิยม แนวคิดทางการสร้างสังคมนิยม การเชื่อมโยงทางเทคโนโลยี*

Abstract

Digital technology is influencing society in how people communicate, work, study and obtain knowledge. Dramatic and rapid changes in technology are challenging universities to rethink pedagogies and incorporate the latest innovations into the delivery of higher education. Students of today live connected lives communicating, socializing and increasingly learning on-line. Therefore, this paper focusses on considering two accepted approaches to education deliver; behaviorism and social constructivism, plus a new concept connectivism. Behaviorism is a learning system based on behavioral responses to physical stimuli. Social constructivism is learning is where the classroom is a commonality of activity and exchange with the learners (rather than the teacher) being responsible for proving,

defending, and communicating ideas to the classroom community. Academics who rely on connectivism asserts that the acquisition of knowledge best takes place in a networked learning experience among a large student group using information technologies. Technology enhances these three teaching approaches yet the over-reliance on technology exposes pedagogical advantages and challenges in each.

Keywords: *technology in learning, behaviourism, social constructivism, connectivism*

1. Introduction

In his books The Gutenberg Galaxy: The Making of Typographic Man and Understanding Media Marshall McLuhan, a professor at the University of Toronto's St. Michael's College put forth a revolutionary vision of the future where communication technology would change the way the world thought about media and technology. At the time he observed that the youth of the day would facilitate a global shift from print to electronic media. He cited the effects of television in transforming the world into an interconnected tribe he called a "global village." (Marshall McLuhan, May 18,1960).

Half a century later the reach of McLuhan's vision is being seen in the area of education where educators are being challenged by the advent of new communication technologies which are shifting the foundations of education. In a replay of the past computers, Internet search engines and the algorithms that power them provide vast new avenues of information. Multimedia platforms such as Youtube, social media platforms of Facebook, Line and WhatsApp are again being readily adopted by the youth of this age and tasking the educators of today to meet the needs of a rapidly changing cohort of students. The way we define learning and how teachers understand, design and then implement different pedagogies has important implications for the classroom. Learning theories, strategies and techniques provide practitioners with the foundation for facilitating learning in the traditional classroom setting as well as the brisk and agile technology-based learning environment. Examining the research on learning theory can be critical when attempting to select an effective prescription for overcoming a given instructional problem. This paper is an attempt to familiarize educators with three relevant positions on learning (behaviorism, social constructivism and connectivism) with an emphasis on how the growth of technology platforms can present new instructional opportunities and challenges.

2. Methodology

The methodology employed in the instant research is literature review. Publications addressing the issues explored in this paper include peer-reviewed research papers relevant to the topic which are recognized for establishing principles under discussion herein, plus websites which announced or explained rationale on the three learning style were chosen for review: behaviourist, social

constructivist, connectivist pedagogy Behaviourist and social constructivist were chosen as they well establish pedagogies in the realm of learning, an in this paper, were addressed in the context of the application of technology. Connectivist pedagogy was addressed because of the growing interest in this style of learning in the application of technology. In exploring the application of technology to the different educational strategies explored important advantages and shortcomings were address. Both quantitative and particularly qualitative sources are included.

3. Discussion

The advent of digital technology in the last two decades has changed the world dramatically, and will continue to do so. Digital technology is influencing every corner of society and is the central focus of how most communicate, work, study and obtain knowledge and information. Dramatic and rapid changes in technology are challenging universities to rethink pedagogies and incorporate the latest innovations into the delivery of high education. (Bradley & O'Toole, 2016)

A direct result of these changes is that digital technologies have proved disruptive to many sectors in the last decade. The publishing, music and travel industries, for example, have drastically changed in the products and services offered with the entrance of new competitors and the departure of some long-established participants. While it is doubtful that the higher education sector could be dramatically swept away, it is shortsighted to believe that the current form and mode of education will not be thrust in a new direction. The challenge is the chart a course which will meet the changes to occur. (Buckley, 2015)

The impact is already visible – both for conventional and distance learning. Teachers and students alike have access to a wider range of educational materials, delivery platforms and innovative technologies. Traditional degree programs are modernizing to meet the evolving demands of students and the work sector. The result is that new, novel academic approaches are being "blended" with the traditional classroom setting. Students of today live connected lives and learn better when the instructional methods mirror the information accessibility and immediacy of their day to day habits. Modern students communicate, socialize and increasingly learn on-line. Blended learning assimilates online and face-to-face methods to create a unified learning experience, providing learners with flexibility and support. The fusion of traditional classroom methodology with technology presents the potential to nurture independent learning and foster greater collaboration, in addition to providing more conduits of communication between students and instructors. (Johnson, Adams, Cummins, Estrada, Freeman, & Hall, 2016)

Educators are debating what characteristics make a particular delivery technology improve learning. Delivery technologies can provide efficient and timely access to learning materials; however as technologies represent merely a vehicle to deliver instruction, they do not necessarily influence

student achievement. Students can gain significant learning benefits from computer media over conventional instruction, but the same studies also suggest that the reason for the gain is not the medium of instruction, but the instructional strategies built into the learning materials. Engaging online learning should relate to the real world context in which the activity is structured toward, exhibit high interactivity and encourage collaboration. Online learning must create challenging activities enabling students to link new information to old, acquire meaningful knowledge and use their critical thinking capacity. (Ally, 2004).

The landscape of learning has changed quite dramatically in recent years. The technological capacities have evolved, and are evolving, with increasing rapidity when it comes to the speed, interactivity and potential reach of new technologies and online platforms. Yet, despite the seeming promise of digitalization to revolutionize the discipline of educational the true impact of digital technologies on education itself has merely scratched the surface of potential. Substantial investments in ICT (Information and Communication Technology) in educational institutes has not yet resulted in the hoped for transformation of educational practices. This shortcoming is possibly linked to a variety of factors. Possibly the most impactful is the paramount concentration toward hardware and connectivity over other applications of ICT. New approaches for developing teachers' ICT skills through teachers' professional development would spur the expansion in IT use for education. This effort could stimulate the production of software and courseware which harnesses the potential of technology while meeting the needs of students, industry and society. (OECD, 2016)

Two very different types of interactivity exist in learning, the social and the individual. Social interaction between learners and teachers needs is balanced with an individual student's interaction with teaching-learning resources, including traditional printed sources of textbooks or videos, games plus other computer assisted learning programs. It is wrong to conclude that students in conventional institutions spend the greater part of their time in meaningful, face to face interaction with teachers as the reality is both conventional and distance education students spend the largest part of their studying alone, interacting with textbooks or other learning media. (Taylor, 1995) Yet set against this traditional observation about learning, new technologies and communication platforms can allow for greater teacher and student interactivity, both inside and outside the classroom. Computer-based support can aid in assessing the learning progress of a student and tailoring the proper response to maximize the learning experience as an essential component of high quality education. As modern technology-based delivery methods can facilitate "self-administered" e-learning, teachers can concentrate on their role as a mentor, developing with students the skills of information management, understanding and questioning, critical thinking and knowledge application. Thus, digital media can facilitate more active, problem- based learning which has been demonstrated to encourage greater student engagement and leads to better learning outcomes. (Mazza & Dimitrova, 2004)

In the near-term the classroom will retain primacy as the focus of the education experience, yet the integration of multimedia applications, social media, online games and mobile devices will influence how and who will be taught. Digital technologies in themselves do not necessarily constitute an enhancement of the quality of learning and teaching, but they are an enabler for such enhancement and can underpin efforts towards more student-centered teaching. Teachers now have the opportunity to draw on a wide range of materials in a variety of formats which can improve the quality and diversity of the curriculum. Students are unique, and so is the way they learn. Therefore, the teaching tools used in universities and colleges should cater for individual ways of learning, with the student at the center. Some students will learn better and faster with the help of interactive media that incorporate images, graphics, videos and audio elements. Others will prefer static text and numbers in different measures. Technology in the classroom can combine all of these for a personalized learning experience for each student, based on each student's strengths. Digital technologies alone cannot ensure quality learning and teaching, as the quality of content must remain the chief concentration of the learning experience. Teachers now have the opportunity to draw on a wide range of materials in a variety of formats which can improve the quality and diversity of the curriculum. Technology is an enabler, enhancing efforts towards more student-centered teaching. (European Commission, 2014)

Online technologies offer a student the autonomy of when, where and how to study. Interactive media can be better tailored to meet the needs of individual students and quickly chart a student's performance. The use of digital evaluation tools can provide quick feedback on a student progress and curricula can be fine-tuned to meet individual student needs. Technology's potential can liberate teachers and students from antiquated techniques to advance the teaching experience from the mere transmission of information to a co-partnership in learning. (Duong, 2016)

Technology can be useful in meeting three traditional facets of learning, the concepts of student-centered learning, knowledge-centered content and assessment-centered methods. In the student-centered context a teacher works to understand a students' pre-existing knowledge, including any misconceptions toward the new information to be presented. Increasingly, students come to online learning with preconceptions collected from both formal and informal experiences in the virtual setting, some of which will not be appropriate to an educational online context. The student-centered learning environment can appreciate and accommodate particular cultural attributes, or the language and particular forms of expression a learner uses to comprehend and build understanding. The next concept in traditional learning, knowledge-centered content is where activities make extensive use of diagnostic tools and undertakings to identify pre-existing knowledge structures for both the teacher and the student, so that the optimum outcomes can be achieved. Consider the knowledge-centered content of the educational experience. Effective learning is both defined and bounded by the epistemology, language, and context of a particular discipline. Each field of scholarship comprises a unique perspective

of understanding and discussing on a particular subject knowledge. Students need opportunities to acquire, engage and work in this process. In comparison to campus-based learning, online learning neither advantages nor disadvantages knowledge-centered learning, yet the Internet expands opportunities for students to access a variety of knowledge. However, this fountain of information can drown an unwary student, so the skillful e-teacher needs to provide the proper foundation for students to grow their own knowledge and bring to light discipline-centered discoveries. Finally, online learning provides many opportunities for assessment. Software can expand assessments to involve not only the teacher, but peers and possibly most importantly, encourage learners to evaluate their own learning. Understanding what is of the most use, instead of what is most easily assessed, is a challenge for educators in online learning. (Anderson, 2004)

Applying the proceeding philosophies, the next sections will define three learning theories behaviorism, social constructivism and connectivism and consider their relevance in light on the changing face of education, shifting in the light of technological advancement.

3.1 Behaviorism

Pioneering in its time, behaviorism is the doctrine that regards psychology as a scientific study of behavior and explains learning as a system of behavioral responses to physical stimuli. Psychologists working within this theory of learning are interested in the effect of reinforcement, practice, and external motivation on a network of associations and learned behaviors. Educators using a behaviorist framework pre-plan a curriculum by breaking content areas into components, or skills, then stringing these sections into a hierarchy from simple to more complex. Students are viewed as passive, in need of motivation, and affected by reinforcement. Accordingly educators build a curriculum to assess, motivate, reinforce, and evaluate learners. Testing determines a learner's progression on the curriculum continuum. If lessons are clearly conveyed and appropriate motivation, repetition, and reinforcement are provided, progress is expected to be in a linear, quantitative fashion. By engaging in teaching activities and responding to feedback learning will result. (Fosnot & Perry, 2005)

Behaviourist pedagogy emphasis learning as defined by acquiring new behaviors. The focus is on the individual and measuring actual behaviors or capacities. Major behaviorist learning theorists which are the foundation of this theory include American psychologists Edward Watson, John Thordike, and B.F. Skinner. These theoretical ideas influenced instructional system designs as instruction proceeded through structured phases including:

1. Gain learners' attention
2. Inform learner of objectives
3. Stimulate recall of previous information
4. Present stimulus material
5. Provide learner guidance

6. Elicit performance
7. Provide feedback
8. Assess performance
9. Enhance transfer opportunities

(Anderson & Dron, 2011)

Behaviorist learning theories are commonly used in the structure of educational games. Many games teach new skills and contents via operant conditioning with application of the principles of positive reinforcement and punishment. Reinforcement in games is often realized by successfully mastering a sequence of tasks or levels, while punishment can consist of losing a position in a race, ranking or grade. Many digital games can engage learners in problem-solving activities and increase learners' problem solving skills when the players use embedded information, either within the game context or game scenario, to solve complex cognitive problems. Games that operate on this principle contain a strong narrative component as players often have to decide between various potential solutions or alternative paths. While popular adventure and role playing games are classical applications for these principles, these kinds of games can also be used to foster knowledge acquisition and increase comprehension. This is accomplished by providing information within the narrative of the game which needs to be applied to the solution of a given problem. Behaviorist learning mechanisms can be expected to be most effective in terms of practicing and repeating routines in the acquisition of factual knowledge. (Hensel and Mandl, 2012)

Behaviourist notions have been especially attractive in training (as opposed to educational) programs as the learning outcomes associated with training are usually clearly measured and demonstrated behaviorally. Behaviourism emphasizes active learning-by doing with immediate feedback on success the analysis of learning objectives with learning, outcomes. Behaviourism, as a pioneering educational theory had a large impact upon education. Yet even today in the classroom, such activities as games and similar on line resources utilize the fundamental practices of behaviourism. Ascendant in the first half and middle of the twentieth century it became overshadowed by social constructivist explanations of learning. It was considered that the model failed to meet the complexities of people in more rich and complex educational context. Yet it has regained vibrancy in combining this traditional learning theory with technology such as with educational games. (Woollard, 2010)

3.2 Social Constructivism

Jean Piaget postulated that human inquiry is embedded within individuals and with a learner-centered approach students can assimilate knowledge and skills from experiences by applying knowledge, skills and concepts to real-world tasks. Lev Vygotsk emphasized the role that culture plays in cognitive development. Human inquiry is embedded within the culture and knowledge is acquired through the environment. Social constructivism construes learning as an interpretive, nonlinear

accretion of knowledge by active learners. It is a learning theory that describes how language, activity, and understanding occur. (Pass, 2004) This is contrasted with other less robust theories which simply characterize the structures and stages of thought, or segregate behaviors taught by reinforcement. Social constructivism is a theory about learning not a description of teaching; accordingly there is no pat set of instructional techniques. Learning is not the result of development, it a development and it requires invention and self-organization on the part of the learner. Dialogue engenders thinking, so the classroom needs to be seen as a commonality of activity and exchange with the learners (rather than the teacher) being responsible for proving, defending, and communicating their ideas to the classroom community. (Fosnot & Perry, 2005)

The social constructivist concept of learning, takes into account motivation, attitudes, and mental barriers that can only partially be found in observable behaviors. Social constructivist pedagogy recognizes the social nature of knowledge in the minds of individual learners as teachers do not simply convey information to be passively consumed by learners, but each learner originates new knowledge that is both created and integrated with existing knowledge. Social Constructivism models share common themes including:

1. New knowledge as building upon the foundation of previous learning
2. Context in shaping learners' knowledge development
3. Learning as an active rather than passive process
4. Language and other social tools in constructing knowledge
5. Provide learner guidance
6. Metacognition and evaluation as a means to develop learners' capacity to assess their own learning
7. Learning environment as learner-centered and stressing the importance of multiple perspectives
8. Knowledge needing to be subject to social discussion, validation, and application in real world contexts (Fosnot & Perry, 2005)

The role of the teacher is diminished to the extent they becomes more of a guide than an instructor, assuming the critical role of shaping learning activities and designing the structure in which those activities occur. As such, constructivist theories are less easily defined than the behaviourist methods. Teachers can meet the varying needs of all students by utilizing constructivist teaching practices. This learning theory also addresses the unique backgrounds and experiences of students themselves. A student-centered approach allows for a variety of connections both social and personal, to be made to the content. Once a student has achieved this physical literacy through constructivist-based education, the student will be able to utilize these skills throughout his or her life. It can be

argued that the rich student-student and student-teacher interaction of constructivist-based learning is a new "post-industrialist era" of education. (Anderson & Dron, 2011)

The constructivist approach has been used in a variety of settings to empower both instructors and students to find learning and teaching approaches suitable for the particular learning environment. It has been widely embraced by educators. For example students in a teacher training program are allowed to critique and develop course assessment standards based on ideas developed while taking a module of study rather than the traditional essays/end of term examinations. (Rami, Lorenzi, & Lalor, 2009) An online programming-language course faces unique challenges, so to meet the complicated process of learning programming language an on-line course was designed on a constructivist model which incorporated collaborations among students working together via a team project to see how other students approach the same problem coupled with instant feedback from instructors. Finally, constructivist-based teaching practices have been used in teaching physical education by integrating genuine learning tasks that promoted lifelong health-related fitness in the physical education curriculum which created greater student ownership of new content and activities through a personal connection to the subject area. (Butz, 2018)

Computer games find use in the social constructivism model of learning. Games provide a platform for social and cooperative aspects of learning. Games can involve the joint construction of socially shared knowledge that has been traditionally utilized in on-line learning communities or collective information processing. Massively multiplayer online role-playing game (MMORPGs) is a good example, where players have defined roles in the context of a team in order to master tasks when the solution requires a high degree of common planning and coordinated effort. Players not only communicate and cooperate in the game, but also often interact as a community such as online forums, chats or instant messaging which allows players to coordinate and exchange ideas. (Bielaczyc & Collins, 1999)

Constructivist learning has been criticized for falling under the "minimally guided" approach toward learning such as discovery learning, or problem-based learning (PBL). Initially social constructivism was founded on the idea that knowledge is constructed by learners, so first they need to have the opportunity to construct by being presented with goals and minimal information. Second learning is idiosyncratic, so a common instructional format is unproductive. A possible shortcoming is that constructivist theory highlights learning a discipline by experiencing the processes and procedures as contrasted to teaching a discipline as a body of knowledge based on the facts, laws and theories of a discipline's content with the use of discovery and inquiry methods of instruction. An essential error may be to assume that the pedagogic content of learning is equal to the methods and processes of a discipline. A constructivist's mistake is to exclusively focus on methods and processes to the detriment of an appropriate framework for understanding. The distinction is between learning a discipline and

who lack a proper background in a subject find the memorization process of learning is overly burdened. In any case learners must construct a mental representation, even if given complete or partial information. More complete information at the onset lays the groundwork and will result in a more accurate representation that is more easily acquired. (Kirschner, Sweller & Clark, 2006)

3.3 Connectivism

According to its adherents connectivism is the next stage in maximizing learning by combining the wisdom of the past with the promise of technology to create new learning synergies. Connectivism is a theoretical framework for comprehending learning. The concept that the acquisition of knowledge best takes place across networked learning clusters using information technologies is central to connectivism, a learning theory emphasizing networked information resources as central to the processes of learning. Connectivist learning focuses on constructing and sustaining networked connections that are relevant to learning about and solving problems. The Internet and other communication technologies are used to mediate the process of learning. (Siemens, 2004) Learning how to assess and direct information systems is a preliminary step a student must understand to engage in this type of learning. The connectivist paradigm is that learning takes place when learners make connections between ideas located throughout their personal learning networks, which are composed of numerous online information resources and technologies such as electronic databases, web search engines, even student-generated content such as blogs. Thus, connectivism acknowledges networked information technology as a significant part of learning processes. (Dunaway, 2011)

Evaluating information prior to engaging with that information is a fundamental skill to be mastered before learning begins. The connectivist model emphasizes that knowledge is stored and manipulated by information technology. For example, proprietary databases, blogs and web search engines which rank results, stress certain perspectives and obscure others, impacting the kinds of connections that learners can make by limiting the perspectives that a leaner can consider. However, connectivism's focus is on the learner's ability to make such connections; learning occurs when connections are made. Thus, connectivism emphasizes the importance of the ability to recognize connections, patterns, and similarities; the ability to synthesize ideas and information is central to the connectivist perspective. Essentially, connectivism views learning as a process of developing a learning network and making connections between ideas embedded throughout that network (Siemens, 2004)

Assessment in connectivist pedagogy combines self-reflection and a teacher assessment of the student's contributions to the current and future courses. The activity of learners is evidenced by their contributions to wikis, Twitter, threaded conferences, and other network tools. Further, learning reflected in the comments, contributions, and insights of students enrich network interactions for current and future students which can be part of the assessing learning outcomes. These contributions may be critical comments, learning resources, or other digital objects of knowledge creation,

dissemination, and problem solving. As the constructivist model places an emphasis on scaffolding, learning is disadvantaged by a lack of connections. (Anderson & Dron, 2011)

Connectivism is the application of network principles to define both knowledge and the process of learning. These networks are internal, as neural networks, and external, as networks in which we communicate (Kop & Hill, 2008). Conceptually, learning involves the connecting and strengthening of links between concepts and ideas; socially, learning involves interacting with other individuals across technological networks. Arguing that a connection represents the smallest element in the learning process, Siemens suggests that connectivism provides a theoretical framework for exploring questions such as: How are connections formed? What does a particular constellation of connections represent? How important is technology in enabling connections? What, if anything, is transferred during an interaction between two, three, or more learners? What would learning look like if we developed it from the world view of connections? (Siemens, 2009)

Connectivism is posited on the information age as a networked era. For connectivists, learning is the process of building networks of information, contacts, and resources that are applied to real problems. Networked technologies supply a surfeit of information, so the learner's role is not to memorize or possibly even understand everything, but to find and apply knowledge when it is needed. Machines can assume much of the mental processing and problem solving. Connectivist pedagogy stresses the development of a social presence creating networks of current and past learners. Teachers create learning paths by the design and support of interactions, so learners make connections with existing and new knowledge resources. Unlike earlier pedagogies, the teacher is not solely responsible for defining, generating, or assigning content. Rather, learners and teachers collaborate to create the content of study, and in the process re-create that content for future use by others. (Duke, Harper, & Johnston 2013)

An on line environment is central to the application of connectivist principles. According to Downes connectivist teaching principles as employed in an online course are autonomy, diversity, openness and interactivity. The aspect of autonomy allows learners maximum choice of where, when, how, with whom and even what to learn while diversity ensures that learners are from a sufficiently diverse population to avoid group-think and discourage an environment in which students are exposed only to their only beliefs or opinions and alternative ideas are not considered. Students engage in diverse readings, discussions and environments. The principle of openness accommodates all levels of engagement, with no barriers between students. It helps to ensure the free flow of information through the network, and encourages a culture of sharing and a focus on knowledge creation. Connectedness and interactivity is what makes all this possible. Knowledge emerges as a result of connections. (Sanchez-Gordon & Mora, 2014).

In 2008, Stephen Downes and George Siemens offered the course “CCK08” through the University of Manitoba, Canada. The course was an application of connectivist principles within a MOOC (Massive Open Online Course). It was a course - and a network - about the emergent practices and theory of connectivism. Although not formally advertised, more than 2000 participants from all over the world registered for the course, with 24 enrolled for credit. Students were empowered to create a personal perspective on the materials by an interactive method employed in the course design. Course contents evolved from a collection of resources around the course topic rather than a linear set of materials all students were required to follow. Within the framework of the course lessons, students researched and developed their own materials and through on line collaboration incorporated the work of other students into the learning process. As a result students were able to sample a wide range of learning focusing on those ideas they found interesting and relevant. This stimulated a distributive conversation on the learning resources in as wide a format as possible by making it possible for anyone (instructors included) to participate in all forums and master the full range of content. (Dirckinck-Holmfeld et al., 2010).

Another example of how connectivist pedagogy can be found in the approached used by the Open University in the United Kingdom which transformed from the standard “transmission model” of teaching to a curriculum stressing “how one comes to know” teaching. Courses involve students using technology in collaborating on group projects, including consulting actual practitioners making students part of the process of knowledge creation. Students learn through experience by reasoning, strategizing and understanding circumstances that occur in the real world which have application to their future careers. A conversational framework is applied with technology in which a minimum of content is initially outlined. The framework consists of an ongoing dialogue between the teacher and the student operating on two levels: the theoretical, conceptual level and the active, practical, experiential level. (Laurillard, 2008).

A final example of connectivist instruction can be found at Rennselaer Polytechnic Institute (RPI) in Troy, New York that has reformed its undergraduate education in science, mathematics, engineering, and technology. One of the key innovations RPI has implemented is to replace large, introductory lecture-based courses with studio courses. These courses apply an integrated, multidisciplinary approach incorporating technology to create a better learning environment for students and a better teaching environment for faculty. The studio classes are designed to bring the interaction often found in small-enrollment classes to large introductory classes. Lecture, recitation, and laboratory are combined into one facility - the studio - capable of accommodating all three teaching methods in which the faculty conducts hands-on interactive learning sessions. While the courses use advanced-function computing technology and tools, they are actually quite structured; their pace is determined by the faculty rather than by students and/or participants. (Laurillard, 2002).

4. Conclusion

Professor Ken Bain, an American author, in his book “What The Best College Teachers Do” listed six areas of best practice for teachers in higher education including: knowing and understanding subject matter, being prepared to teach, establishing high expectations for student performance, fostering a critical learning environment, creating relationships of trust and respect with students, and assessing personal progress and efforts. (Bain 2004) How has the introduction of technology in the classroom helped teachers meet these aims?

Computers, telecommunications and machine automation have revolutionized many industries and the education field is too facing technological change. An important factor is the nature of today’s students. Social media is a constant in their lives. The use of multimedia games is primary form of entertainment with the current generation and as such their receptivity to new technology is unprecedented. Students are unique and the power of technology provides the opportunity to personalize the learning experience. The question is what traditional elements in the practice of education should be retained and which should be swept aside by the promise of continuing advances in technology to meet the traditional objectives of teachers?

The evolution of learning theories provides counsel on how to incorporate technology into the classroom. Behaviorist principles are being used successfully in the design of games enriching some of the more tedious aspects of teaching while linking learning with activities which meet the current lifestyle of students. Social constructivist learning strategies have demonstrated the advantages of shifting the learning environment from a hierarchical teacher/student one towards a more collaborative one where students have the freedom to learn from learning, and the cooperative nature of technology powers this objective. This focus has proven to foster critical think skills and freed educators to focus less on classroom control and more on guiding self-learners. The communications avenues presented by technology open up new possibilities to augment the benefits social constructivist approaches have shown.

The promise of connectivist principles of teaching lies in its name: the ability of students to access facts, ideas and collaboration with the Internet as the common link which allows students to creates connections which foster learning. For students the Internet opens the door to unparalleled knowledge access, educational tools to leverage the learning process and collaboration in the search for scholarship and knowledge creation.

First consider the impact of communication technology represented by the Internet and learning outcomes. The Internet and such portals are good at finding information, but traditional memorization represents higher learning in two essential ways. Supporters emphasizing the use of databases and search engines underestimate how the meaning of ideas changes with context. The Internet promises quick access as a great advantage. Students can look up algebraic equation rather

than memorize it, but opening a new browser tab takes moments, not the minutes required to locate the right page in the right book. Yet "moments" are still much slower than the brain operates. Imagine solving the problem 397,394 x 9 without memorizing the multiplication table. As in many areas of knowledge, math education is applied by the fast, effortless recall of facts as an essential foundation of learning. Speed is also an issue in the skill of reading. Pausing to find a word definition is disruptive. Online, the mere presence of hyperlinks compromises reading comprehension because the decision of whether or not to click disrupts the flow of understanding. (Willington, 2017). Studies show a relatively linear relationship between the percentage of vocabulary known and the degree of reading comprehension. Readers need to know at least 95 percent of the words in a text for comfortable absorption. The meaning of words depends on context, but dictionaries, including Internet dictionaries usually offer context-free meanings. (Schmitt, Jiang, & Grabe, 2011)

There is always a certain amount of core knowledge that is required to be able to understand any subject of study and depending on the field of study, this core knowledge will vary. A structured study using existing learning theories is preferable when faced with studying core knowledge for a specific field. If a student with limited core knowledge accesses Internet information beyond a student's ability to understand, then that knowledge is useless. Most individuals will not have the understanding in a specific field to access the data in that field and then assimilate the knowledge in a sequence that will make it understandable. Consider vocabulary as an example. Every teacher knows that a sixth grader with a thesaurus will often submit a paper studded with words used in not-quite-correct ways. Content is important. (Duke et al., 2013)

The use of technology is effective or not depending on the material and on characteristics of the student. Students constantly use technology, so do the multimedia experiences engender more student engagement. How appealing a technology is in the learning setting depends on how it is used and the content as student engagement will depend on what they do with technology. Engagement or interest is a mental state, and the environment that will lead to that mental state need not have a technological component. Technologies like hyperlinks can lead students to explore information sources on their own, but it is the content and what the user might do with it that makes it useful or not for a student. The features of many new technologies that provide rapid changes in what the user sees or experiences makes them inherently interesting, irrespective of how they are used or the content they convey. Arresting media and the "bells and whistles" of technology attract interest. (Willingham, 2010)

Through the use of technology have students developed the ability of students to multitask, to perform more than one task at the same time? Survey data indicates that younger people do multitask quite often and laboratory tests show that younger people are better at multitasking than older people. Laboratory tests often find that younger people are better at multitasking than older

people because younger people have less degradation of the speed and accuracy of each task - compared with when each task is done separately. (Willingham, 2010). Young peoples' advantage in multitasking is not associated with greater practice than older people. It is associated with a young person's greater working-memory capacity, the mental "space" in which thinking occurs. People with more room in working memory are better at multitasking, and for reasons that are not well understood, young people generally have more working-memory capacity than older adults do, and so are better at multitasking. Yet, all people perform tasks best when only one is done at a time. (Ophir, & Clifford Wagner, 2009)

In the history of the knowledge the age of Enlightenment is remembered as a time man endeavored to analyze traditional principng. The reason is algorithms by their design tend to acquire the capacity to predict the preferences of users as part of the function of personalizing results. Importantly, computers tend to solve only defined problems while the problem-solving efforts of the human mind often exposes more issues for exploration. The digital world's emphasis is on speed which inhibits reflection. Its incentives empower the radical over the thoughtful. The Internet values are shaped by subgroup consensus, not by introspection. The Enlightenment started with essentially philosophical insights spread by a new technology, as at that time the printing press allowed the dissemination of information on much greater scale than previous eras. In the present day is the reliance on computer processing power moving this age in the opposite direction? Is the artificial intelligence of a computer a technology in search of a guiding philosophy? Should that be the direction of education in the future? (Kissinger, 2018)

Ultimately, like any learning tool from the chalkboard to powerpoint to the collaborative uses of the Internet will still depend on the teacher as the center of the learning experience. A teacher is the one who questions and teaches students how to question. A teacher is an inspiration, an influence directing students toward the right path. Technology currently promises to simply aid this central role in the important process of education.

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