CONNECTIVISM: 21ST CENTURY'S NEW LEARNING THEORY

Dorothy C. Kropf [Dorothy.Kropf@waldenu.edu], Walden University, 100 Washington Avenue South, #900, Minneapolis, MN 55401, United States of America [http://waldenu.edu/]

Abstract

Transformed into a large collaborative learning environment, the Internet is comprised of information reservoirs namely, (a) online classrooms, (b) social networks, and (c) virtual reality or simulated communities, to expeditiously create, reproduce, share, and deliver information into the hands of educators and students. Most importantly, the Internet has become a focal point for a potentially dynamic modern learning theory called connectivism. Like any learning theory, connectivism has its share of supporters and critics. Unlike any other learning theory, connectivism attributes learning through cyber nodes specifically rooted in social networks. The purpose of this article is to introduce or reacquaint readers with three of the largest reservoirs of information attributed to the principles of connectivism. In addition, it aims to examine these information reservoirs through modern empirical studies in order to determine if their findings carry sparks of likeness or alignment with the principles of connectivism.

Keywords: connectivism, e-learning, information repositories, learning theory

Introduction

Siemens (2008) suggested that modern day learning occurs through network connections as individuals share their interests, knowledge, perspectives, expertise, and opinions in online or virtual learning environments (Dunaway, 2011). Internet technologies, comprised of databases and search engines, are capable of housing thousands of blogs, news articles, book excerpts, journal articles, video clips, and podcasts. According to Siemens (2008), connectivism is a learning theory comprised of different series of nodes to connect hundreds of networks to facilitate synchronous and asynchronous learning (Dunaway, 2011). These connections provide individuals with direct access to reliable information from millions of sources to duplicate, reproduce, and share within their social networks, and to delete, critique, and discard inaccurate, irrelevant, and unreliable information.

Network connections contain streams of information constantly flowing with substantiated data including empirical findings from peer-reviewed journals as well subjective information from personal websites or blogs (Siemens, 2008). One of the principles of connectivism is how higher order thinking skills are activated when individuals can distinguish which of the abundant and diverse information available online are reliable or sustainable (Siemens, 2008). This connectivism principle is aligned with Center for Advancement of Learning and Assessment (CALA)'s definition of higher order thinking skills as skills achieved by individuals who work in environments that facilitate "persistence, self-monitoring, open-minded, and flexible attitudes" (King, Goodson & Rohani, 2009, p.1).

Today's students are "do-it-yourself" learners (Nussbaum-Beach & Hall, 2012, p.11). Having acquired information from a series of nodes, connectivism describes learning as an informal opportunity that transforms individuals into 'nodes' themselves, equally capable of sharing their knowledge and expertise with other individuals (Sangra & Wheeler, 2013). This principle is similar to constructivism's foundation in which social and cultural interactions become triggering

mechanisms for learning (Driscoll, 2005). Constructivism posits that individuals learn from mediators including parents, instructors, peers, or even computer applications (Wertsch, 2008). Individuals, according to the constructivist's viewpoint, learn from these mediators just as individuals, according to the connectivist's viewpoint learn from several series of nodes. Another classical learning theory equally effective in transforming individuals is behaviourism (Driscoll, 2005). Individuals, according to behaviourist theorists including Thorndike and Skinner, can change or transform their behaviour through stimuli such as rewards and punishments (Gould, 2008). In the daily chaos of abundant information, online collaborative tools can transform learners into individuals who can manage their time and organize their tasks accordingly (Couros, 2009; Garcia, Brown & Elbetagi, 2012, p.165).

The most radical educational transformation befalls on higher education (Hogg & Lomicky, 2012). The transformation of higher education institutions, as primary providers of esteemed traditional education to facilitators of informal and virtual learning environments surprised several research organizations, including the Pew Research Center (Hogg & Lomicky, 2012). In 2002, Pew Research Center indicated that despite the popularity of MOOCs, college students would persist in their traditional brick and mortar classrooms (Hogg & Lomicky, 2012). Contradicting to this prediction, six million students enrolled in online classes in 2010. By 2011, thirty-three percent of college students in traditional classrooms were taking at least one online course (Allen & Seaman, 2011 as cited in Hogg & Lomicky, 2012). Higher education students are satisfied with their online classes, perceiving online education as equal to traditional education (Allen & Seaman, 2011 as cited in Hogg & Lomicky, 2012). Consequently, building more course modules and offering more MOOCs are some of the strategic plans that higher education institutions are now undertaking (Hogg & Lomicky, 2012).

Learning through internal processes is evident in the classical cognitive learning theory (Driscoll, 2005). According to Piaget and other cognitive learning theorists, individuals learn from internal processes such as "insights, information processing, perceptions, and memory" (Gould, 2008, p.2). The principles of cognitivism enable individuals to understand abstract lessons and to make sense of the world around them (Gould, 2008). In cognitivism, individuals acquire knowledge through reflective exercises such as journal writing.

Reid (2013) conducted a study for healthcare professionals on the subject of mindfulness. Mindfulness, an important skill for healthcare professionals, involves "attending to one's moment to moment experience" (Brown & Ryan, 2003; Kabat-Zinn, 2005; Shapiro, Carlson, Astin, & Freedman, 2006 as cited in Reid, 2013). "Content modules were delivered with guided recordings of meditations" (Reid, 2013, p.44). This mindfulness class was the first of its kind for all participants who admitted feeling nervous and sceptical. At the end of the study, most participants affirmed that the downloadable e-learning materials and online journals helped increase their knowledge about mindfulness. The online class helped the students learn several meditation and breathing techniques, and most importantly, the class taught them how to manage their well-being. It also helped them achieve higher order thinking skills, which according to King, Goodson and Rohani (2009) can be triggered when students face new problems and uncertainties. Connectivism explains how individuals use their internal processes to activate learning through a series of nodes originating from the instructor. Mindfulness is a unique internal process, one that can generate instinctive learning and reflection.

Learning and instructional theories

Critics of connectivism as a learning theory, including Bell (2010), referred to connectivism as an instructional theory, not a learning theory. An instructional theory is a conceptual framework based on empirical findings and grounded in learning theories, which recommends the design of learning materials, resources, or situations to help learners achieve their learning outcomes and maximize their learning potential. Individuals learn through instructional strategies performed by teachers, aimed to "motivate students to learn and think on higher levels" (King, Goodson & Rohani, 2009, p.43). Learning is the acquisition of knowledge and learning theories explain how individuals learn (Driscoll, 2005). The primary evidence of learning is an individual's change in performance (Driscoll, 2005; Gould, 2008).
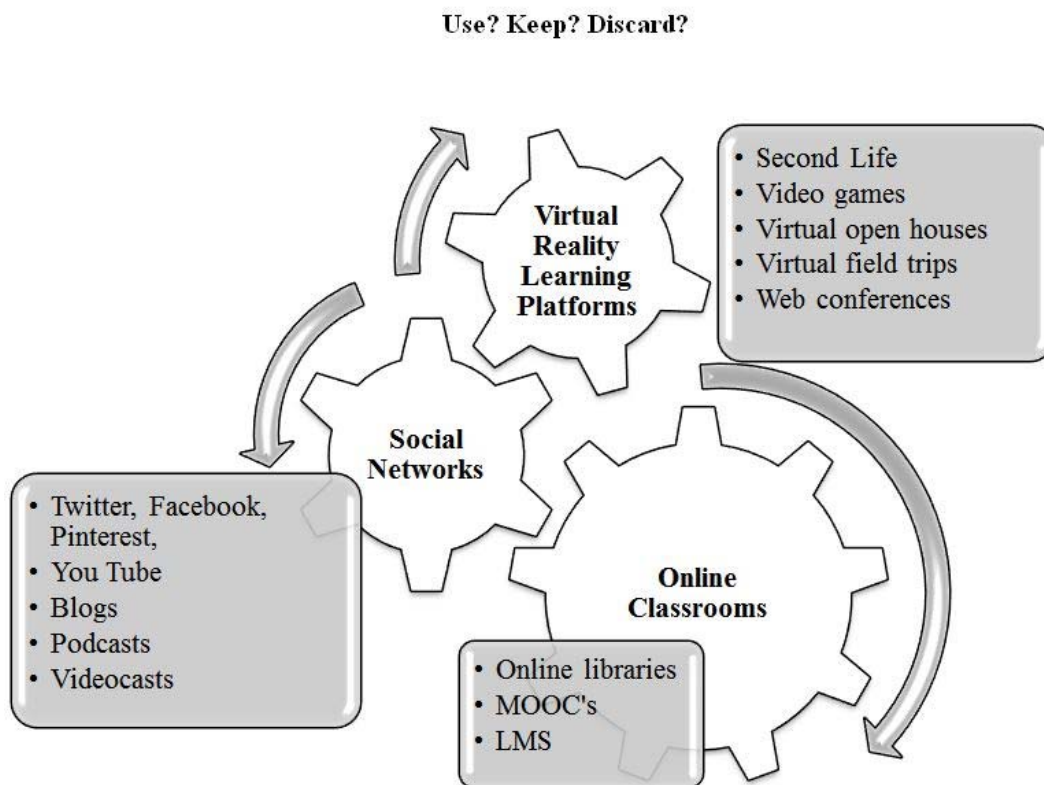
Information reservoirs

Figure 1.

According to the principles of connectivism, individuals acquire information through modern-day reservoirs of information. Currently, there are three major reservoirs where individuals can acquire information: (a) online classrooms including massive open online courses (MOOCs), (b) social networks including podcasts and video clips, and (c) virtual reality platforms, including 'Second Life' and 3-dimensional video games. The article examines distinct studies in which researchers hypothesized participants' changes in their performances by using one of the primary information repositories.

Online courses

Learning in this digital age consists of online courses delivered synchronously and asynchronously. The offerings of massive open online courses (MOOC) are increasing while hundreds of learners from various disciplines take advantage of their cost effectiveness and convenience. Several colleges and universities offer online courses to attract more students. Researchers continue to watch the disruptive effects of online course movements (Salas, 2013).

Undergraduate engineering students of Malaysia

Like many of their European and Asian counterparts, the government of Malaysia emphasizes the importance of producing higher education graduates who are independent, technologically knowledgeable, and well-prepared to compete with the rest of the world (Subramaniam, Nordin & Krishnan, 2013). Prompted by the Malaysian government's announcement that 50% percent of the nation's learning materials should consist of e-content by 2015, the researchers conducted a study on the readiness and the needs of Malaysian engineering students in online classrooms (Subramaniam, Nordin & Krishnan, 2013). Forty-six engineering students, all with extensive experience with learning management system (LMS) platforms similar to Blackboard participated in the study. They downloaded e-Content learning materials including PowerPoint slides and connected with their friends and lecturers online (Subramaniam, Nordin & Krishnan, 2013).

The study's results indicated a significant change in performance (Driscoll, 2005). Nearly 90 percent of the students perceive themselves as technically knowledgeable with almost 50 percent admitted to using their smart phones to surf the web (Subramaniam, Nordin & Krishnan, 2013). Eighty-seven percent of the students preferred to have access to more online learning materials and over seventy percent of the students asserted that online courses significantly increased their knowledge (Subramaniam, Nordin & Krishnan, 2013). Finally, students felt confident and prepared to take their engineering courses online (Subramaniam, Nordin & Krishnan, 2013), a scaffolding effect developed with higher order thinking skills, wherein students eventually learn to work autonomously (King, Goodson & Rohani, 2009).

The results are not at all surprising since Malaysian students are accustomed to online learning. Having taken science courses including university-level physics, bio-technology, and even physiotherapy courses online, their exposure to e-Content, online discussions and exercises continue to activate their higher order thinking skills (Donnelly & Fitzmaurice, 2005; Poikela et al. 2007 as cited in Subramaniam, Nordin & Krishnan, 2013, p.286).

Online EPHOC

"In 2007, the University of Alabama in Birmingham's (UAB) School of Public Health (SOPH), with the Jefferson County (Alabama) Department of Health (JCDH), and the Centers for Disease Control and Prevention's National Center for Environmental Health (CDC/NCEH) partnered" together (McCormick & Pevear, 2013, p.52). This alliance aimed to produce a "comprehensive online package of courses for environmental public health (EPH) practitioners" (McCormick & Pevear, 2013, p.52). The initiative includes free of charge courses utilizing the LMS platform operated by "South Central Public Health Partnership for Workforce Development" (McCormick & Pevear, 2013, p.52). Lack of qualified workforce, training materials and shortage of trainers in 2007 prompted this initiative leading to a series of online classes called "Environmental Public Health Online Courses (EPHOC) (McCormick & Pevear, 2013, p.52). Data generated came from "355" survey respondents (McCormick & Pevear, 2013, p.52).

The study indicated that 73.73 percent of the respondents were satisfied with the EPHOC series. Nearly 65 percent of the respondents attested that the EPHOC courses increased their knowledge about their jobs. When asked if EPHOC series are applicable and relevant to their daily jobs, 51.06 percent rated the series 8 or better, with 10 being the most applicable. Results of the study indicated significant changes in their job performance. Before taking the EPHOC series, only 60.41percent passed the Registered Environmental Health Specialist (REHS) exam. However, after taking the EPHOC series, over ninety-percent of the students passed the exams.

Topical information in the video lecture series include "General Environmental Health, Food Protection, Hazardous Materials, and Air Quality and Environmental Noise" (McCormick & Pevear, 2013, p.53). "Applications of procedural knowledge that involve analysis and synthesis of two or more concepts" are referred to as higher order thinking skills" (King, Goodson & Rohani, 2009, p.12).

Social networks

Social networks are nodes of idea generators (Kijkuit & Van Den Ende, 2007). Social networks are built on mutual understanding, which is the "ability to understand and build on each other's knowledge base" (Kijkuit & Van Den Ende, 2007, p.863). Businesses and educational institutions utilize social networks in their marketing efforts, particularly in their branding processes. An organization's marketing efforts are grounded in both traditional ad campaigns and in social network campaigns. Their constant presence in the Internet is crucial to maintaining a stream of prospective customers.

Remix World

"Remix World, an educational social network, functions as an interactive online constituent for Digital Youth Network in Chicago, Illinois" (Zywica, Richerds & Gomez, 2011, p.33). The Remix World study required students from 6-12 grades to join the network by setting up their profiles (Zywica, Richerds,& Gomez, 2011). The purpose of the study was to analyze the use of learning networks in the educational community and its capacity to bring collaboration between students (Zywica, Richerds & Gomez, 2011). Researchers hypothesized that the network community for students will enhance their creativity and help with their knowledge acquisition. In the web space provided for them, students communicated with their friends, mentors, and other members of their communities. Students can add comments and other materials that they created or found from the Internet. The study indicated that there were 252 Remix World registered users with 4,883 site visits, at an average of 31.3 visits each day. There were 1965 photos, 355 videos, 222 blog entries, and 3800 discussion posts shared within the community (Zywica, Richerds & Gomez, 2011).

Teachers were given flexibility to integrate their curriculum within Remix World. Both teachers and mentors visited students' personal pages, which provided more opportunities to provide feedback. Remix World demonstrated that their content-driven social network system created a sense of community for students, teachers, and mentors. Collaborative activities such as "student discussions, peer tutoring and cooperative learning are effective in the development of thinking skills" (King, Goodson & Rohani, 2009, p.2). Moreover, creativity skills such as "divergent and convergent thinking to produce new ideas" (Crow et al., 1997 as cited in King, Goodson, & Rohani, 2009, p.13) also trigger higher order thinking skills.

NING site

Peck conducted a study at Nacquarie University in Australia, using NING site, a social networking site. He hypothesized that the NING site can motivate students to interact with one another, participate in class lectures, read tutorials, increase student confidence, and improve social literacy (Peck, 2012). Fifty Linguistics students participated, ranging from ages 18 to 23. Twenty participants were international students from China, Korea, and Japan. Local students also had ethnic diversities, ranging from British, Greek, Indian, Polish, and Lebanese (Peck, 2012). The study indicated that by the end of the first semester, the NING site had 61 blogs and 52 forum comments.

Teachers selected a topic for further discussions while students added comments in the discussions. Students admittedly felt as if they belonged in a cultural community (Peck, 2012). Peck (2012) noted that students who frequently posted online were usually quiet in the classrooms. Blogging requires social literacy skills not familiar to many students. The study generated friendships and students were less sceptical about the study. Social learning theorist, Vygotsky, noted that social interactions with peers, instructors, and parents contribute to learning and cognitive development (King, Goodson & Rohani, 2009, p.13).

Podcast study for nursing students

Vogt, Schaffner, Rivar and Chavez (2010) hypothesized that students who acquired lectures from podcasts will achieve higher exam scores compared to students who acquired lectures in classroom. The researchers also hypothesized that students would prefer podcast lectures over lectures delivered in the classroom (Vogt, Schaffner, Rivar & Chavez, 2010). The researchers conducted a study with 63 undergraduate nursing students in 2007 to 2008, who acquired lectures in classrooms and 57 students who acquired lectures via podcasts. The first exam covered topics in health promotion, the second exam covered topics in growth and development, and the third exam covered topics in immunizations (Vogt, Schaffner, Rivar & Chavez, 2010, p.40). The results of the study indicated no significant difference in the first exam test scores between students who acquired lectures via podcasts and students who acquired lectures in the classrooms. However, there was an increase in test scores for the second exam for students who acquired lessons using podcasts compared to students who acquired lessons in the classrooms. For the third exam, students who acquired podcast lectures did worse than students who acquired lectures in the classrooms. In addition, only 44 % of the students preferred to use podcast lectures. Majority of the students preferred classroom lectures.

According to Vogt et al. (2010), students were not familiar with the podcast technology, and therefore, preferred the traditional classroom lectures. Since the study was conducted in 2007 and 2008, the author recommends more studies using podcasts and videocasts (podcasts simultaneously played with video clips) to deliver lectures. Nevertheless, the study failed to produce performance changes in exam scores and generated negative perceptions from the students regarding podcast lectures.

Podcasts for General Biology students

White (2009) has been delivering General Biology lessons to undergraduate students since 2005. He typically has 150-200 students enrolled in his biology classes. Since 2005, he has made 39 podcast lectures, allowing his students to listen to his podcasts to enhance their knowledge acquisition. The researcher's log indicated that 1,333 lecture audio files were downloaded from 228 different IP addresses. On the weeks before exams 1, 2, and 3, there were 76 % downloads, 70 % downloads, and 98 % downloads respectively. For the final exam, 100 % of the students

downloaded his podcasts. According to White (2009) several educators worry that podcast lectures would keep students from entering the classrooms. However, in this study, data indicated no significant difference in student attendance. The students continued to download the podcasts while maintaining active participation in the classrooms. This "executive control of behavior" also considered metacognition, wherein "attitudes, commitment, and attention" are demonstrated by individuals constitute to higher thinking order (King, Goodson & Rohani, 2009, p.22). The study demonstrated consistent changes in the students' performances and participation.

Virtual Learning Platforms

In a virtual world, a "networked learning environment is transformed into a 3-D shared learning space in which the learners are represented by avatars (Lin, Chou & Kuo, 2007, p.101). Avatars are representations of learners (Lin, Chou & Kuo, 2007, p.100). Virtual learning platforms encourage creativity from both educators and students. They also encourage virtual collaboration through activities that enable avatars to talk, walk, move, and point on objects to create intense social and intellectual interactions" (Lin, Chou & Kuo, 2007, p.100).

Chinese manual for Second Life

In this study, the researchers, also language instructors, utilized second life (SL) to enhance knowledge acquisition. Their study was conducted in China, requiring Chinese students to use SL to create a Chinese version of the second life manual (Wang & Shao, 2012, p.15). The study demonstrated that SL provided effective "language learning tasks" (Wang & Shao, 2012, p.15). This activity demonstrated skills in several areas, including linguistic-verbal skills wherein the participants were able to distinguish correct meanings and word orders (King, Goodson & Rohani, 2009, p.29). The activity also triggered creativity as participants learned to "use basic principles or rules in this new situation" while trying to "put pieces together into a coherent system that integrates new information with what a person already know (Sternberg & Davidson, 1995; Crowl et al., 1997 as cited in King, Goodson, & Rohani, 2009, p.14).

MBA students and Second Life

In Schiller's study (2009), MBA students specializing in Information Systems, participated in an SL project to enhance their experiences with commerce and to improve teamwork efforts. Through reflective essays and online chats, the study indicated that students perceive this SL project as relevant to their course content (Schiller, 2009). Students enjoyed this class and perceived the project to be fun and engaging. It is important to note that the "emotional tone of person solving problems" affects insights (Sternberg & Davidson, 1995, p. xi as cited in King, Goodson, & Rohani, 2009, p.16). The internal processes that activated learning in this study was similar to the 'mindfulness' study conducted by Reid (2013). The students learned from their reflective exercises, gaining knowledge about several distinct ways to solving problems.

Geology and virtual reality

In this study, "Geology students in Northern Arizona University utilized virtual environment in the Geowall" (Kelly & Riggs, 2006, p.158). The researchers hypothesized that the virtual reality landscape would increase student "confidence and performance in the introductory level field class" (Kelly & Riggs, 2006, p.158) First year geology students often find learning "baseline terrain-analysis skills" to be challenging (Kelly & Riggs, 2006, p.158). The project included "field-mapping experiences and exercises" (Kelly & Riggs, 2006, p.158) Geowall software was designed to enhance spatial understanding.

The researchers hypothesized that this project would improve students' spatial skills and student confidence. The students entered a virtual environment where geology laboratory activities and 3-dimensional earth data were explored. The study indicated that Geowall delivered positive results in student performance. However, students asserted that the software did not help them acquire better visual images that would clearly explain heights, distances, slopes and other spatial knowledge needed to conduct a land survey (Kelly & Riggs, 2006). In situational learning, students achieve higher order thinking skills when faced with real-life context to solve problems and overcome obstacles (King, Goodson & Rohani, 2009, p.37). It is unclear if the researchers realized the participants' constant exposure to more dynamic three-dimensional audio-visual materials including video games and simulated environment including SL may have affected the way students perceived Geowall. Nevertheless, geological concepts take into consideration creative and critical thinking skills as well as complex analysis which constitute to higher order thinking skills (King, Goodson & Rohani, 2009).

Mobile Devices

All information repositories can now be acquired through mobile devices. Hence, a portion of this article is dedicated to examining studies in which researchers utilize mobile devices to find connections between versatility and learning. Since connectivism starts with the individual, personal knowledge consists of an individual's network, which is made up of various online information repositories (Mackey & Evans, 2011), that can trigger learning. A common practice for students is to surf the web and acquire data from these online information repositories by using their mobile devices such as cell phones, iPads, and iPods. Not only are they used for social and entertainment purposes, mobile devices are pivotal in helping individuals acquire higher order thinking skills.

Nintendo DS Lite to increase self-study

The author draws the readers' attention to mobile devices, devices that most students use to surf the web. These mobile devices include smart phones, iPads, iPods, and handheld video games. According to Kondo, Ishikawa, Smith, Sakamoto, Shimomura and Wada (2012) Japanese university students prefer to receive learning materials from their mobile devices, not from their personal computers (Thornton & Houser, 2005 as cited in Kondo et al., 2012). Kondo et al.'s (2012) study utilized a Nintendo DS Lite to determine if students will spend "more time on self-study" (p.172). Even after completing the modules, Kondo et al. (2012) hypothesized that students will continue to engage in "independent self-study" (p.172). Also hypothesized, with an increased involvement in their studies, test scores would also increase. Language skills courses were imbedded in these mobile devices with modules that foster "self-study" (Kondo et al., 2012, p.173).

The study indicated that 'reading and listening' test scores of 99.4 percent of students who utilized the mobile devices significantly increased. The students stated that learning with 'Nintendo DS' was enjoyable. The study also indicated that students spent 104.18 minutes per week to view or download E-learning materials. Eighty-one percent of the students would like to continue learning the English language with the Nintendo DS. Self-study behaviour has significantly increased and evidently motivated students to be actively engaged in their studies. "Playfulness, creativity, and an ability to unify separate elements are major parts of insight" which contributes to higher order thinking skills (King, Goodson & Rohani, 2009, p.15).

Sociology and m-learning

McConatha, Praul, and Lynch (2008) conducted a study on m-learning, or mobile learning. Out of 112 sociology students, 42 chose to use their smartphones to study for two scheduled exams while the remainder of the students chose to study using their desktop computers (McConatha et al., 2008). The software utilized was the HotLava Software's Learning Mobile Author (McConatha et al., 2008). URLs were given to the two groups of students. Learning materials such as handouts, practice exams, and review sessions were delivered online. The software for the cell phone can track access to the site, frequency of the access and "quiz scores feedback" from the instructor (McConatha, 2008, p.19). The results of the study indicated that the average scores for the two exams for students who utilized their cell phones to access their learning materials is 89 % compared to the average score of 84 % from students who did not utilize their cell phones to access their learning materials

The study's results are similar to other studies indicating that the use of mobile devices can activate learning and improve student performance.

Vocabulary words as text messages

Katz and Yablon's (2011) study consisted of 241 freshman university students in Israel enrolled in an English language course. Eighty-one of the students acquired vocabulary words from text messages in their cell phones, eighty-five percent of them acquired vocabulary words from email messages in their personal computers, including laptops, and seventy-five students acquired vocabulary words via snail mail. Although there were no significant differences in the examination scores of students in each of the three groups, students who acquired vocabulary words from text messages in their cell phones perceive the method as effective and efficient, leading them to have positive attitudes towards the foundational course. In terms of autonomy, students who acquired their vocabulary through text messages are also the most autonomous students in the group.

If one is looking for increased achievement scores to assess performance change as prescribed by Driscoll (2005), the study failed to deliver those results. However, students who are satisfied with their courses tend to persist in their programs and researchers may have to consider slight changes in the e-Content materials delivered through mobile devices.

Conclusion

A learning theory "comprises a set of constructs linking observed changes in performance with what is thought to bring about those changes" (Driscoll, 2005, p.1). It explains why and how learning occurs. Learning theories consist of internal or external variables that can activate learning (Driscoll, 2005). As learning theorists observe these variables over time, they can provide accurate descriptions of how students learn. A learning theory utilizes empirical findings to integrate several factors that can explain learning phenomenon. Is connectivism a learning theory? Examining the information reservoirs commonly used in connectivism led the author to recommend that connectivism has a dual role in education. It serves as a learning theory and as an instructional theory. On one hand, out of the 13 studies evaluated in this article, 11 of the studies demonstrated significant changes in performance and achievement of higher order thinking skills along with diverse E-learning materials in diverse learning environments. However, the articles do not support Siemen's suggestion that connectivism can replace all three schools of learning theories. In fact, connectivism can also be part behaviourist, part cognitive, and part constructionist learning theory. With thousands of materials flowing through the network nodes,

connectivism can provide thousands more E-learning materials in which all three classical learning theories are embedded.

The author also suggests that connectivism is an instructional theory because 2 out of 13 studies in the article need significant design improvements predominantly in the aesthetic quality of the content. Future instructional design specialists should prioritize improving the aesthetic quality of E-learning content since this generation's students have been exposed to high quality and lifelike audio-visual materials including movies with IMAX screens and lifelike images in video games since they were born. The way the content in these studies is designed could be the reason why the studies did not deliver changes in performance. It is also necessary for researchers to determine if their student participants are familiar with the innovation introduced in their studies.

Finally, future researchers must understand that E-learning content perceived by students as fun, would most likely increase their self-study skills, which will enhance their performance scores. There are hundreds of innovations that can be housed in the three major information reservoirs introduced in this article. Evidently, there will be more information reservoirs scheduled to emerge in the future. Surely, connectivism, through various information reservoirs can explain how individuals in the 21st century learn.

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