SJIF Impact Factor 2022: 8.197| ISI I.F. Value:1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 7 | Issue: 5 | May 2022 - Peer Reviewed Journal

EVALUATION OF COMPUTER-BASED TECHNOLOGY AND ITS RELEVANCE TO STUDENT'S PERFORMANCE

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ABSTRACT

Computer-based technology and digitalization has implied many aspects of life, community and industry, yet there is small understanding of how it can be used to improve and promote student's engagement. An idea receiving huge focus in higher education because it is accompanied with a number of positive academic outcomes. The purpose of this research study is to present a review of the literature from the past 6 years related to how digitalization and web- services software, Wikipedia, networking sites, and online digital games influence student's engagement to classroom setting. The research study began the findings with a practical overview of student's engagement and its definitions and indicators towards learning that revealed various kinds of engagement such as behavioral, emotional, and cognitive that informed how we classified literatures. The findings suggest that digitalized online games provide the most influence across different types of student's engagement. Next to it is website services engagement and Facebook use. The findings on Wikipedia, and Twitter are a little decisive and relevantly limited in quantity in terms of studies conducted within the past 6 years. The overall findings provide initial support that computer-based technology influences student's engagement. However, additional study is needed to confirm and build on these findings. It is concluded that this writing by providing a list of recommendations for practice, with the purpose of increasing understanding of how digitalization and computer-based technology may be relevantly implemented in order to achieve the specific and ultimate purpose to increase students perfomance.

KEYWORDS: *computer-based, technology, integration, performance, students*

INTRODUCTION

The digitalized uprising of technology has greatly affected the walk of living, the daily lives of individual has been evident in the ubiquity of mobile devices and the seamless integration of technology into common tasks such as online shopping, reading, and finding directions (Ders, 2017). The use of personal computers, mobile devices, and the Internet is at its highest level to date and expected to continue to increase as technology becomes more accessible, particularly for users in developing countries (Hiter, 2017).Additionally, there is a growing quantity of people who are dependent to gadgets and relying solely on smartphones for Internet access (Gane, 2015) than more luxurious devices such as hi-end laptops and tablets. Better access to internet and demand for technology has presented exceptional opportunities and challenges for many industries, some of which have thrived by effectively digitizing their operations and services and others that have struggled to keep up with the pace of technological innovation (Dhanna, 2015). Integrating technology into classroom setting is not a new challenge for schools and universities. Since the early 1900s, administrators and faculty have contended with how to effectively and efficiently use technical innovations such as video and audio recordings, email,and teleconferencing to replace traditional instructional delivery methods (Tira, 2015). Within the past years, this challenge has been much difficult due to the pure volume of new technologies in the market. Like for 6 years (from 2006 to 2015), the quantity of active apps in store. Over the next years, the number of apps is projected to rise by almost 80%, totaling over 6 million (Nel, 2015). Further intensifying this challenge is the limited shelf life of new acquired devices and software together with significant organizational barriers that hinder schools and universities from efficiently and effectively integrating new technologies (Tira, 2015).

There are organizational barriers to integrating technology arise from competing tensions between institutional policy and practice and faculty beliefs and abilities. For example, university administrators may view technology as educational tool to attract and retain students, whereas faculty members may struggle to identify how technology coincides with existing teaching styles (Hav, 2016). In addition, some faculty are hesitant to use technology due to lack of technical knowledge and skills about the efficacy of technology to progress student learning outcomes (Redi, 2014). Organizational barriers to technology adoption are particularly problematic given the growing demands and

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perceived benefits among students about using technology to learn (Rran, 2013). Surveys suggest that two-thirds of students use mobile devices for learning and believe that technology can help them achieve learning outcomes and better prepare them for a workforce that is increasingly dependent on technology (Chenrom, 2014). Universities that fail to effectively integrate technology into the learning experience miss opportunities to progress student outcomes and meet the expectations of a student body that has grown accustomed to the integration of technology into every facet of life (Tira, 2015).

The purpose of this paper is to provide an evaluation on how computer-based technology influences student's engagement within higher education settings. The study focused on computer-based technology given the different types of technologies (i.e., website software, Wikipedia, social networking sites, and digital online games) that emerged from a broad search of the literature, which is described in more detail below. Computer-based technology (hereafter referred to as technology) requires the use of specific hardware, software, and micro processing features available on a computer or mobile device. We also focused on student engagement as the dependent variable of interest because it encompasses many different aspects of the teaching and learning process (Baden, 2013), compared narrower variables in the literature such as final grades or exam scores. Furthermore, student engagement has received significant attention over the past several decades due to shifts towards student-centered, constructivist instructional methods.

Our review aims to address existing concerns and gaps in the student's engagement to technology and seeks to determine whether student engagement models should be expanded to include technology. The review also addresses some of the organizational barriers to technology integration y providing a comprehensive account of the research evidence regarding how technology influences student engagement. One limitation of the literature, however, is the lack of detail regarding how teaching and learning practices were used to select and integrate technology into learning. For example, the methodology section of many studies does not include a pedagogical justification for why a particular technology was used or details about the design of the learning activity itself. Therefore, it often is unclear how teaching and learning practices may have affected student engagement levels. Our initial search revealed themes regarding which technologies were most prevalent in the literature (e.g., social networking, digital games), which then lead to several, more targeted searches of the same databases using specific keywords such as Facebook and student engagement. After both broad and targeted searches, we identified five technologies (web-conferencing software, blogs, wikis, social networking sites, and digital games) to include in our review.

STUDENT ENGAGEMENT TO TECHNOLOGY

Many existing models of student's engagement reflect the latter set of definitions, depicting engagement as a complex, psychosocial process involving both student and university characteristics. Such models organize the engagement process into three areas: factors that influence student engagement (e.g., institutional culture, curriculum, and teaching practices), indicators of student engagement (e.g., interest in learning, interaction with instructors and peers, and meaningful processing of information), and outcomes of student engagement (e.g., academic achievement, retention, and personal growth) (Nora et al., 2005). In this review, we examine the literature to determine whether technology influences student engagement. In addition, we will use Fredricks et al. (2013) typology of student engagement to organize and present research findings, which suggests that there are three types of engagement (behavioral, emotional, and cognitive). The typology is useful because it is broad in scope, encompassing different types of engagement that capture a range of student experiences, rather than narrower typologies that offer specific or prescriptive conceptualizations of student engagement. In addition, this typology is student-centered, focusing exclusively on student-focused indicators rather than combining student indicators with confounding variables, such as faculty behavior, curriculum design, and campus environment (Kuh, 2011). While such variables are important in the discussion of student engagement, perhaps as factors that may influence engagement, they are not true indicators of student engagement. Using the typology as a guide, we examined recent student engagement research, models, and measures to gain a better understanding of how behavioral, emotional, and cognitive student engagement are conceptualized and to identify specific indicators that correspond with each type of engagement.

CONCEPTUAL FRAMEWORK OF TYPES AND INDICATORS OF STUDENT ENGAGEMENT

Behavioral engagement is the degree to which students are actively involved in learning activities (Zepe, 2014). Indicators of behavioral engagement include time and effort spent participating in learning activities (Trowler, 2010) and interaction with peers, faculty, and staff. Indicators of behavioral engagement reflect observable student actions and most closely align with (Ustin's, 1984) original conceptualizations of student engagement as quantity and quality of effort towards learning. Emotional engagement is students' affective reactions to learning (Trowler, 2010). Indicators of emotional engagement include attitudes, interests, and values towards learning (Cornell, 2015) and a perceived sense of belonging within a learning community. Emotional engagement often is assessed using self-report measures (Fredricks et al., 2013) and provides insight into how students feel about a particular topic, delivery method, or instructor. Finally, cognitive engagement is the degree to

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which students invest in learning and expend mental effort to comprehend and master content (Lester, 2013). Indicators of cognitive engagement include: motivation to learn (Leach, 2010); persistence to overcome academic challenges and meet/exceed requirements (Trowler, 2010); and deep processing of information (Newby, 2006) through critical thinking (Witkowski, 2015), self-regulation (e.g., set goals, plan, organize study effort, and monitor learning; Fredricks, 2011), and the active construction of knowledge (Coates, 2008; Kuh, 2011). While cognitive engagement includes motivational aspects, much of the literature focuses on how students use active learning and higher-order thinking, in some form, to achieve content mastery. For example, there is significant emphasis on the importance of deep learning, which involves analyzing new learning in relation previous knowledge, compared to surface learning, which is limited to memorization, recall, and rehearsal.

INFLUENCE OF TECHNOLOGY ON STUDENT ENGAGEMENT

This study identified five technologies post-literature search (i.e., web-conferencing, blogs, wikis, social networking sites, and digital games) to include in our review, based on frequency in which they appeared in the literature over the past 6 years. One commonality among these technologies is their potential value in supporting a constructivist approach to learning, characterized by the active discovery of knowledge through reflection of experiences with one's environment, the connection of new knowledge to prior knowledge, and interaction with others (Clements, 2015). Another commonality is that most of the technologies, except perhaps for digital games, are designed primarily to promote interaction and collaboration with others. Our search yielded very few studies on how informational technologies, such as video lectures and podcasts, influence student engagement. Therefore, these technologies are notably absent from our review. Unlike the technologies we identified earlier, informational technologies reflect a behaviorist approach to learning in which students are passive recipients of knowledge that is transmitted from an expert (Boghossian, 2006). The lack of recent research on how informational technologies affect student engagement may be due to the increasing shift from instructor- centered, behaviorist approaches to student-centered, constructivist approaches within higher education (Hright, 2011) along with the ubiquity of web 2.0 technologies.

Facebook

Facebook is a web-based service that allows facebook users to create a public or private profile and invite others to connect with them. Users may build social, academic, and professional connections by posting messages in various media formats (i.e., text, pictures, videos) and commenting on, liking, and reacting to others' messages (Bowma, 2014). Within an educational context, Facebook has often been used as a supplementary instructional tool to lectures to support class discussions or develop, deliver, and share academic content and resources. Many instructors have opted to create private Facebook groups, offering an added layer of security and privacy because groups are not accessible to strangers (Ambe, 2014). The majority of studies on Facebook address behavioral indicators of student engagement, with far fewer focusing on emotional or cognitive engagement.

Studies that examine the influence of Facebook on behavioral engagement focus both on participation in learning activities and interaction with peers and instructors. In most studies, Facebook activities were voluntary and participation rates ranged from 19 to 89%, with an average of rate of 58% (Lau, 2015). Participation was assessed by tracking how manystudents joined course- or university-specific Facebook groups (Fagi et al., 2015), visited or followed course-specific Facebook pages (Staine, 2013), or posted at least once in a course- specific Facebook page (Rambe, 2014). The lowest levels of participation (13%) arose from a study where community college students were invited to use the Schools App, a free application that connects students to their university's private Facebook community. While the authors acknowledged that building an online community of college students is difficult (Gioli et al., 2015), downloading the Schools App may have been a deterrent to widespread participation. In addition, use of the app was not tied to any specific courses or assignments; therefore, students may have lacked adequate incentive to use it. The highest level of participation (89%) in the literature arose from a study in which the instructor created a Facebook page where students could find or post study tips or ask questions. Followership to the page was highest around exams, when students likely had stronger motivations to access study tips and ask the instructor questions (Kirwin, 2014). The wide range of participation in Facebook activities suggests that some students may be intrinsically motivated to participate, while other students may need some external encouragement. According to (Bahati, 2015) found that when students assumed that a course-specific Facebook was voluntary, only 28% participated, but when the instructor confirmed that the Facebook group was, in fact, mandatory, the level of participation rose to 95%.

Blogging

A blog is a collection of personal entries that are published online and presented chronologically, to which readers or subscribers may respond by providing additional commentary or feedback. In order to create a blog, one must compose content for an entry, which may include text, hyperlinks, graphics, audio, or video, publish the content online using a blogging application, and alert subscribers that new content is posted. Blogs may be informal and personal in na ture or may serve as formal commentary in a specific genre, such as in politics or education (Coghlan et al., 2014).

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Fortunately, many blog applications are free, and many learning management systems (LMSs) offer a blogging feature that is seamlessly integrated into the online classroom. The ease of blogging has attracted attention from educators, who currently use blogs as an instructional tool for the expression of ideas, opinions, and experiences and for promoting dialogue on a wide range of academic topics (Weng, 2008).

Studies on blogs show consistently positive findings for many of the behavioral and emotional engagement indicators. For example, students reported that blogs promoted interaction with others, through greater communication and information sharing with peers (Chua & Pikei, 2015) and analyses of blog posts show evidence of students elaborating on one another's ideas and sharing experiences and conceptions of course content (Tiejen, 2015). Blogs also contribute to emotional engagement by providing students with opportunities to express their feelings about learning and by encouraging positive attitudes about learning (Cheng and Chang, 2014). (Dir, 2013) found that students expressed prejudices and fears about specific course topics in their blog posts. In addition, Yang and (Chang, 2014) found that interactive blogging, where comment features were enabled, lead to more positive attitudes about course content and peers compared to solitary blogging, where comment features were disabled.

Web-conferencing

There are various studies on web-conferencing and behavioral engagement reveal mixed findings. For example, voluntary attendance in web-conferencing sessions ranged from 70 to 87% (Hoton, 2014) and, in a comparison between a blended course with regular web-conferencing sessions and a traditional, face-to-face course, researchers found no significant difference in student attendance in courses. However, students in the blended course reported higher levels of class participation compared to students in the face-to-face course (Lobter, 2013). These findings suggest while web-conferencing may not boost attendance, especially if voluntary, it may offer more opportunities for class participation, perhaps through the use of communication channels typically not available in a traditional, face-to-face course (e.g., instant messaging, anonymous polling). Studies on web-conferencing and interaction, another behavioral indicator, support this assertion. For example, researchers found that students use various features of web- conferencing software (e.g., polling, instant message, break-out rooms) to interact with peers and the instructor by asking questions, expressing opinions and ideas, sharing resources, and discussing academic content (Wowik, 2014).

Wikipedias

A wiki is a web page that can be edited by multiple users at once (Namaru, 2014). Wikis have gained popularity in educational settings as a viable tool for group projects where group members can work collaboratively to develop content (i.e., writings, hyperlinks, images, graphics, media) and keep track of revisions through an extensive versioning system (Rous, 2013). Most studies on wikis pertain to behavioral engagement, with far fewer studies on cognitive engagement and none on emotional engagement. Studies pertaining to behavioral engagement reveal mixed results, with some showing very little enduring participation in wikis beyond the first few weeks of the course (Sber, 2014) and another showing active participation, as seen in high numbers of posts and edits (Jimo, 2013). The most notable difference between these studies is the presence of grading, which may account for the inconsistencies in findings. For example, in studies where participation was low, wikis were ungraded, suggesting that students may need extra motivation and encouragement to use wikis (Slaber, 2014). Findings regarding the use of wikis for promoting interaction are also inconsistent. In some studies, students reported that wikis were useful for interaction, teamwork, collaboration, and group networking (Cacho, 2014).

Social networking sites

Social networking is the practice of expanding knowledge by making connections with individuals of similar interests (Guna, 2011). Social networking sites, such as Facebook, Twitter, Instagram, and LinkedIn, allow users to create and share digital content publicly or with others to whom they are connected and communicate privately through messaging features. Two of the most popular social networking sites in the educational literature are Facebook and Twitter (Rani, 2013), which is consistent with recent statistics suggesting that both sites also are exceedingly popular among the general population (Dugan, 2015). In the sections that follow, we examine how both Facebook and Twitter influence different types of student engagement.

Twitter

Twitter is a web-based service where subscribers can post short messages, called tweets, in real-time that are no longer than 139 characters in length. Tweets may contain hyperlinks to other websites, images, graphics, and/or videos and may be tagged by topic using the hashtag symbol before the designated label. Twitter subscribers may "follow" other users and gain access to their tweets and also may "retweet" messages that have already been posted (Tieran, 2014;). Instructors may use Twitter to post updates about the course, clarify expectations, direct students to additional learning materials, and encourage students to discuss course content (Witin, 2015). Several of the studies on the use of Twitter included broad, all-encompassing measures of student engagement and produced mixed findings. Some studies suggest that Twitter increases student engagement (Loke, 2011) while other studies suggest that Twitter has little to no

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influence on student engagement (Binba, 2014). In both studies suggesting little to no influence on student engagement, Twitter use was voluntary and in one of the studies faculty involvement in Twitter was low, which may account for the negative findings (MKay et al., 2014). Conversely, in the studies that show positive findings, Twitter use was mandatory and often directly integrated with required assignments (Yuno et al., 2011). Therefore, making Twitter use mandatory, increasing faculty involvement in Twitter, and integrating Twitter into assignments may help to increase student engagement.

Digital games

Digital games are applications using the characteristics of video and computer games to create engaging and immersive learning experiences for delivery of specified learning goals, outcomes and experiences (Freia, 2006). Digital games often serve the dual purpose of promoting the achievement of learning outcomes while making learning fun by providing simulations of real- world scenarios as well as role play, problem-solving, and drill and repeat activities (Whitton, 2011). In addition, gamified elements, such as digital badges and leaderboards, may be integrated into instruction to provide additional motivation for completing assigned readings and other learning activities (Chu, 2015). The pedagogical benefits of digital games are somewhat distinct from the other technologies addressed in this review, which are designed primarily for social interaction. While digital games may be played in teams or allow one player to compe te against another, the focus of their design often is on providing opportunities for students to interact with academic content in a virtual environment through decision-making, problem-solving, and reward mechanisms. For example, a digital game may require students to adopt a role as CEO in a computer-simulated business environment, make decisions about a series of organizational issues, and respond to the consequences of those decisions. In this example and others, digital games use adaptive learning principles, where the learning environment is re-configured or modified in response to the actions and needs of students (Bower, 2015). Most of the studies on digital games focused on cognitive and emotional indicators of student engagement, in contrast to the previous technologies addressed in this review which primarily focused on behavioral indicators of engagement.

Existing studies provide support for the influence of digital games on cognitive engagement, through achieving a greater understanding of course content and demonstrating higher-order thinking skills (Mario, 2015), particularly when compared to traditional instructional methods, such as giving lectures or assigning textbook readings (Erman, 2013). For example, in a study comparing courses that offered computer simulations of business challenges (e.g, implementing a new information technology system, managing a startup company, and managing a brand of medicine in a simulated market environment) and courses that did not, students in simulation-based courses reported higher levels of action-directed learning (i.e., connecting theory to practice in a business context) than students in traditional, non-simulation-based courses (Lu et al., 2014). Similarly, engineering students who participated in a car simulator game, which was designed to help students apply and reinforce the knowledge gained from lectures, demonstrated higher levels of critical thinking (i.e., analysis, evaluation) on a quiz than students who only attended lectures (Siddique et al., 2013).

DISCUSSION AND IMPLICATIONS

Student engagement is linked to a number of academic outcomes, such as retention, grade point average, and graduation rates (Carx et al., 2006; Center for Postsecondary). As a result, universities have shown a strong interest in how to increase student engagement, particularly given rising external pressures to progress learning outcomes and prepare students for academic success (Kuh, 2011). There are various models of student engagement that identify factors that influence student engagement (Lea, 2016); however, none include the overt role of technology despite the growing trend and student demands to integrate technology into the learning experience (Tera, 2015). Therefore, the primary purpose of our literature review was to explore whether technology influences student engagement. The secondary purpose was to address skepticism and uncertainty about pedagogical benefits of technology (Yeid, 2014) by reviewing the literature regarding the efficacy of specific technologies (i.e., web-conferencing software, blogs, wikis, social networking sites, and digital games) for promoting student engagement and offering recommendations for effective implementation, which are included at the end of this paper. In the sections that follow, we provide an overview of the findings, an explanation of existing methodological limitations and areas for future research, and a list of best practices for integrating the technologies we reviewed into the teaching and learning process.

SUMMARY OF FINDINGS

Findings from our evaluation provide preliminary support for including technology as a factor that influences student engagement in existing models (Table 1). One overarching theme is that most of the technologies we reviewed had a positive influence on multiple indicators of student engagement, which may lead to a larger return on investment in terms of learning outcomes. For example, digital games influence all three types of student engagement and six of the seven indicators we identified, surpassing the other technologies in this review. There were several key differences in the design and pedagogical use between digital games and other technologies that may explain these findings. First, digital games were designed to provide authentic learning contexts in which students could practice skills and apply

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learning (Siddi2013), which is consistent with experiential learning and adult learning theories. Experiential learning theory suggests that learning occurs through interaction with one's environment (Loeb, 2014) while adult learning theory suggests that adult learners want to be actively involved in the learning process and be able apply learning to real life situations and problems (Cerco, 2008).

METHODOLOGICAL LIMITATIONS

While there appears to be preliminary support for the use of many of the technologies to promote student engagement, there are significant methodological limitations in the literature and, as a result, findings should be interpreted with caution. First, many studies used small sample sizes and were limited to one course, one degree level, and one university. Therefore, generalizability is limited. Second, very few studies used experimental or quasi-experimental designs; therefore, very little evidence exists to substantiate a cause-and-effect relationship between technologies and student engagement indicators. In addition, in many studies that did use experimental or quasi-experimental designs, participants were not randomized; rather, participants who volunteered to use a specific technology were compared to those who chose not to use the technology. As a result, there is a possibility that fundamental differences between users and non-users could have affected the engagement results. Furthermore, many of the studies did not isolate specific technological features (e.g, using only the breakout rooms for group work in web-conferencing software, rather than using the chat feature, screen sharing, and breakout rooms for group work). Using multiple features at once could have conflated student engagement results. Third, many studies relied on one source to measure technological and engagement variables (single source bias), such as self-report data (i.e., reported usage of technology and perceptions of student engagement), which may have affected the validity of the results. Fourth, many studies were conducted during a very brief timeframe, such as one academic term. As a result, positive student engagement findings may be attributed to a "novelty effect" (Dichev, 2017) associated with using a new technology. Finally, many studies lack adequate details about learning activities, raising questions about whether poor instructional design may have adversely affected results. For example, an instructor may intend to elicit higher- order thinking from students, but if learning activity instructions are written using low-level verbs, such as identify, describe, and summarize, students will be less likely to engage in higher-order thinking.

RECOMMENDATIONS

Despite the existing gaps and mixed findings in the literature, we were able to compile a list of recommendations for when and how to use technology to increase the likelihood of promoting student engagement. What follows is not an exhaustive list; rather, it is a synthesis of both research findings and lessons learned from the studies we reviewed. There may be other recommendations to add to this list; however, our intent is to provide some useful information to help address barriers to technology integration among faculty who feel uncertain or unprepared to use technology (Hauptman, 2015).

CONCLUSION

In 1987, Steve Jobs predicted that computers and software would revolutionize the way we learn. Over 32 years later, his prediction has yet to be fully confirmed in the student engagement literature; however, our findings offer preliminary evidence that the potential is there. Of the technologies we reviewed, digital games, web-conferencing software, and Facebook had the most far-reaching effects across multiple types and indicators of student engagement, suggesting that technology should be considered a factor that influences student engagement in existing models. Findings regarding blogs, wikis, and Twitter, however, are less convincing, given a lack of studies in relation to engagement indicators or mixed findings. Significant methodological limitations may account for the wide range of findings in the literature. For example, small sample sizes, inconsistent measurement of variables, lack of comparison groups, and missing details about specific, pedagogical uses of technologies threaten the validity and reliability of findings. Therefore, more rigorous and robust research is needed to confirm and build upon limited but positive findings, clarify mixed findings, and address gaps particularly regarding how different technologies influence emotional and cognitive indicators of engagement.

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