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The Future of Technology in Education

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Higher education has faced many challenges in the early 2000s. Downturns in the national economy have often led to increased enrollments in higher education by people who lost their jobs and are looking to retrain for new careers (Carnevale, Jayasundera, & Cheah, 2012). However, the most recent downturn in the national economy saw with it a downturn in funding for higher education. Furthermore, college costs have outpaced inflation since the early 1980s (U.S. Bureau of Labor Statistics, 2010). The increased cost of attendance, especially at publicly funded institutions, has spurred increased scrutiny by politicians and society at large. These groups have called for greater accountability to show that higher education institutions are adding value to our students' lives.

The rise of for-profit institutions has intensified the call for accountability. Online-only programs and universities have seen sharp increases in enrollment. New models of course delivery, such as the MOOC (Massive Open Online Course), have grown in popularity. Sadly, many of these online service delivery models assume that *content delivery* is the key ingredient driving learning – that providing students with content knowledge is the sole requirement for improving educational outcomes. However, this is farthest from the truth. Student learning is not only measured in quiz scores but in domains that include psychosocial development, interpersonal skills, critical thinking, peer to peer learning, and learning how to be a lifelong learner. While new modes of online course delivery are growing in popularity, offline institutions have started to implement programs such as *flipped classrooms* in order to more fully engage students. In these classrooms, students use technologies like learning management systems to cover course material outside of class time and use class time to engage in active learning led by the instructor. Again, issues of accountability are in play for flipped classrooms have the potential to improve student retention and therefore to increase profits for educational institutions.

In their desire to provide the best learning experience for students, educators have also examined the viability of tablets to promote student learning. Many K-12 school districts have programs to provide iPads for students, identifying their ease of use and

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ability to help improve learning more so than laptops. However, laptops are different – they are a means of content production and used in just about every workplace setting in the industrialized world. They are the tools by which work happens and by which content is produced. Tablets, on the other hand, are unapologetically content consumption devices. That is, they are not designed to create content but to consume it. Unfortunately, while schools have done a great job providing tablets, they have done an unsatisfactory job integrating them into the curriculum and/or assessing the effectiveness of their integration. Rarely is professional development provided to ensure that teachers are using the tablets in meaningful ways. Even when professional development opportunities are provided, we have no way of knowing how best to train teachers to integrate tablets into the curriculum. This is because we have barely begun to scratch the surface of understanding how we can use new technologies to best support student learning, engagement, and motivation.

This chapter will review research on four technologies/processes that have popularly been thought to show great promise in helping support student learning: social media, MOOCs, flipped classrooms, and tablets. While other technologies and/or processes might have been included, these are the four that are most popular at the time of this writing. Educators are encouraged to maintain a critical eye on emerging technologies and evaluate their effectiveness. Of critical importance is the fact that technologies in and of themselves do not *magically* bring about learning; instead, how educators use those technologies matters a great deal in the outcomes achieved.

Social Media

While there are a number of popular social media sites and services among students, this section will focus solely on Facebook and Twitter because of the amount of research available on these two sites compared to other social media. Furthermore, Facebook and Twitter are the two most popular social media sites among college students as of this writing. It is worth pointing out that the social media landscape can and does change quite rapidly. MySpace was a perfect example – it was first an early competitor to Facebook and now is only used by 7% of teen social media users (Madden et al., 2013). While the sites and services will change and new ones will take their place as frontrunners on the social media scene, the educational processes examined in the following review can likely be applied to future technologies.

Facebook

Adoption and usage In a recent report by the Pew Internet & American Life Project, 94% of teens reported having a Facebook profile, with 81% using Facebook more than any other social networking site (Madden et al., 2013). Facebook is the most used social networking platform, with two-thirds of online adults claiming to be Facebook users, and women and younger adults (18–29) most likely to use the site (Duggan & Brenner, 2013). Women have more Facebook friends than men (Pempek, Yermolayeva, & Calvert, 2009), and are more likely to use the site for communication and relationship-building activities, to post photos and status updates, comment on content (Junco, 2013), and send private messages and friend requests (Muscanell & Guadagno, 2011). Latino students have been found to be less likely to use Facebook, while Asian

American students and students with college-educated parents were more likely to use Facebook (Hargittai, 2008). In addition, African American students have been found to be less likely to engage in social information-seeking activities such as checking up on friends and tagging photos, and students whose parents have lower levels of education are overall less likely to use Facebook for various activities (Junco, 2013).

Research on Facebook use has found that students use Facebook for around 30 minutes throughout the day and it is primarily used for social interaction with friends that the users had already established relationships with offline (Junco, 2013; Pempek et al., 2009). Almost 80% of students reported that none of their friendships on Facebook originated online, and few reported using Facebook to meet new people (9%) or find help with schoolwork (2%; Pempek et al., 2009). Selwyn (2009) found that university students used Facebook to reflect on their university experience, exchange information, and offer moral support, but only 4% of a total 68,169 wall postings were related to educational uses. Mazman and Usluel (2010) suggest that a user's perceived usefulness of Facebook is the most important factor in determining Facebook adoption, with ease of use, social influence, facilitating conditions, and community identity also being important factors in Facebook adoption processes.

Facebook as a learning management system Facebook has been used as a replacement or supplement to traditional learning management systems (LMSs) due to many LMSs lacking tools for social interactions and personal profile spaces found on Facebook (Mazman & Usluel, 2010). Schroeder and Greenbowe (2009) compared activity in Facebook groups to a learning management system (i.e., WebCT), using it as a tool for generating student discussion. The results showed that the number of discussion posts in the Facebook groups was nearly four times more than on the WebCT discussion forum. Those who posted on Facebook raised more intricate topics and generated more detailed responses using complex communication patterns. Despite being more active on Facebook, students listed Facebook as one of the aspects of the course that they liked the least, indicating a discomfort with using it for traditional courses (Schroeder & Greenbowe, 2009; Vincent & Weber, 2011). However, Irwin, Ball, Desbrow, and Leveritt (2012) report that students found Facebook to be an effective learning tool due to enhanced interaction between students and instructors, as the social networking properties of Facebook make interaction with the page easier. In addition, students were able to receive updates and information, respond to questions, and participate in discussions more efficiently.

Using a Facebook group in a Chinese language learning class, Ooi and Loh (2010) found that the Facebook group allowed students to share course resources, provide comments, and participate in organized learning activities through Facebook events. McCarthy (2010), who studied the Facebook group as a blended learning environment, found increased course engagement, using activity logs as an indicator. In addition, 95% of participants felt that using Facebook as a learning management system helped them develop peer relationships, with 92% appreciating the interactive design of the course (McCarthy, 2010). Wang, Woo, Quek, Yang, and Liu (2011) found the Facebook group could be used as a course management system, because it has all of the basic functions of an LMS such as making announcements, sharing resources, and facilitating online discussion and weekly activities. In addition, they argued that the Facebook group can be used as a substitute or supplement to traditional LMSs, and can even be a fully functioning LMS in schools where LMSs cannot be afforded

(Wang et al., 2011). Wang, Scown, Urquhart, and Hardman (2014) also found that students were positive about using Facebook over traditional learning management systems, because it served as a useful platform for sharing information and ideas and to monitor and coordinate collaborative work. In a comparison of Facebook to Blackboard, Buzzetto-More (2012) found both systems to be rated equally when it came to hosting study sessions, supporting group projects, and providing answers to questions. Although Blackboard was considered to be better than Facebook for course announcements and providing links to course resources, learners thought Facebook was overwhelmingly better for socialization and strengthening interpersonal relationships, which is important for student persistence (Buzzetto-More, 2012). DiVall and Kirwin (2012) also found students to be more likely to be exposed to content when it is posted on Facebook instead of Blackboard. Lim and Ismail (2010) suggest that Facebook be used as an alternative to traditional learning systems for meaningful online academic discussions, but the quality of the outcome depends on the facilitator/instructor, the topic of discussion, and the timing and order of the posts (Lim & Ismail, 2010).

Facebook as a learning tool Various researchers have explored students' usage and perception of Facebook (Ismail, 2010; Madge, Meek, Wellens, & Hooley, 2009; Ophus & Abbitt, 2009) as well as specific uses of Facebook in the classroom (Bosch, 2009; Irwin et al., 2012; Smith, 2011). In a survey of student Facebook use, Ophus and Abbitt (2009) found students to be largely supportive of using Facebook in their college courses. Communication with other students and family were among the most common activities, followed by accessing notes and course materials, and viewing the schedule. Most students indicated that they had never used Facebook to communicate with their instructor or for school tasks (Ophus & Abbitt, 2009). In a study of university students, Madge et al. (2009) reported that a majority of students used Facebook for primarily social purposes, with few students using it to discuss academic work (10%) or contact academic staff (<1%). Ismail (2010) found that students are likely to use a social networking site (SNS) if their friends do the same and that the technological support provided by the institution affects their intention more than their personal use does.

Bosch (2009) found that students used Facebook for finding learning materials, helping friends answer questions about course and assignment details, sharing information about projects, lectures, and study notes, and to communicate with the professor. In Bosch's (2009) study, one lecturer used Facebook as a convenient way of communicating information to students, while another lecturer felt that Facebook helped students overcome shyness and ask questions that they might otherwise feel uncomfortable asking in class (Bosch, 2009). In a study that used the Facebook Application Programming Interface (API) as an instructional tool to teach web programming, Smith (2011) found that Facebook gave students the ability to engage with a wider audience, allowing them to easily benefit from peer feedback and develop and refine their programming skills. In a study of the use of Facebook pages within university courses, Irwin et al. (2012) found that students initially felt that Facebook could be an effective learning tool, and believed increased interaction, participation in course discussion, and posted lecture notes and assessments to be the anticipated benefits of using Facebook within a course. However, post-course surveys showed that only half of the students felt that Facebook helped them learn course

concepts, a perception resulting from the instructors' inconsistent course integration (Irwin et al., 2012).

Additional research has shown that Facebook has been proven to be an effective means of providing its users with external resources (Bahner et al., 2012; Pilgrim & Bledsoe, 2011), discussion and collaborative learning (Estus, 2010; McCarthy, 2010; Shih, 2011), and informal learning (Cain & Policastri, 2011; Robelia, Greenhow, & Burton, 2011). Pilgrim and Bledsoe (2011) also found that pre-service teachers used Facebook as a learning tool to gain knowledge about professional organizations and resources through social networks. In a study that used Facebook and Twitter to deliver curriculum to medical students, Bahner et al. (2012) found the social media platforms to effectively deliver descriptive educational content to students using "push technology."

In a study that used a Facebook group as a discussion tool, Estus (2010) found that students felt using Facebook for discussion was a valuable part of the course, because it encouraged healthy classroom discussion. Students supported its continued use in the course as well as the integration of additional Facebook capabilities when expanding into future course offerings (Estus, 2010). McCarthy (2010) found that Facebook acted as a space to mediate interaction between local and international students, increasing interactions by suppressing social inhibitions as well as intercultural and language barriers. Students reported improved academic relationships through rewarding academic discussions and increased interaction with the peer group (McCarthy, 2010). Shih (2011) examined the effect of integrating Facebook and peer assessment using a blended teaching approach. The findings suggest that incorporating Facebook and peer assessment in learning English writing can enhance knowledge construction and engagement and be effective when combined with collaborative learning (Shih, 2011).

In a study that sought to understand how Facebook could be used to support informal learning about environmental issues, Robelia et al. (2011) found that students who used the Facebook application "Hot Dish" increased their understanding of environmental issues. Participation on the site encouraged environmentally friendly behavior, and pushed participants to learn more about environmental issues through social and civic engagement (Robelia et al., 2011). Cain and Policastri (2011) studied the effectiveness of using Facebook as an informal learning tool, using a Facebook group to introduce students to issues outside of the course curriculum. Most students appreciated the lack of interaction requirements, making the use of Facebook as an informal learning environment a success (Cain & Policastri, 2011).

Facebook, student engagement, and grades Positive correlations between Facebook use and college student engagement have been found, as students who spend more time on Facebook spend more time socializing with friends and engaging with student groups at their university (Heiberger & Harper, 2008). Contrary to the Higher Education Research Institute (2007) and Heiberger and Harper (2008), Junco (2012b) found time spent on Facebook to be negatively related to student engagement (as measured by an instrument based on the National Survey of Student Engagement), but commenting on content and creating or RSVPing to events was found to be stronger, a positive predictor of engagement score. Additional research has shown that using Facebook to check up on friends is positively related to building the social ties needed to maintain relationships as well as GPA, but this activity is

negatively related to student engagement (Ellison, Steinfield, & Lampe, 2007, 2011; Junco, 2012a, 2012b).

Research on the impact of Facebook on academic outcomes has shown mixed results (Junco, 2012a; Kirschner & Karpinski, 2010; Kolek & Saunders, 2008; Pasek, More, & Hargittai, 2009). In a representative sample of college students, Kolek and Saunders (2008) found no correlation between Facebook use and GPA between users and non-users of Facebook. Using existing data sets, Pasek et al. (2009) also found mixed results on the relationship between Facebook and academic performance, finding no relationship between Facebook use and grades. Kirschner and Karpinski (2010) found a negative relationship between Facebook use and GPA, as Facebook users reported a lower average GPA than non-users. Junco (2012a) found that Facebook activities related to collecting and sharing information (checking up on friends and sharing links) are positively predictive of GPA, while social Facebook activities (status updates and chatting) are negatively predictive of GPA.

Twitter

Adoption and usage Twitter, a microblogging tool and social networking site, is used for information sharing, information seeking, and interpersonal relationships, and offers a faster mode of communication, with the average blogger updating every few days to several times a day (Java, Song, Finin, & Tseng, 2007). Over the past few years, Twitter use has grown significantly, with currently 16% of adult Internet users on Twitter and 24% of online teens using the site. Younger adults (18–29), urban dwellers (Madden et al., 2013), and African Americans (Duggan & Brenner, 2013; Hargittai & Litt, 2011) are among the most likely to use Twitter.

Twitter as a learning tool Various researchers have studied the effectiveness of Twitter as an instructional tool in the classroom (Al-Khalifa, 2008; Borau, Ullrich, Feng, & Shen, 2009; Clarke & Nelson, 2012; List & Bryant, 2009; Retelny, Birnholtz, & Hancock, 2012). Al-Khalifa (2008) sent course announcements using a third-party service called Twitterfeed to convert the RSS feed from the course blog into Twitter updates. He found that most of the students (93%) preferred receiving Twitter text announcements to visiting the course blog, and said they would subscribe to Twitter if offered in future courses (Al-Khalifa, 2008). Borau et al. (2009) used Twitter as a communication and cultural competence training tool in a blended English as a foreign language course. The authors found that 70% of the students felt that Twitter was effective in developing their English skills when used as a supplementary practice tool (Borau et al., 2009). List and Bryant (2009) also found Twitter to be an effective facilitator for student learning, because it allows for effective communication with other students and staff and access to archival logs to reference prior discussions regarding topics of interest. Retelny et al. (2012) used a Twitter page to involve students in the development of course materials, making lectures more relevant to students and improving student preparation and motivation. He found that a majority of his students felt the Tweets helped them grasp course concepts and would recommend the use of Twitter in the future (Retelny et al., 2012). In a study of Twitter use across two courses, Clarke and Nelson (2012) found that the course with heavier Twitter usage had a higher sense of classroom community and perception of course

effectiveness, with pedagogical effectiveness rated more favorably among the course that used Twitter. Although there were not significant group differences in perceived learning, the course that used Twitter outperformed the other course in regards to measures of actual learning, such as final course grade and scores from a departmental learning assessment test (Clarke & Nelson, 2012).

Research has also shown that Twitter has a positive impact on student learning (Dunlap & Lowenthal, 2009; Kassens-Noor, 2012) and supports informal learning (Ebner, Lienhardt, Rohs, & Meyer, 2010). Dunlap and Lowenthal (2009) used Twitter as a course management system (CMS) to encourage an interactive social learning community. Learning management systems (LMSs) and CMSs both have online discussion boards, support for quizzes, course materials, and gradebooks; however, LMSs tend to be more comprehensive, allowing for administrative functions like enrollment-related tasks. The researchers suggest that the advantages of Twitter over a traditional CMS is that Twitter use addressed issues quickly, encouraged concise writing and writing to an audience, connected students to a professional community of practice, and supported informal learning (Dunlap & Lowenthal, 2009). Kassens-Noor (2012) divided a classroom into two groups: one group used Twitter for communication and information exchange and the other group kept a personal diary to discuss with group members at the end of the course. Kassens-Noor (2012) found that students using Twitter reported a higher level of team-created activities than the traditional group, because tweeting fosters team communication and continuous interactive engagement in the learning process. Twitter has also been found to support informal and collaborative learning, by facilitating a constant information flow between students and teachers. The transparent working process afforded by Twitter allows the teacher to intervene and guide student learning (Ebner et al., 2010).

Ally (2012) found increased levels of classroom participation, attentiveness, and engagement from students when using Twitter in the classroom, and a majority of the students were supportive of its use. In a study of Twitter usage across two groups, Junco, Heiberger, and Loken (2011) found that the GPAs of the group that used Twitter were significantly higher than the non-users. The authors found that Twitter use led to more frequent interaction and engagement, which in turn may have helped increase GPA. Twitter helped students build connections more quickly than classroom discussions, and improved instructor–student communication by providing a platform to ask probing questions (Junco et al., 2011). In a later study, Junco, Elavsky, and Heiberger (2012) found an increase in student engagement and grades in courses in which Twitter use was required compared to courses in which it was optional. This result shows that the way instructors integrate Twitter into the course is an important factor in the engagement and achievement gains received from Twitter (Junco et al., 2012).

Massive Open Online Courses (MOOCs)

What are MOOCs? "MOOCs," which stands for "Massive Open Online Courses," is a term coined by George Siemens and Stephen Downes in 2008, and an emerging method of online teaching (Fini, 2009). A MOOC is a large online course, consisting of several hundred to several thousand students, which offers open and often free registration, a publicly accessible online curriculum and resources, and social network integration. MOOCs are often facilitated by leading educators in the field of study,

and have been offered both in conjunction with academic institutions and with independent providers (McAuley, Stewart, Siemens, & Cormier, 2010).

There are two pedagogically distinct types of MOOCs: *connectivist* MOOCs (cMOOCs) based on the connectivist theory of learning with informal networks (Siemens, 2005); and *content-based* MOOCs (xMOOCs), which follow more instructional and assessment-based teaching methods (Yuan & Powell, 2013). According to Siemens (2012), the cMOOC model "emphasizes creation, creativity, autonomy and social networking learning" while the xMOOC model "emphasizes a more traditional learning approach through video presentations and short quizzes and testing," suggesting that cMOOCs emphasize knowledge creation while xMOOCs focus on knowledge duplication. The major non-profit MOOC-style initiatives (e.g., edX, PSPU, and Coursera) have given learners from across the globe the opportunity to access learning materials for free, and commercial companies have also been set up to help universities offer for-profit xMOOCs (e.g., Coursera, Udacity, and Udemy) (Yuan & Powell, 2013).

Case studies of MOOCs Research has been done on the effectiveness of the following cMOOCs: Connectivism and Connective Knowledge (CCK08) (Bell, 2010; Fini, 2009; Mackness, Mak, & Williams, 2010) and Personal Learning Environments Networks Knowledge (PLENK2010) (Kop, 2011; Stewart, 2010). Fini (2009) found that participants in CCK08 were able to participate in the course according to their own learning styles, goals, and availability, and use only the tools they felt were relevant to the course. In another study of CCK08, Mackness et al. (2010) suggest that CCK08 can support the connectivist principles of diversity, autonomy, openness, and emergent knowledge, but they need to be managed in order to avoid barriers to learning. Bell (2010) found that participants of CCK08 exhibited a high level of agency in connecting themselves, their work, and resources using the platform, and the high number of CCK08 participants and participant interactions suggests increased connections among students.

In a survey of the experiences of PLENK2010 participants, Stewart (2010) found that prior engagement with social media did not determine the MOOC participants' perception of course value (Stewart, 2010). Kop (2011) found that participants of PLENK2010 interacted with each other, gathered information and resources, and shared resources, but only a minority of students participated in the creation and distribution of content such as blog and video posts. Kop and Fournier (2010) also found that silent participants, "lurkers," did not produce course content, but participated in other course activities such as collecting and sharing information with others. Participants with previous MOOC experience more actively engaged in the course, and time management, goal setting, and time availability were the most important factors in influencing participation (Kop & Fournier, 2010). Kop, Fournier, and Mak (2011) also found that participants who were more confident with the MOOC technology were more likely to create content and learning networks, while MOOC novices were more likely to be consumers of the material. On a similar note, Kop and Carroll (2012) found that for some participants creating content and participating in discussion is not necessary to advance learning, while the creation of discussion among other participants inspired and motivated others to create their own original content.

Other studies of MOOCs include Future of Learning (Bremer, 2012) and MobiMOOC (DeWaard et al., 2011). In a study of the open course Future of

Learning, Bremer (2012) concluded that open online courses are appropriate for learners who are intrinsically motivated, well organized, and possess a certain level of digital literacy to be able to fully participate. In an analysis of MobiMOOC, a course that integrates mobile learning into a MOOC platform, DeWaard et al. (2011) found that 77.5% of the participants used mobile devices to access the course, suggesting the potential for mobile learning MOOCs in increasing and widening participation.

Flipped Classrooms

What are flipped classrooms? A "flipped classroom" is a pedagogical method that shifts learning outside of the classroom, and replaces the standard in-class lecture by providing students with the opportunity to review lecture materials outside of class in their own individual learning space, and then review and discuss course materials with the instructor in class (Hughes, 2012). Instructors use various technologies to create readily available course content for students to access whenever and wherever it is convenient, enabling them to come to class more prepared (Musallam, 2011). In a flipped classroom, students come to class prepared to engage with the instructor in guided learning activities such as question-and-answer sessions and problem-based small group activities. Flipping a classroom can serve as an effective way for instructors to add active learning to their classroom, and gives educators more time to integrate and apply student knowledge as well as gauge student understanding of course concepts (Hamdan, McKnight, McKnight, & Arfstrom, 2013).

Case studies of flipped classrooms Research has shown that flipped classrooms can help students learn more effectively than traditional class structures in both K-12 (Bergmann & Sams, 2012; Fulton, 2012; Green, 2012; Ruddick, 2012) and higher education (Moravec, Williams, Aguilar-Roca, & O'Dowd, 2010; Papadopoulos, Santiago-Roman, & Portela, 2010; Talbert, 2012; Warter-Perez & Dong, 2012; Zappe, Leicht, Messner, Litzinger, & Lee, 2009). Byron High School in Minnesota adopted the flipped learning model using open source materials to improve student math scores and replace outdated textbooks during a financial crisis. As a result, student engagement increased, state math test scores leaped from one-third of students passing three years earlier to nearly three-quarters, and ACT scores improved from 21.2 to 24.5 (Fulton, 2012). Students at Woodland Park High School in rural Colorado were missing too many classes, having to leave school early for extracurricular activities. In an attempt to solve this problem, Bergmann and Sams (2012) flipped their chemistry classrooms, recording and posting lectures so that absent students could have access to course materials. As a result, student peer interactions increased, and struggling students received the assistance they needed to better understand course concepts (Bergmann & Sams, 2012). After Detroit's Clintondale High School introduced flipped learning into all freshman classes, the school's failure rates dropped by as much as 33%. In addition, the number of student discipline cases dropped 74% in two years, from 736 in 2009 to 187 in 2011, and parent complaints from 200 to 7 (Green, 2012). In a study of college preparatory courses, Ruddick (2012) found that students in the flipped course had higher final exam scores than students in the lecture-based course, and students reported that the online resources were useful and helped them become more interested and less

intimidated by chemistry. On the contrary, when comparing a flipped to a traditional class in a Kentucky high school, Johnson and Renner (2012) found no significant differences between the test scores of those who were in the flipped classroom and those who were not. The authors suggest, however, that the lack of benefits found in the flipped method of classroom instruction can be explained by the fact that the flipped classroom model was implemented without any perceived need for the intervention (Johnson & Renner, 2012).

In a flipped undergraduate architectural engineering course, Zappe et al. (2009) found that students felt the flipped classroom had a positive impact on student learning, thought it was a more effective method of teaching than lecturing, and benefited from having access to lecture videos outside of class. In a study of a flipped electrical engineering class at the University of Puerto Rico, Mayagüez, Papadopoulos and Roman (2010) found that students progressed through material faster and had a deeper understanding of course topics when they watched lectures on their own and worked on exercises and problems during class time. Additionally, three-quarters of students "frequently" or "always" helped their peers in class, 81% preferred the flipped class to the traditional format, and test scores in the flipped classroom exceeded those in the traditional classroom (Papadopoulos et al., 2010). When a traditional large-lecture introductory biology class was flipped at the University of California at Irvine, Moravec et al. (2010) found that students in the flipped classroom saw an increase of 21% on exam questions that were covered in pre-recorded videos and watched outside of class and then followed up with in-class exercises. In a digital engineering course at California State University, Los Angeles, Warter-Perez and Dong (2012) found that flipping the classroom was effective in helping students deepen their understanding of course materials and improving design skills. In a linear algebra class at Franklin College in Indiana, students were given the option of attending a traditional lecture or watching a pre-recorded lecture, then participating in group work during class. Talbert (2012) found that students exposed to the flipped class environment performed better on the exam than students in the traditional lecture setting.

Other research has shown that flipped classrooms provide a space for collaborative learning, despite dissatisfaction with the way the learning objectives were set up (Frederickson, Reed, & Clifford, 2005; Strayer, 2012). In an experiment at University College London, Frederickson et al. (2005) found that compared to students in traditional classrooms, students in the flipped classroom conditions were more aware of their own learning process, and recommended that students be given adequate space to reflect on course activities to make connections to the content. However, students in the flipped classrooms were less satisfied with the quality of instruction they received online, but were more satisfied with the opportunity to collaborate with peers that was stimulated by this learning environment. In addition, no significant difference in improvements in knowledge and levels of anxiety was found between the two versions of the course (Frederickson et al., 2005). Likewise, Strayer (2012) found that when comparing students in a flipped introductory statistics course to a traditional statistics course, students in the flipped course reported being less satisfied with the way the classroom structure prepared them for the learning tasks they were given in the course, but were open to cooperative learning and innovative teaching methods.

Tablets

Adoption and usage Tablets have emerged as a new category of mobile device that blend the features of laptops and smartphones and have the ability to be personalized with thousands of applications (Johnson et al., 2013). The larger screen and gesture-based interface of tablets make them ideal tools for consuming and sharing content due to their ease of use and portability (Johnson, Adams, & Cummins, 2012). Among Americans over the age of 16, 43% own a tablet or an e-reading device, with higher ownership rates among those highly educated and upper-income households (Rainie & Smith, 2013). The popularity and portability of tablets have caused them to capture the attention of educators around the world, as mobile learning affords the opportunity to access information and knowledge and support learning anytime, anywhere (Traxler, 2007). The idea behind mobile learning is based on a social constructivist concept of learning that relies on the exchange and sharing of knowledge in social contexts (Bremer, 2012), and includes the process of knowledge acquisition "through continuous conversations and explorations across multiple contexts amongst people and interactive technologies" (Sharples, Taylor, & Vavoula, 2007, p. 244).

Tablets as a learning tool In exploring the potential of tablets as a learning tool, many researchers have examined the attitudes and perceptions of students and faculty toward adopting tablet PCs in the classroom (El-Gayar, Moran, & Hawkes, 2011; Ifenthaler & Schweinbenz, 2013; Rossing, Miller, Cecil, & Stamper, 2012; Weitz, Wachsmuth, & Mirliss, 2006). In a study of the usefulness of tablets among faculty at Seton Hall University, Weitz et al. (2006) found that faculty were confident about the impact of tablets on learning but only a few were motivated to use them. More than 80% of faculty who used tablets in at least one of their courses would prefer to keep their tablet instead of going back to a standard laptop, and felt that the university should keep providing faculty with the option to use tablets in their courses. In addition, 90% of faculty felt that the tablet had positive value with regard to teaching and learning in their course (Weitz et al., 2006). When exploring the perception of learning and engagement from iPad use in graduate classrooms at Indiana University–Purdue University Indianapolis (IUPUI), Rossing et al. (2012) found that iPads provided easy access to information that encouraged students to apply course concepts to the real world as well as participate in collaborative learning and group work, improving the quality of class discussions. Students were also enthusiastic about using the iPad as a learning tool in a dynamic learning environment and felt that use of the tablet helped reinforce the concepts students learned in class and was particularly valuable for those who learned at a different pace. Features such as speed, portability, user-friendly interfaces, and comfortable design contributed to the iPad's convenience, and the visual learning opportunities afforded by the tablet were found to be useful in connected course content (Rossing et al., 2012). In a study of a tablet PC computing initiative at a Midwest university, El-Gayar et al. (2011) found that students' attitudes toward using tablets had the most direct influence on technology acceptance, followed by the availability and access to support mechanisms, the expected gain in school performance, and the social influence of peers and faculty. El-Gayar et al. (2011) suggest that instructors ensure that students continue to view tablets as easy to use, an important factor in influencing student intention to use technology, through continuous support and training throughout

the year. In a contradictory study of middle school teachers' perceptions of tablet use in the classroom, Ifenthaler and Schweinbenz (2013) found that only a few respondents believed that tablets can improve learning outcomes, and most were unsure of specific ways that the technology could be used to facilitate learning and instruction. Even those with positive attitudes toward tablets had reservations about tablet use, but the respondents' negative attitudes were possibly influenced by other factors. Overall, all teachers expressed the need for a smoothly running technology infrastructure as a prerequisite for tablet use and when using it in the classroom (Ifenthaler & Schweinbenz, 2013).

Research has also studied the effectiveness of tablets as an instructional tool and learning aid in both K-12 and university settings (Enriquez, 2010; Galligan, Loch, McDonald, & Taylor, 2010; Keller, 2011; Kerawalla et al., 2007). Kerawalla et al. (2007) studied the effectiveness of teaching numeracy in elementary classrooms using a homework system on tablet PCs. The results showed that the homework system helped students better understand the learning materials, and got parents more engaged in their children's learning. The children were more enthusiastic, confident, and began to connect numeracy activities at school with activities at home. Tablets helped make schoolwork less of a chore and more of a seamless and transparent learning experience (Kerawalla et al., 2007). In a study of the usability and functionality of tablets in distance education mathematics courses at the University of Southern Queensland, Galligan et al. (2010) studied the effectiveness of tablets in teaching face-to-face and distance lectures, tutorials, and consultations. Using tablets in large lecture courses provided the ability for real-time modeling of math problems as a teaching tool, and gave the students opportunities for self-directed learning. Tablets used in smaller tutorial sessions personalize learning for each student, and can be used to provide timely feedback for both distance and face-to-face students. An advantage of using tablets in one-on-one consultations with students is that the session can be recorded and reused by the student for later reflection and/or use by other students as a reference (Galligan et al., 2010). In two case studies that used tablets and wireless technology to create interactive learning networks, Enriquez (2010) found that students in the courses with the tablets had higher attendance rates and spent more time on assignments outside of class, and performed better overall than students in traditional classes. The students reported that using tablets during lectures improved their ability to take notes, organize class materials, and integrate handwritten notes into course materials (Enriquez, 2010). Keller (2011) reported on pilot trials at Seton Hill University that integrated the iPad into classroom instruction as an e-textbook. The textbook software, Inkling, gave students the ability to add notes to the text as they read and comprehended the materials. Instructors can access these notes to gauge students' understanding of the readings, and correct a student's misunderstanding of a concept while remotely receiving and answering questions in real time (Keller, 2011).

Conclusion

Research has shown various affordances of using emerging technologies and processes to support learning. It is perhaps no surprise that technologies developed to help support social interactions (such as Facebook and Twitter) have been found to

promote social interactions among students. Research showed that students felt positively about using social media in their courses, allowing instructors to *meet them where they are* and support their engagement in the learning process. Most students are familiar with social media and do not require the same kind of steep learning curve required by other types of learning management systems. Additionally, since these platforms are an engaging part of their digital worlds, there might be some intrinsic motivation that transfers when they are used in educational settings. While social media can easily facilitate student engagement, MOOCs, on the other hand, require experience with online learning models and a higher level of student motivation in order for them to be effective in supporting student learning. Perhaps along similar lines, the research on tablets shows that they are unlikely to be used in ways that improve learning outcomes and their use tends to be focused squarely on content delivery. This is in stark contrast to flipped classrooms, which tend to provide rich engaging experiences for students.

The research on flipped classrooms shows that they are effective ways to add active learning to classrooms. Students saw increased engagement, improvement in a wide range of educational outcomes (e.g., standardized test scores, pass rates, and disciplinary referrals). However, it seems that for some disciplines, flipped classrooms may not be an effective intervention. Of the technologies/processes discussed, it is no surprise that flipped classrooms seem to support the greatest amount and types of learning outcomes – this method was created to help support active learning and student engagement, both of which are directly related to student success. Extrapolating the flipped classroom movement, we can imagine that the classroom of the future will look like an engaging social space, bringing forth vigorous conversation and debate while using technologies to help students collaborate, communicate, and build a sense of classroom community.

There are two major themes that are highlighted in this review:

1 The affordances of the technologies matter in terms of outcomes. Those technologies that are aligned with course goals and used in ways that support them tend to see more beneficial outcomes. For instance, Facebook seems to be an effective replacement for a learning management system discussion board.
2 *How* the technologies are used makes a difference when evaluating educational outcomes. Using a tablet as a content consumption device, for instance, does nothing to promote critical thinking skills. Conversely, using Twitter to engage students in class discussions promotes offline discussions.

Educators are encouraged to think critically about new technologies that are promoted to support learning. As new technologies are adopted, it is essential for educators both to understand how they can be used to support learning based on learning theories and to collect data to evaluate their effectiveness. We have much more to learn about how these and future technologies will affect student learning. While some research is cited in this review, important questions remain about causal links between technology usage and particular outcomes. For instance, how do we know that social media themselves provided the catalyst for improved student engagement? Perhaps the increased engagement had much to do with the faculty member using the technology. Junco (2014) discusses how some faculty, by the nature of their personality style, are more likely to be engaging in the classroom and more likely to use technology in

engaging ways. Therefore, we need to conduct research to answer these questions and to discover how much of the variance in outcomes is due to the technology, how much is due to how it is used, and how much is due to the educators using them.

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