International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 21, Number 4

November – 2020

Faculty and Student Technology Use to Enhance Student Learning

Margaret L. Gaddis
University of Colorado, USA

Abstract

Scholarly research has indicated that technology adoption to facilitate blended learning promotes the academic success of many different types of students and improves the quality of existing educational offerings. To understand how technology enhances learning, surveys queried the faculty and students of a statewide community college system. The results indicated widespread technology use among the faculty and students. The faculty survey revealed details of technology tools employed and the motivations for their use or discontinued use. Details regarding faculty use of learning management systems, textbooks, and other media characterized the current technology adoption climate. The student survey collected information about students' perceptions of how technology influenced their learning, their preferences for specific technology tools, and their student progress. Ninety-three percent of student respondents indicated that technology enhanced their learning. Alignment between the faculty use and student preference for technology tools suggested that students are actively engaged in the technology resources used by faculty to enhance learning. Students described how technology facilitated multimodal learning. They also noted that technology increased communication, access, and inclusion in learning. Successful technology use and integration, accompanied by ongoing scholarly debate and monitoring, has the potential to provide more access, promote learning outcomes, and preserve the investment of technology for the institution. The surveys employed here, when used semi-annually, may provide a low-cost model for technology integration monitoring and evaluation. The responses to the surveys also have the potential to provide technology use and integration data that informs strategic planning processes and institutional learning outcome development.

Keywords: educational technology, higher education, blended learning, technology integration

Introduction

Scholarly research has indicated that technology adoption promotes the academic success of diverse students and improves the quality of existing educational offerings (Allen & Seaman, 2013; Courts & Tucker, 2012; Lewis, Fretwell, Ryan, & Parham, 2013; Lertwanasiriwan, 2010; Simkins, 2002; Zucker & Light, 2009). Technology facilitates a blended learning environment in which teaching presence, as well as social and cognitive development, are enhanced (Garrison, 2017). However, technology integration requires appropriate faculty support and institutional support to promote learning gains (Mbati & Minnaar, 2015; Quillerou, 2011). The long-term goal of this research project is to enhance educational technology integration to increase student learning within their disciplines, and for both faculty and students to increase technology literacy skills required for success in the 21st century workplace. The general problem is that the acquisition of institutional technology is an administrative process, but the implementation of technology is a process that unfolds in variable classroom environments. As a faculty, we rarely hear why or how the technology adopted is chosen, even though we live the outcomes. The specific problem is the absence of monitoring protocols to track technology integration by faculty and subsequent learning outcomes for students.

The goal of this observational research was to provide a picture of how students and faculty interact with the technology available. Since there was no coordinated effort for technology integration and monitoring across the campuses of this rural community college, the complementary surveys released to the faculty and students collected technical and perceptive data about how the technology tools were employed to enhance learning. No student learning assessments accompanied the survey data collection, and no experimental conditions were established before data collection. The qualitative data collected here explored the enhancement of learning with technology use. Quillerou (2011) used similar methods to investigate whether students used the technology tools available in their learning environments.

Learning is the acquisition of knowledge. In the context of this study, if faculty or students perceived that a technology tool enhanced learning, the perception was interpreted as a positive indication of learning. Lancaster and Lundberg (2019) employed similar student-identified learning gain metrics to explore correlations between faculty behavior and student learning gains. From a theoretical perspective, the willingness of adult learners to use technology must be self-motivated for practical reasons. According to theories of andragogy, both self-motivation and the practicality of the subject matter and its real-world context are important parameters for adult learning (Knowles, Holton, & Swanson, 2011; Merrill, 2002). Therefore, students' perceptions of how technology enhances their own learning is a valid data point in the monitoring of technology integration in the learning environment.

The survey results presented here describe the technology adoption climate among the faculty and students of a multi-district, rural community college. These results describe the parameters of technology use at the college. The results also described student perceptions of the value of this technology adoption to their learning experience. Administrators may use these results to characterize the current use value of technology the organization already supports. These results may also provide insight regarding professional development opportunities for faculty to promote increased use of educational technologies, with the goal of technology integration over time. Finally, these results may identify gaps between student perceptions of and faculty preferences for educational technology use.

Use of Technology for Learning

The goal of education technology use is to enhance learning. Scholars have described a number of productive educational advancements facilitated by technology adoption and blended learning (Garrison, 2017; Laurillard, 2013). Educational technology facilitates learning by enriching the course content with multimodal resources that provide opportunities for students to engage with the course content in different ways (Laurillard, 2013; Simkins, 2002). Mathematics education has seen a productive shift from didactic instruction to student-centered, constructivist approaches (Abdulwahed, Jaworski, & Crawford, 2012) and computer-assisted instruction (Potocka, 2010). Technology has transformed language learning by allowing for programmed instruction and self-paced learning (Butler-Pascoe, 2011). Participants have gained knowledge from online self-learning modules (Crall et al., 2010; Gagnon et al., 2015). Instructional video training for pediatric health care professionals (Cheng, Lang, Starr, Pusic, & Cook, 2014) and nurses (Serna et al., 2016), as well as citizen scientists (Crall et al., 2010; Gaddis, 2018) have increased their knowledge and procedural performance. Participants have been more ready to engage in self-directed learning after an online training experience (Gagnon et al., 2015). For students who are working adults, parents, and for those who have encountered other barriers that prevented traditional school attendance, asynchronous instruction has increased access, allowing for a more flexible learning schedule (Johnson, Becker, Estrada, & Freeman, 2014; Yamagata-Lynch, 2014).

Technology Adoption Versus Technology Integration

The use of technology in numerous educational settings is well-documented, but technology adoption and technology integration are not the same phenomenon. Technology adoption concerns the application and ease of technology use, while technology integration concerns the fundamental integration of technology into the organization's educational philosophy, planning, and implementation (Keengwe, Onchwari, & Onchwari, 2009; Mbati & Minnaar, 2015; Russell, 2014). A precursor to technology integration is the holistic acceptance of technology use as both an educational tool and a learning outcome (Courts & Tucker, 2012). Technology adoption and integration are challenging concepts for some educators because they imply that the traditional educational framework is no longer the only effective means to educate students (Johnson, Wisniewski, Kuhlemeyer, Isaacs, & Kryzkowski, 2012).

Faculty may be encouraged to use technology in the classroom, but an administration's failure to explain the educational benefits of its use leaves faculty without solid evidence for its efficacy. Professional development may remedy this outcome by building a learning community among the faculty in which they can share best practices and experiences (Johnson et al., 2012). The technological competencies of faculty remains a consistent scholarly inquiry since the generational constellation of students and faculty is an ever-changing phenomenon (Ajjan & Hartshorne, 2008; Allen, Seaman, Poulin, & Straut, 2016; Moule, Ward, & Lockyer, 2011; Roney, Westrick, Acri, Aronson, & Rebeschi, 2017).

When technology integration is achieved, it expands the technological knowledge of the faculty and students together, thereby strengthening the 21st century skills of both groups. The research described here provides a snapshot of technology adoption by faculty and students, upon which technology integration efforts can grow. Studies exist that assess various characteristics of the technology users and their self-efficacy (Roney et al., 2017). The goal of this investigation was to instill a spirit of monitoring and self-assessment to the

technology integration process itself by keeping a pulse on the perceptions and practices of faculty and students regarding technology use over time.

Case Study: Colorado Mountain College

Colorado Mountain College (CMC) is a rural, multi-district community college system with 11 campuses in the intermountain region of Colorado, serving over 20,000 students in an area spanning 12,000 square miles ("Colorado Mountain College: CMC Facts," 2016). Colorado Mountain College ranks in the top 13% of community colleges in the United States, offers five bachelor's degrees, and is recognized as the community college that offers the third-most affordable bachelor's degrees in the United States. Colorado Mountain College is supported by property taxes, governed by a Board of Trustees, and accredited by the Higher Learning Commission ("Colorado Mountain College: Snapshot," 2016). The strategic plan for Colorado Mountain College includes five goals: (a) student success, (b) teaching and learning, (c) access, (d) community and economic development, and (e) organizational effectiveness ("Colorado Mountain College, 2014). The use of technology addresses two of these goals, namely student success, and teaching and learning. According to the strategic plan, CMC will "promote student success with relevant student support services" and will "provide excellent learning opportunities" by improving "the quality of existing educational offerings" (Colorado Mountain College, 2014).

Technology integration has the potential to meet these strategic goals. The research presented here provides a snapshot of current technology use and student perception of its use. Both are measures that may be used to evaluate strategic goal attainment. Colorado Mountain College is a leader in innovation; however, tracking and analyzing the specific technology-based learning innovations employed by faculty is challenging due to the multiple campus design of the college and the sheer volume of instructors teaching for the college.

Methods

Two surveys investigated technology use by CMC faculty. One survey queried the faculty (Appendix A) and the other queried the students (Appendix B). Both were disseminated by campus e-mail servers as well as posted on the organizational internal Web portal called Basecamp. The response period was one month long. The intention was for this survey to be offered semi-annually to collect longitudinal data about the technology adoption and integration process at CMC. These are the results of the pilot release of the study.

Results

The faculty survey included a series of questions that collected information about faculty use of educational technology and teaching experience. The student survey collected information about students' perceptions of how technology influenced their learning, their preferences for specific technology tools, and their student progress. Both surveys included closed response questions for which respondents could select multiple responses if appropriate. These questions also included an opportunity to provide a written response if the options presented by the survey did not characterize the respondent. This was an important

design feature because many of the questions provided a common list of technology tools, but it was possible that faculty used tools beyond those choice options. The student survey also included an open-ended question to capture the authentic student responses of how technology enhanced or did not enhance their learning. In the context of this study, a technology tool was defined as a digital resource that was used to enhance the classroom learning experience.

Faculty Survey Results

The survey was responded to by 104 faculty members, of which 63% were adjunct faculty, and 37% were full-time faculty. This mirrored the college-wide instructional profile; 71% of courses were taught by adjunct faculty. Respondents quantified their experience in higher education. The majority of faculty (65%) had 10 or more years of experience. The remaining respondents had six to nine years (18%), three to five years (13%), and zero to two years (4%) of experience (Figure 1). These data indicated that the faculty had significant experience teaching in higher education.

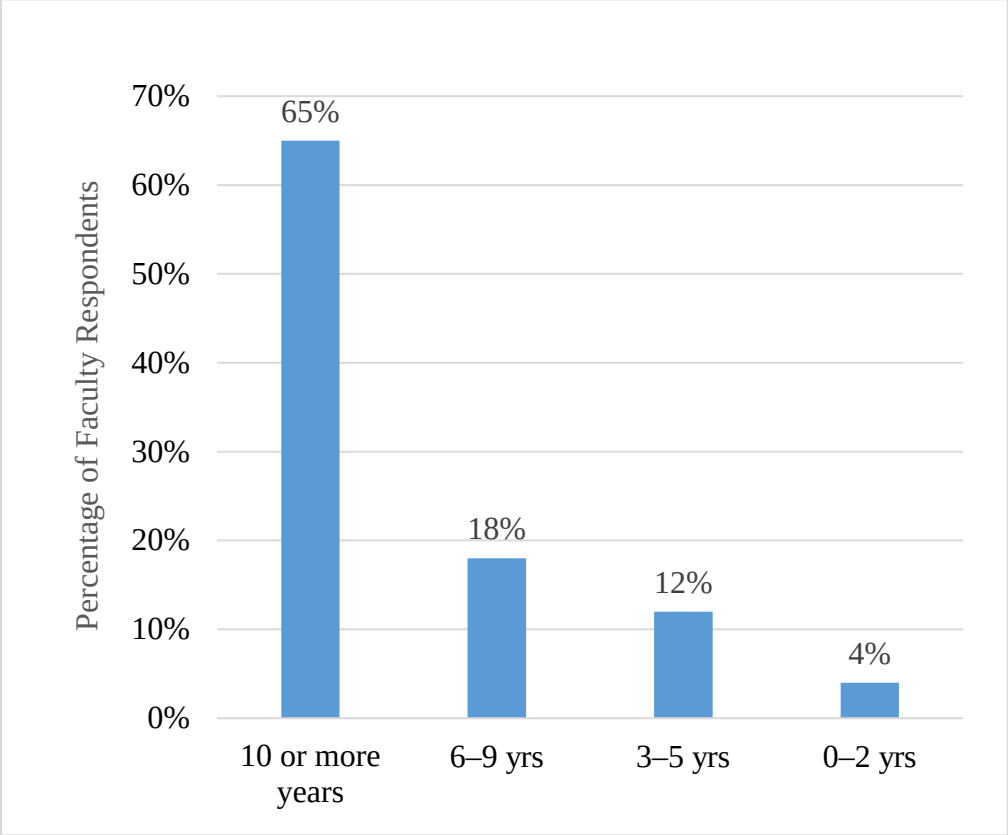

Figure 1. Years of teaching experience.

Several questions queried faculty use and production of technology tools. When asked what technology tools faculty use, their responses were well-aligned to the student responses. As illustrated in Figure 2, faculty reported using Websites (87%), instructional videos (72%), slide presentations (61%), wiki pages (17%), SoftChalk lessons (12%), and Google communities (12%). Other tools used with lesser frequency included (a) blogs, (b) LinkedIn groups, and (c) Facebook groups. Only one respondent noted using a

Twitter feed. Among the open responses, (a) YouTube, (b) Kahn Academy, (c) GoToMeeting, (d) Kahoot, (e) Camtasia, and (f) 3D and virtual classrooms were written in by faculty. The technology tools chosen for investigation were the tools freely available and/or promoted in faculty professional development offerings. The majority of faculty used up to five technology tools per semester, but not more.

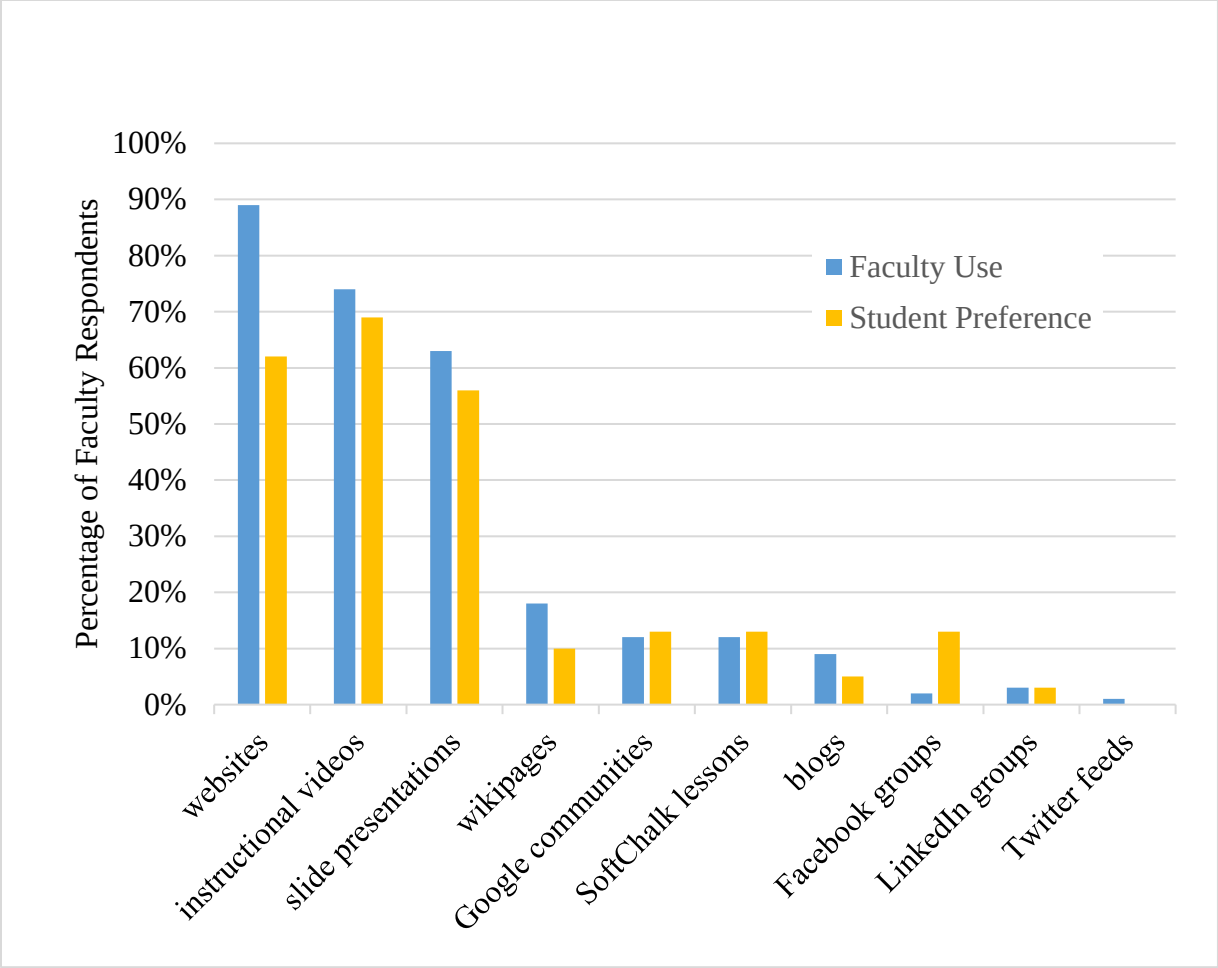

Figure 2. Faculty use and student preferences for technology tools.

To ascertain why faculty members stopped using a technology tool, a survey question offered likely stumbling blocks to technology adoption as choices. The most popular responses included too time-consuming to set-up (57%), not an effective learning tool according to faculty (49%), hard to set up according to students (35%), too difficult to integrate into the learning management system (LMS; 29%), and too costly (8%).

All faculty responded regarding their own production of technology tools. Faculty produced their own slide presentations (81%), instructional videos and/or podcasts (54%), Websites (43%), Web conferences (30%), SoftChalk lessons (18%), and wiki pages (15%). Other tools produced by faculty included (a) blogs, (b) Google communities, (c) Facebook groups, and (d) LinkedIn groups. Faculty wrote in responses to indicate they used (a) 3D and virtual reality environments, (b) Instagram, and (c) VoiceThread. Of all the faculty

respondents, 13% never produced a technology tool (see Figure 3). These data suggested that faculty were authoring their own instructional resources in addition to employing the technology itself. This is evidence for technology integration.

These technology tool production patterns were similar to faculty technology tool use patterns but there were some interesting discrepancies to note. The tools used by the majority of faculty respondents included Websites, instructional videos, and slide presentations. The percentages of faculty that produced Websites (43%) and instructional videos (53%) was less than the percentage of faculty that used each tool (Figures 2 and 3). However, in the case of slide presentations, 80% of the faculty produced slide presentations, but only 61% reported using them. Perhaps slide presentations are something all faculty have made at some point but in the age of blended learning, they have found more engaging resources. This is purely speculative since no open response questions queried faculty motivations for their evolving choices. Including open response questions in the faculty survey would have enhanced interpretation of these data.

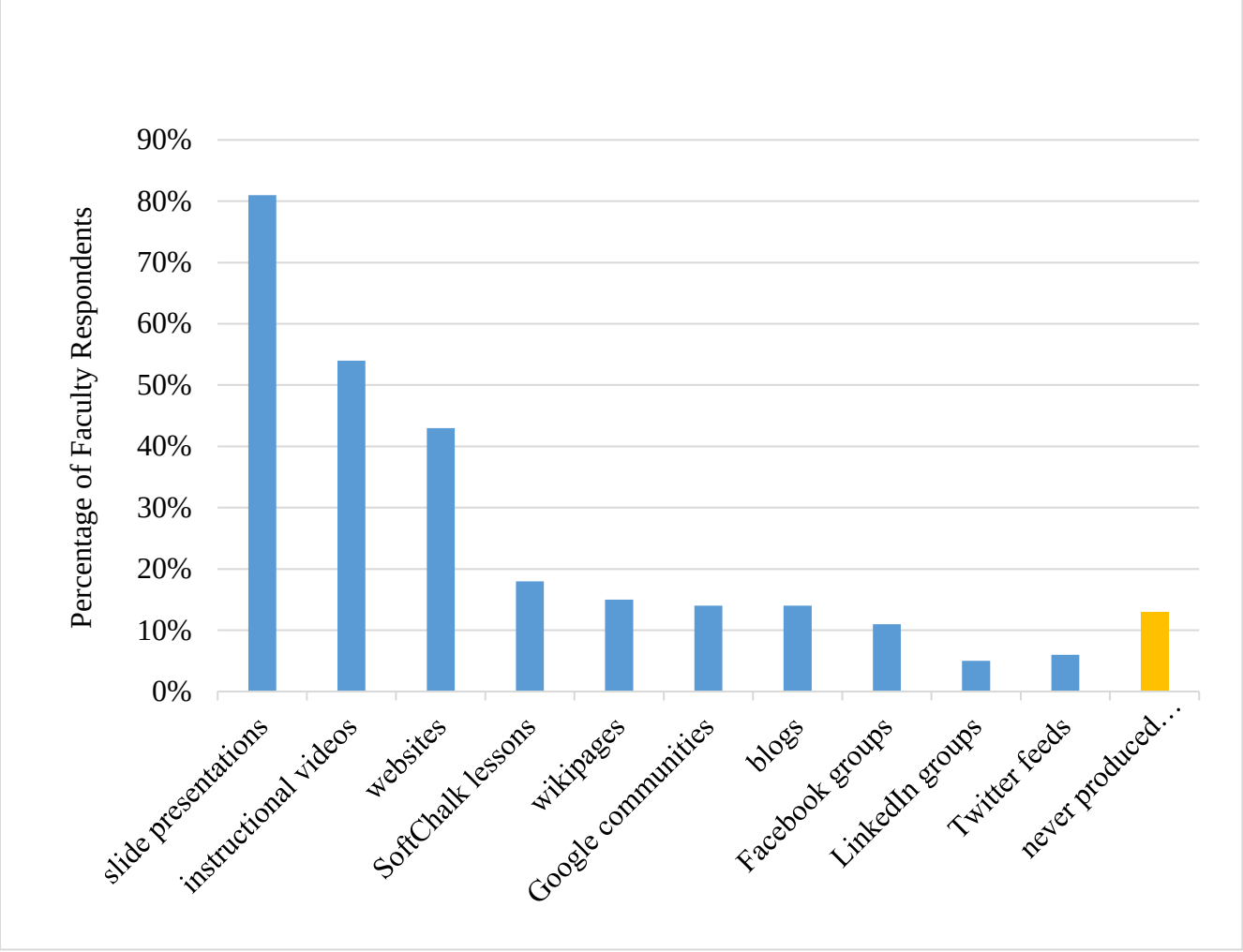

Figure 3. Types of technology tools faculty produced.

When faculty respondents produced media, 73% published these resources to the LMS only, 25% published them in the LMS and on the Internet, and 11% published them on the internet. It will be interesting to see how this trend shifts over time given the movement for open source course media. An Internet search with the limitations site:.edu returns only Web pages published by academic institutions and their affiliates, including faculty. This is an open source treasure trove of instructional materials created by faculty for their students. Additional open response questions in the faculty survey would have strengthened interpretation by offering insights into the motivations behind faculty behaviors regarding publishing their technology tools.

Faculty respondents learned how to use a technology tool by teaching themselves using training resources proprietary to the tool (70%), by taking CMC professional development workshops (60%), by learning from a colleague (51%), by watching videos or tutorials produced by other users (48%), or by taking some other college or university's professional development opportunities (32%). Faculty also wrote in that they were self-taught, just figured it out, or used trial-and-error to learn how to use technology tools.

Faculty apparently learned about the use of technology when they participated in professional development courses. For example, faculty produced and used SoftChalk more than any other technology tools aside from instructional videos, Websites, and slide presentations. The CMC Office of Innovations offered an institutional license and workshops on SoftChalk at the time of the survey. While this study did not connect the number of respondents who participated in professional development to the number of respondents who reported producing these technology tools, it is a reasonable assumption that the high use of this technology tool is related to professional development opportunities. Adding survey questions that identified professional development participation would provide valuable information about the efficacy of these programs. All faculty respondents used Canvas, the LMS used by Colorado Mountain College. Respondents also used Blackboard (76%), D2L/Brightspace (17%), Moodle (17%), Pearson eCollege (9%), and Google Classroom (8%). Respondents wrote in responses to indicate that they used (a) Sakai, (b) Schoology, (c) Angel, (d) Vista, (e) WebCT, and (f) MacMillan LaunchPad (see Figure 4). The college began using Canvas in 2012. The previous LMS was Blackboard. The survey choices were (a) Canvas, (b) Blackboard, (c) D2L/Brightspace, (d) Pearson eCollege, (e) Moodle, and (f) Google classroom. These LMSs were chosen because each were used by Colorado institutions of higher education or were free to use. This question had value in predicting the potential ease with which faculty might adopt a new LMS. However, in retrospect, it did not lend itself to the goal of understanding how technology enhances learning because students experience only the LMS that the institution is currently using when they are enrolled.

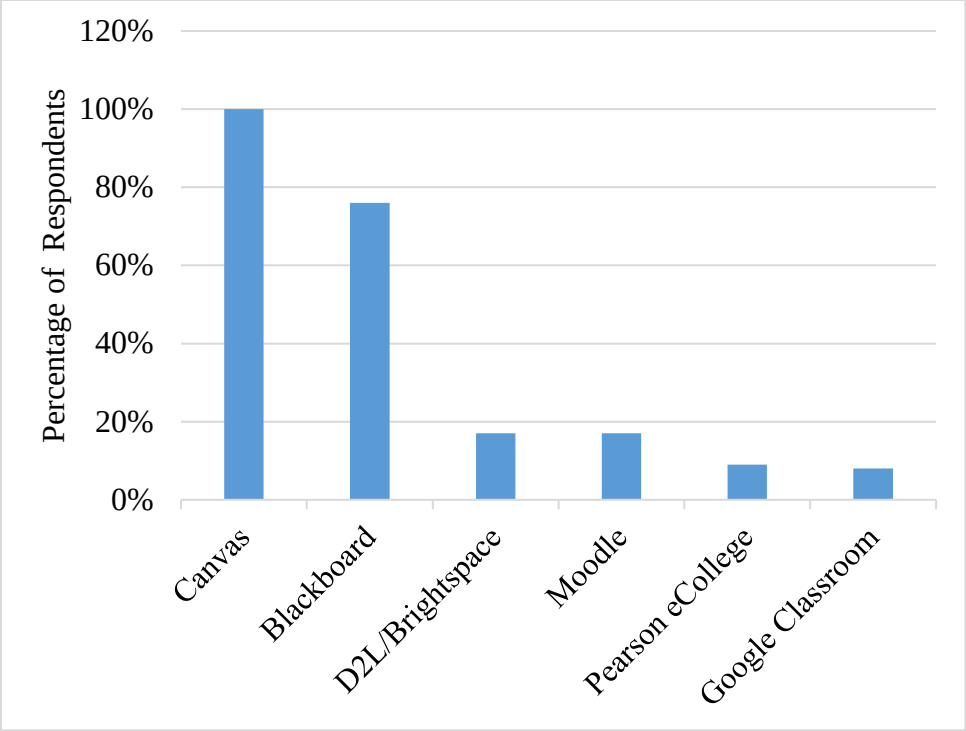

Figure 4. Learning management systems used by faculty.

Regarding the use of the LMS in the classroom, of the instructors who taught for six or more years, 83% used the LMS in the classroom, while only 31% of instructors who taught for up to five years did so. It is possible that using the LMS is a skill one develops after gaining confidence with the practice of teaching itself. The use of open response questions might have elucidated these motivational factors. As shown in Figure 5, faculty respondents used the LMS to manage the gradebook (87%), for assignment submission (82%), to curate documents (68%), to administer tests and quizzes (66%), and to run discussions (61%). In addition to the survey-prompted uses of the LMS, faculty wrote in that they used the LMS to identify goals and objectives and allow for student choice in learning activity. Faculty noted that they used the LMS for (a) announcements, (b) student communication, (c) attendance, (d) posting schedules, syllabi, and class notes, and (e) managing online critique.

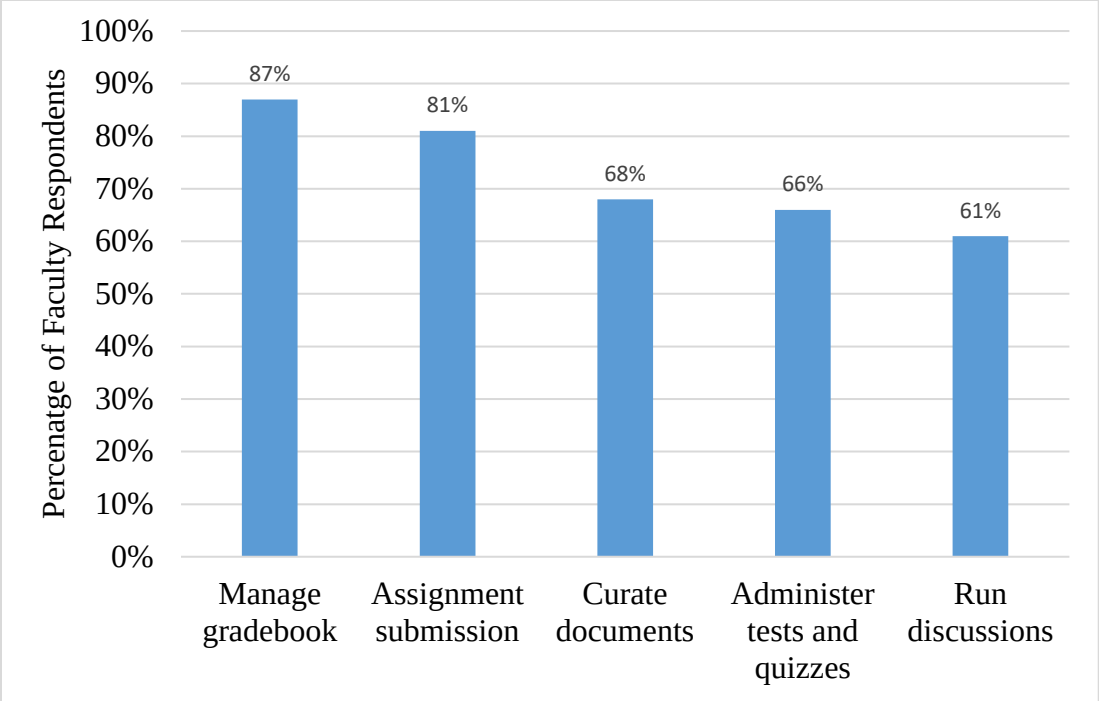

Figure 5. Ways faculty used the learning management systems.

A series of survey questions queried the use of electronic textbooks. Twenty-four percent of faculty used digital textbooks and 24% did not use a textbook at all. One of the great advancements in textbook publishing includes the availability of digital resources that support the textbook. Among faculty who used a textbook, some also used slide presentations (50%), instructional videos (49%), publisher test banks (46%), lecture outlines (28%), adaptive study programs (14%), and virtual labs (9%) provided by the textbook publisher.

Student Survey Results

The student survey probed student perceptions of instructor technology use in the context of their learning and academic progress. Fifty-seven students responded to the survey. Respondents were freshman students (31%), sophomores (21%), juniors (28%), and seniors (21%). The majority of respondents had attended CMC for one to three semesters at the time of the survey. To ascertain the environment in which students experienced technology integration, respondents identified their mode of learning. Sixty-five percent of respondents took online classes, and 80% took face-to-face courses. Thirty-nine percent of respondents had completed one to three online classes to date, 34% had never taken an online course, 12% had completed four to six online courses, and 7% had completed either seven to nine online courses, or 10 or more online courses, to date.

In this study, learning was confirmed by student survey responses. The student survey contained one open-ended question. “How does technology enhance your learning? Please describe here or explain why it does not enhance your learning.” The responses to this question provided an authentic and qualitative perspective of student perceptions of how technology enhances their learning. Additional questions explored the technical details of technology use and the students’ academic progress.

Ninety-three percent of students indicated that technology enhanced their learning (see Figure 6). Respondents noted that technology facilitated self-paced learning and "made going to school more time manageable." Technology "increases interaction with the subject matter," is "available anywhere," and makes "it easier to do research." Other students added the following responses to characterize how technology enhances their learning. "Technology is just part of the world we live in and how we access information and learning. It makes some processes more efficient." "Technology is needed for everyday activities. One cannot conduct business or communication without it."

Several students used the terms "information access" or "access to information" when describing how technology enhanced their learning. One student remarked that "technology helps me to learn a great deal. I love that after a few short minutes I can find a variety of information, studies, blogs, and articles online." "Anything you need to know is right on the Internet." Although information access was not a direct measure of learning, some students interpreted technology's enhancements of their learning as it related to access. At CMC, the students' perception of access enhancement is evidence that technology is facilitating strategic goal attainment for the institution.

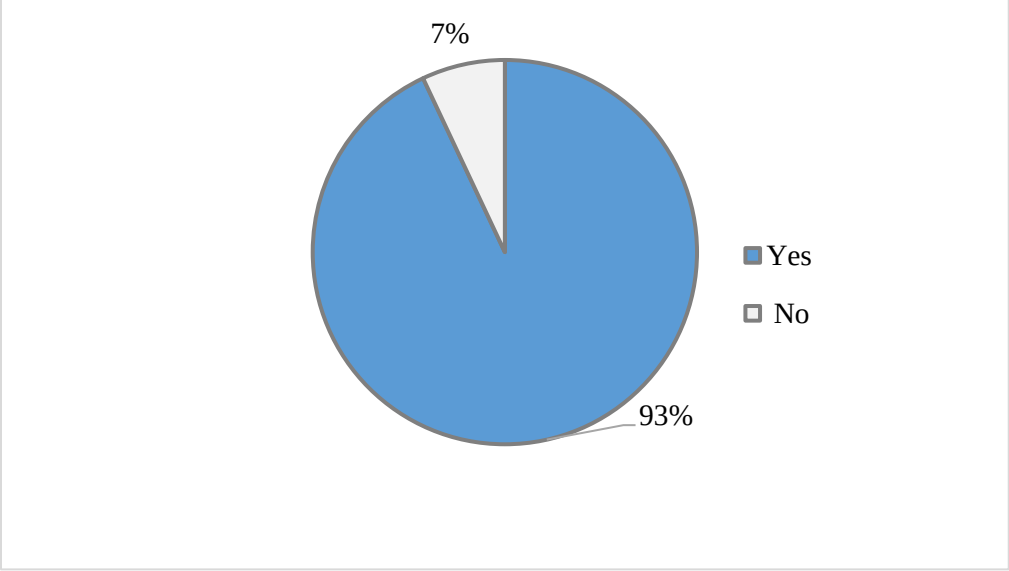

Figure 6. Student responses when asked if they think technology enhances their learning.

Several students discussed how technology allowed for more communication among students and with the instructor, which enhanced their learning. One student described lecture-based instruction as multimodal and noted that it accommodated his or her learning. Another student wrote that technology

> provides an additional access point to instructors and fellow students. That extra communication opportunity is not available without technology tools. Also, better types of content (video, audio, interactive tools, etc.) are available via some tech solutions, adding to the ability for students to learn the material via these non-text methods.

When asked what their favorite technology tools were, students responded with instructional videos (66%), Websites (59%), and slide presentations (54%) which faculty also noted they used with regularity. These

comments confirm scholarly research that indicated blended learning facilitates social and cognitive development (Garrison, 2017). These data also indicated that there was a connection between resource access (e.g., learning materials, instructor) and the perception of learning enhancement. Lancaster and Lundberg (2019) drew similar conclusions when they queried faculty and students to explore correlations between faculty behaviors and students' self-perceptions of learning.

Although not the majority opinion, one student remarked that she or he learns "best by the old school lecturing at a chalkboard where the instructor lectures to the notes that he or she writes on the board. In this way, I hear the lecture, see the lecture being written and write the lecture myself, reinforcing the materials through three different mediums at one time."

Discussion and Considerations for Future Research

Regarding the representativeness of the sample, the majority of respondents were adjunct faculty. The response rate for full-time faculty was approximately 30%. Seventy-one percent of courses at CMC were taught by adjuncts. Sixty-three percent of survey respondents were adjuncts. These percentages were well aligned and therefore likely represented the Colorado Mountain College teaching population with some degree of accuracy. The exact number of adjuncts across all 11 campuses was unknown to the researcher due to the dynamic and ever-changing number of adjuncts at any one time. Furthermore, there were fewer adjunct instructors working in the summer semester, so the respondent percentage rate of adjuncts might have been affected by the summer delivery of this survey.

While there were no open-ended questions in the faculty survey, several questions in the faculty survey contained an open field so respondents could write their own answer if it did not align with the multiple-choice options. This afforded a glimpse of technology tools in use that were not supported directly by the institution. In the on-going monitoring of technology use, institutions might use this open field choice for early detection of new technology tools on the horizon that are favored by faculty and/or students and to which resources may be lent in future budgets.

In future iterations of the faculty survey, open-ended questions might elucidate the motivational climate for faculty behaviors reported. For example, questions investigating the use, production, and publication of technology tools by faculty was not accompanied by open-ended questions that would have explained why faculty use, do not use, produce, and/or publish technology tools. One closed-ended question asked why faculty stopped using a technology tool, but no similar questions related motivation and context to other technology use parameters.

There were structural flaws in the survey design. It was difficult to draw comparisons between student and faculty responses because the questions in the student and faculty surveys were not paired. If they were, a chi-squared contingency table could be established to compare technology tool choices to a general faculty or student identity. Additionally, questions that ask respondents to check all that apply should be accompanied by paired questions that select a top choice. With these two pieces of information, a chi-squared analysis could be done.

Student preferences for technology tools were closely aligned with professors' efforts to integrate technology tools. This begs the question: do students like the technology tools professors are using, or is it that professors are responsive to what students want? For example, no students liked using Twitter in an educational context, but only one faculty member reported using Twitter in an educational context. Understanding the causal relationships here would provide valuable information regarding technology trends in higher education.

Conclusions

In this investigation, faculty and student surveys employed at a multi-campus, rural community college revealed the current technology adoption climate, including faculty and student technology tool preferences and perceptions of their own learning gains. The faculty surveys described faculty use, production, and publication of technology tools in addition to details regarding their teaching experience. The student surveys revealed students' perceptions of the effect of technology on their learning and details regarding their academic progress. The overwhelming sentiment from students was that technology enhanced their learning (93%). This perceptive gauge was not accompanied by experimental methods that confirmed or refuted the student self-reported perceptions of technology's effect on their learning. Nonetheless, these data suggested that the organization's efforts to offer and support educational technology were valuable to the student population.

Faculty and students tended to prefer the same technology tools, including instructional videos, websites, and slide presentations. Faculty apparently worked to both produce and provide these resources to their students. While some tools were too challenging or ineffective to continue using, faculty employed, on average, five technology tools each semester. Faculty with more experience were more likely to employ a blended approach in which they used the LMS in the classroom. There were no apparent differences in the behaviors of part-time and full-time faculty, but these conclusions could not be made with statistical analysis due to the survey design. The majority of faculty respondents had 10 or more years of teaching experience, thereby indicating that these data reflect the behaviors of a seasoned faculty who have had time to use and reflect on the technology climate in their professional environments. The student population represented students in every class year, indicating the validity in generalizing these conclusions to the entire student population.

The coordinated analysis of technology adoption and integration within teaching and learning practices is an opportunity for institutions of higher education. The shortcomings of these data are informative. Across 11 campuses, technology integration is one of many topics to consider on an institution-wide level. Nonetheless, there is a significant institutional investment involved in providing technology and staff to support it. Successful technology use and integration that is accompanied by ongoing scholarly debate and monitoring has the potential to provide more access, promote learning outcomes, measure strategic institutional goals, and protect the institutional investment in technology. Since new technologies tools are always becoming available, the key to sustainable technology integration is a community-wide commitment to its effectiveness and continuous improvement.

Technology integration is a continuous process, and its success is assured through monitoring and program evaluation. Prior to this investigation, there was no evidence that ongoing technology integration monitoring practices existed. The surveys employed here, when used semi-annually, may provide a low-cost model for the monitoring of technology integration. The surveys also have the potential to provide technology use and integration data that may inform strategic planning processes and institutional learning outcome development.

References

Abdulwahed, M., Jaworski, B., & Crawford, A. R. (2012). Innovative approaches to teaching mathematics in higher education: a review and critique. *Nordic Studies in Mathematics Education*, 17(2), 49–68. Retrieved from https://hdl.handle.net/2134/11988

Ajjan, H., & Hartshorne, R. (2008). Investigating faculty decisions to adopt Web 2.0 technologies: Theory and empirical tests. *The Internet and Higher Education*, *11*(2), 71–80. doi:10.1016/j.iheduc.2008.05.002

Allen, I. E., & Seaman, J. (2013). *Changing course: Ten years of tracking online education in the United States*. n.p.: Babson Survey Research Group. Retrieved from http://onlinelearningconsortium.org/survey_report/changing-course-ten-years-tracking-online-education-united-states/

Allen, I. E., Seaman, J., Poulin, R., & Straut, T. T. (2016). *Online report card: Tracking online education in the United States*. Babson Survey Research Group and Online Learning Consortium. Retrieved from http://onlinelearningconsortium.org/read/online-report-card-tracking-online-education-united-states-2015/

Butler-Pascoe, M. E. (2011). The history of CALL: The intertwining paths of technology and second/foreign language teaching. *International Journal of Computer-Assisted Language Learning and Teaching*, *1*(1), 16–32. doi:10.4018/ijcallt.2011010102

Cheng, A., Lang, T. R., Starr, S. R., Pusic, M., & Cook, D. A. (2014). Technology-enhanced simulation and pediatric education: A meta-analysis. *Pediatrics*, *133*(5), e1313–e1323. doi:10.1542/peds.2013-2139

Colorado Mountain College. (2014). *Strategic plan (2014–2018).* Retrieved from http://coloradomtn.edu/wp-content/uploads/filebase/2014%20StrategicPlan%20onepage-2-27-14.pdf

Colorado Mountain College: CMC Facts. (2016). Retrieved from https://coloradomtn.edu/contact-departments/institutional-research/cmc-facts/

Colorado Mountain College: Snapshot. (2016). Retrieved from http://coloradomtn.edu/about-cmc/cmc_snapshot/

Courts, B., & Tucker, J. (2012). Using technology to create a dynamic classroom experience. *Journal of College Teaching & Learning*, *9*(2), 121–128. doi:10.19030/tlc.v9i2.6907

Crall, A. W., Newman, G. J., Jarnevich, C. S., Stohlgren, T. J., Waller, D. M., & Graham, J. (2010). Improving and integrating data on invasive species collected by citizen scientists. *Biological Invasions*, *12*(10), 3419–3428. doi:10.1007/s10530-010-9740-9

Gaddis, M. L. (2018). *Training citizen scientists for data reliability: A multiple case study to identify themes in current training initiatives* (Doctoral dissertation Order No. 13423764). Available from ProQuest Dissertations & Theses Global. (2159515806).

Gagnon, J., Gagnon, M. P., Buteau, R. A., Azizah, G. M., Jette, S., Lampron, A., . . . Reviriego, E. (2015). Adaptation and evaluation of online self-learning modules to teach critical appraisal and evidence-based practice in nursing: An international collaboration. *Computers Informatics Nursing*, *33*(7), 285–294. doi:10.1097/CIN.0000000000000156

Garrison, D. R. (2017). *E-learning in the 21st century: A community of inquiry framework for research and practice*. (3rd ed.) New York, NY: Routledge.

Johnson, L., Becker, S., Estrada, V., & Freeman, A. (2014). *NMC horizon report: 2014 higher education*. Austin, TX: The New Media Consortium. Retrieved from http://www.editlib.org/p/130341/

Johnson, T., Wisniewski, M. A., Kuhlemeyer, G., Isaacs, G., & Kryzkowski, J. (2012). Technology adoption in higher education: Overcoming anxiety through faculty bootcamp. *Journal of Asynchronous Learning Networks*, *16*(2), 63–72. Retrieved from https://www.learntechlib.org/p/132464/

Keengwe, J., Onchwari, G., & Onchwari, J. (2009). Technology and student learning: Towards a learner-centered teaching model. *AACE Journal*, *17*(1), 11–22. Retrieved from https://www.learntechlib.org/primary/p/26258/

Knowles, M. S., Holton, E. F., & Swanson, R. A. (2011). *The adult learner* (7th ed.). Burlington, MA: Elsevier.

Lancaster, J. R., & Lundberg, C. A. (2019). The influence of classroom engagement on community college student learning: A quantitative analysis of effective faculty practices. *Community College Review*, *47*(2), 136–158. doi:10.1177/0091552119835922

Laurillard, D. (2013). *Teaching as a design science: Building pedagogical patterns for learning and technology*. New York, NY: Routledge.

Lertwanasiriwan, C. (2010). *The effects of a technology-enhanced inquiry instructional model on students' understanding of science in Thailand* (Doctoral dissertation). Retrieved from http://repositories.lib.utexas.edu/bitstream/handle/2152/18445/lertwanasiriwanc79440.pdf?sequence=2

Lewis, C. C., Fretwell, C. E., Ryan, J., & Parham, J. B. (2013). Faculty use of established and emerging technologies in higher education: A unified theory of acceptance and use of technology perspective. *International Journal of Higher Education*, *2*(2), 22–34. doi:10.5430/ijhe.v2n2p22

Mbati, L., & Minnaar, A. (2015). Guidelines towards the facilitation of interactive online learning programmes in higher education. *The International Review of Research in Open and Distributed Learning*, *16*(2). doi:10.19173/irrodl.v16i2.2019

Merrill, M. D. (2002). First principles of instruction. *Educational Technology Research and Development*, *50*(3), 43–59. doi:10.1007/BF02505024

Moule P., Ward R., & Lockyer L. (2011). Issues with e-learning in nursing and health education in the UK: Are new technologies being embraced in the teaching and learning environments? *Journal of Research in Nursing*, *16*, 77–90. doi:10.1177/1744987110370940

Potocka, K. (2010). An entirely-online developmental mathematics course: Creation and outcomes. *Primus*, 20(6), 498-516. doi:10.1080/10511970802398151

Quillerou, E. (2011). Increased technology provision and learning: Giving more for nothing? T*he International Review of Research in Open and Distributed Learning*, *12*(6), 178–197. https://doi.org/10.19173/irrodl.v12i6.998

Roney, L. N., Westrick, S. J., Acri, M. C., Aronson, B. S., & Rebeschi, L. M. (2017). Technology use and technological self-efficacy among undergraduate nursing faculty. *Nursing Education Perspectives*, *38*(3), 113–118. doi:10.1097/01.NEP.0000000000000141

Russell, S. M. (2014). *Technology integration for technical and vocational faculty in North Carolina community colleges* (Doctoral dissertation Order No. 3586198). Available from Proquest Dissertations. (1513578313).

Serna, R. W., Foran, M. M., Cooke, C., Hurd, K. E., Tello, A. J., Vangapalli, R., & Hamad, C. D. (2016). Teaching discrete trial training: The effects of asynchronous computer-based instruction on live implementation. *Journal of Special Education Technology*, *30*(4). doi:10.1177/0162643416633334

Simkins, M. (2002). *Increasing student learning through multimedia projects*. Alexandria, VA: Association for Supervision and Curriculum Development.

Yamagata-Lynch, L. C. (2014). Blending online asynchronous and synchronous learning. *The International Review of Research in Open and Distributed Learning*, *15*(2). doi:10.19173/irrodl.v15i2.1778

Zucker, A. A., & Light, D. (2009). Laptop programs for students. *Science*, *323*(5910), 82–85. doi:10.1126/science.1167705

Appendix A

Faculty Survey

1. What learning management systems (LMS) have you used? [check all that apply]
    a. Canvas
    b. Blackboard
    c. D2L/Brightspace
    d. Pearson eCollege
    e. Moodle
    f. Google classroom
    g. Other, please name here:
2. A **technology tool** is a digital resource that you use to enhance your teaching. How many technology tools do you use in a single class per semester, not including the LMS?
    a. 1
    b. 2–5
    c. 6–8
    d. 9–10
3. Do you use the LMS when you teach in the classroom?
    a. Yes
    b. No
4. If you use the LMS when you teach in the classroom, how do you use it? [check all that apply]
    a. To curate documents
    b. To run discussions
    c. To administer tests and quizzes
    d. For assignment submission
    e. To manage the gradebook
    f. Other, please describe:
5. Do you use an electronic textbook?
    a. Yes
    b. No
6. If you use a textbook (digital or paper), which of the following do you also use? These are often available on the publisher's Website. [check all that apply]
    a. I don't use a textbook
    b. Testbanks
    c. Adaptive study program
    d. Lecture outlines
    e. Slide presentations
    f. Instructional videos
    g. Virtual labs
7. Which of the following external technology tools do you use on a regular basis, or plan to use on a regular basis (even though at the time of survey you may have used it only once to try it out)? If you used a tool only once and chose not to use it again, do not check it here. [check all that apply]

a. Instructional videos/ podcasts
b. Slide presentations
c. SoftChalk lessons
d. Blogs
e. Websites
f. Wiki pages
g. Twitter feeds
h. Google communities
i. LinkedIn groups
j. Facebook groups
k. Other, please name here:

8. If you stopped using a technology tool, why did you stop? [check all that apply]
    a. Too difficult to integrate into the LMS
    b. Was not an effective learning tool, in your opinion
    c. Was not an effective learning tool, as determined by your students
    d. Cost too much money
    e. Too time-consuming to set up
    f. Other, please describe:
9. What kinds of technology tools have you produced at least once? [check all that apply]
    a. Instructional videos/podcasts
    b. Slide presentations
    c. SoftChalk lessons
    d. Web conferencing
    e. Blogs
    f. Websites
    g. Wiki pages
    h. Twitter feeds
    i. Google communities
    j. LinkedIn groups
    k. Facebook groups
    l. I have never produced a technology tool
    m. Other, please name here:
10. How did you learn to use a technology tool? [check all that apply]
    a. CMC professional development
    b. Other college or university professional development
    c. Self-taught from publisher resources
    d. Internet videos or tutorials produced by a user, not the publisher
    e. A colleague
    f. Other, please describe:
11. Do you publish your media? [check all that apply]
    a. In the LMS
    b. On the Web
    c. In the LMS and on the Web

d. Other, please describe:

12. How many years have you been teaching in higher education?
    a. 0–2 years
    b. 3–5 years
    c. 6–9 years
    d. 10 or more years
13. How many years have you been teaching at Colorado Mountain College?
    a. 0–2 years
    b. 3–5 years
    c. 6–9 years
    d. 10 or more years
14. Approximately how many courses do you teach per fall and spring semesters at CMC? [check all that apply]
    a. not always teaching every semester
    b. 1 non-lab course
    c. 2–3 non-lab courses
    d. 1 lab course
    e. 2–3 lab courses
15. Approximately how many courses do you teach per fall and spring semester at CMC and any other college or university combined?
    a. Not always teaching every semester
    b. 1 course
    c. 2–4 courses
    d. 5–7 courses
    e. 8–10 courses
    f. More than 10 courses
16. How many years have you taught online courses?
    a. 0–2 years
    b. 3–5 years
    c. 6–9 years
    d. 10 or more years
17. Are you an adjunct instructor or a full-time instructor?
    a. Adjunct
    b. Full-time

Thank you for your participation.

Appendix B

Student Survey

1. A **technology tool** is a digital resource that instructors use to facilitate your learning. What technology tools are your favorites? [check all that apply]
    a. Instructional videos/podcasts
    b. Slide presentations
    c. SoftChalk lessons
    d. Blogs
    e. Websites
    f. Wiki pages
    g. Twitter feeds
    h. Google communities
    i. LinkedIn groups
    j. Facebook groups
    k. Other, please name here:
2. Do you think technology enhances your learning?
    a. Yes
    b. No
3. How does technology enhance your learning? Please describe here or explain why it does not enhance your learning.
    [open response]
4. What is your class year?
    a. Freshman
    b. Sophomore
    c. Junior
    d. Senior
5. How many semesters have you been enrolled at CMC?
    a. 1–3 semesters
    b. 4–6 semesters
    c. 7–9 semesters
    d. 10–12 semesters
    e. More than 12 semesters
6. Do you take courses online?
    a. Yes
    b. No
7. Do you take courses in the physical classroom (i.e., face-to-face courses)?
    a. Yes
    b. No
8. How many online courses have you taken?
    a. 0 courses
    b. 1–3 courses

c. 4–6 courses
d. 7–9 courses
e. 10 or more courses

9. How many face-to-face courses have you taken?
    a. 0 courses
    b. 1–3 courses
    c. 4–6 courses
    d. 7–9 courses
    e. 10 or more courses
10. How many hybrid courses have you taken? Hybrid courses have either the lab or lecture component online and the other component face-to-face.
    a. 0 courses
    b. 1–3 courses
    c. 4–6 courses
    d. 7–9 courses
    e. 10 or more courses
11. How many interactive video system (IVS) courses have you taken?
    a. 0 courses
    b. 1–3 courses
    c. 4–6 courses
    d. 7–9 courses
    e. 10 or more courses
12. How many non-credit courses have you taken in total?
    a. 0 courses
    b. 1–3 courses
    c. 4–6 courses
    d. 7–9 courses
    e. 10 or more courses
13. How many credit courses have you taken?
    a. 0 courses
    b. 1–3 courses
    c. 4–6 courses
    d. 7–9 courses
    e. 10 or more courses

Thank you for your participation.