Building A Healthy Online Student Community Through Education Environment Design

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Abstract

Studies have highlighted social interaction and collaborative effort within a student community as important elements that contribute to successful learning. College students in face-to-face settings build a sense of community and bond through real-time interpersonal interactions during classroom experiences and co-curricular activities. Online college students often do not enjoy such substantive community experiences, and, in part because of this, they achieve lower rates of persistence to degree completion. Studies have examined this discrepancy in persistence to degree and found that the physical separation between an online student and their educational institution can lead to a sense of isolation. This sense of isolation in turn can lead to an online student's sense of alienation from their institution and powerlessness to change their situation. Numerous underlying factors appear to contribute to these feelings, including the usability of the technology tools that power the online education environment and the quality of student-faculty and student-student interactions that those tools enable. As online education becomes increasingly pervasive, educational institutions should consider how best to design online programs to foster healthy student communities. The literature suggests several methods for achieving such communities and improving student retention. First, students (and faculty) should be carefully introduced to effective online education tools that facilitate interaction. Second, effective channels of student-faculty communication should be outlined and encouraged so that students and faculty interact in a timely, clear, and positive manner. Third, education-related student-student avenues for online interaction should be introduced so that a sense of student community can develop. The activities reported here build upon the literature, which has generally focused upon asynchronous online learning environments, by considering development of student community in a synchronous online environment. While the underlying strategies are similar, the particular solutions vary. This paper describes a recently developed online learning environment for engineering education and student use of the tools of that environment to forge bonds with one another, their faculty instructors, and the broader engineering community. The strengths and opportunities for improvement from the perspective of the student were captured in a survey administered to students participating in the online engineering program. This survey serves as a baseline from which to measure the development of community and to determine which resources offer the most effective means for communication and community development.

Introduction

Over the past decade, global interest in and engagement with online education at the postsecondary level has grown steadily. At the end of 2011, enrollment in U.S. online education accounted for 32% of the total enrollment in American postsecondary education, having grown from 9.6% in 2002.[1] According to the U.S Department of Education, students cite flexibility, accessibility and cost effectiveness as motivations for choosing online programs.[2] Over the past decade, the growth rate of U.S. online enrollment peaked in 2005 at 36.5% but remained strong in 2011 at 9.1%.[1] These numbers compare with the 2-3% total annual enrollment growth seen at degree-granting postsecondary institutions in the United States during most of the past decade.[1] In 2012 over two thirds of postsecondary institution chief academic officers stated that online

learning is critical to their institution's long-term strategy, up from about 50% in 2002.[1] At the same time, just 30% of institutions offering online courses (but no online degree programs) and 60% of institutions offering online courses and degree programs include online education as part of their strategic plan. Additionally, while awareness of and interest in online postsecondary education is high, many in higher education are wary of the medium and cite shortcomings related to student academic achievement and persistence in the medium as central to their concern. 73.5% of the chief academic officers surveyed about online learning in 2012 indicated that the low persistence rate of students in online courses was likely to be a key barrier to continued growth of the medium.[1]

Studies suggest that the persistence rate to degree for students in online programs can be as low as 60%[3], and therefore addressing the root cause(s) of this shortcoming represents a significant opportunity for improving the acceptance and impact of online education. While 88.8% of academic leaders believe that lower retention rates are due to a lack of discipline on the part of the online learner[1], various studies indicate that the extent to which online students consider themselves to be part of a learning community is more closely linked to student persistence. This paper will explore the research basis for this statement and describe an effort to develop solutions that help students to overcome the barriers to community engagement within a primarily synchronous online undergraduate engineering degree program.

Educational community

Studies have highlighted social interaction and collaborative effort between students as important elements contributing to successful, community-based learning.[3, 4, 5] Traditional on-campus students develop a sense of community through real-time in-class discussions, group projects that lead to personal interactions, and informal, spontaneous pre-and post-class conversations with one another and their instructor. As a result of these interactions, the students' sense of community increases, their motivation grows, and their respect for peers deepens, leading to a greater sense of academic engagement and satisfaction.[6, 7] Students feel engaged, and their performance and persistence increases.[6]

For online students, the limited student-to-student contact and narrow, text-based form of communication typical in many online (particularly asynchronous) programs make community building more difficult.[8] If community is not carefully crafted in these environments, learning is negatively impacted, and students focus less on learning and more on seeking out the community that they desire.[6, 9] If the need for community is not met, students may leave a course or even the entire degree program and institution in pursuit of a learning environment that offers them what they desire and need.[9]

When designing an online community, the whole of a student's life beyond academics should be considered, as those other elements can help to define the engagement of a student in their learning community.[6] Compared to the members of a traditional on-campus student body, today's online learners are more likely to be older[9] working adults[11] with family or social commitments[2] whose choices of educational institutions are limited due to geographical constraints.[2] Consequently, the optimum learning environment for such students may be different than that for on-campus students. For instance, while younger, on-campus students might be

comfortable with primary communication centered around texting, instant messaging, and social media posting that includes "modern" abbreviations, older students may prefer e-mail or real-time voice and video exchanges in unabridged form!

Like their traditional classroom brethren, though, online students need to be able to develop relationships that give them a sense of identity within the confines of their courses while providing a level of comfort that encourages collaboration. When the learning environment is well designed, the online students can become emotionally invested and identify with their peers due to their common experiences within the class setting.[6] However, if online students feel a lack of support or connection within their learning environment, they often develop a feeling of alienation.[10] Rovai and Wighting believe alienation leads to self-isolation, failure, absenteeism and dropping out.[10] Furthermore, the strength of an online student's connection to community has been found to inversely correlate with feelings of isolation, time management struggles, and problems with access to materials, fellow students and instructors.[9] When students feel isolated or alienated there can be a personal element missing from their interactions.[8] In addition to alienation, the isolated student can then experience a sense of powerlessness to control or improve their environment. A student who feels powerless may give up when faced with failure or resistance.[10]

Alienation, isolation, and powerlessness can be overcome by developing substantive, interactive student-faculty and student-student relationships that can be fostered online in many ways. Interacting with members of a community increases the sense of relationship commitment and responsibility to a group which in turn increases rates of persistence and reduces feelings of alienation, isolation, and powerlessness.[6] As an example, Palloff and Pratt[8] recommend that students build an "online presence" to encourage a personal bond with instructors and fellow students. In this context, an online presence is the personality that a student adopts when communicating online. Typically, this is expressed in asynchronous online learning environments through introductory discussion board postings at the start of the course, threaded discussions, personal web pages and non-instructor monitored resources such as virtual cafés and chat rooms.[8]

Finally, since online students often have less ability to pick those with whom they interact in their online education environment, it is also critical that they be able to carve out a safe learning space online where they can feel a sense of membership, belonging, and engagement.[6] As in the face-to-face learning environment, healthy, safe engagement within the context of a community can lead to intellectual stimulation, student retention, and academic success.

Online education learning environments

While interpersonal interactions are central to success in any learning environment, online learning environments depend heavily upon technology to facilitate such interactions, more so than face-to-face environments. At the core of the online learning environment is the communication and collaboration hardware and software employed to deliver class sessions, to facilitate student-faculty and student-student connections during and outside of class, and to allow online students to engage in their overall learning environment. Experience shows that, to create a healthy online learning community, the hardware and software that forms this

environment should be reliable, easy to operate and navigate, and capable of supporting multiple communication channels.[8] A system that is difficult to operate will serve as a barrier to community building.[8]

Educational institutions can take important steps towards developing a healthy student community online, through their hardware and software choices. At the same time, today's online student shares in the responsibility of constructing the infrastructure of their learning environment, as they are typically expected to supply some of the tools needed to participate. Thus, students need to be prepared to invest in recommended tools and learn how to apply those tools for engagement in their education.[7] When students use inadequate hardware or unreliable internet connections, their reduced ability to interact with the instructor and other students may cause them to withdraw from the classroom community.[7] While not all students need to have the identical technology, all should be willing to invest in technology that allows for their full participation.

Even though educational institutions lack ultimate control over the technology used by their online students, they can stress the importance of learning how to operate online program tools prior to the start of studies.[7] In addition to proficiency with their own technology, online students should be prepared to use other technical resources as requested by an instructor for an individual course.[12] Canada[12] even goes so far as to suggest that students sign an agreement prior to the beginning of the course that stipulates their ability to access online resources and confirms their familiarity with their technology. Failure to learn the technology before a course begins will lead to student preoccupation with the technology that distracts from mastery of the learning objectives courses.[7]

Finally, institutions, faculty, and students need to accept that technology will fail at some point. The delivery systems of today's online learning environments are sufficiently complex and intertwined with other internet components so that 100% reliability is simply not possible. Thus, all participants need to be prepared to rely upon pre-selected alternative communication channels when problems occur.[7] In terms of student persistence, technical difficulties can become the scapegoat for struggling students,[7] and the responsibility for alleviating software and technical anxiety rests with both the institution and the student. The institution must ensure that its tools for course delivery are robust, redundant, and easy to access. Students must be willing to equip themselves with all the expected tools, familiarize themselves with the established technology environment prior to joining a course, and be willing to tolerate occasional technology failures.[7]

Research context

Since 2007 the University of Virginia has partnered with the Virginia Community College System to deliver an online undergraduate engineering degree program – *Engineers PRODUCED in Virginia*. Students in the program typically complete a two year associate's degree at their community college (usually in a face-to-face setting) before transitioning to a fully online program delivered by the University of Virginia for third and fourth year undergraduate studies in their home community. Online students take the same courses as on-campus students in a live (synchronous) classroom environment, i.e. faculty teach students simultaneously in a physical classroom and online. Through the program, online students earn the same undergraduate engineering degree as on-campus students. The initial goal of the

program has been to grow a local engineering workforce among non-traditional students who might otherwise have difficulty attending a residential program of study and in primarily rural communities that struggle to recruit and retain engineering talent for technology companies in the local communities.

From the outset of the program, there has been a general recognition of the importance of engaging online students across the many facets of undergraduate education. The importance of connecting online students - into class sessions, to faculty instructors, to fellow students, and to the university – has guided the definition of the program's technology solutions. Indeed significant time was invested in considering how best to connect students – in class, outside of class, and to the university more generally – so that they could further their knowledge through robust access to the important components of their learning environment and not feel like isolated learners. These thoughts led to articulation of a three level education environment model and the selection of hardware and software solutions that could support online student engagement across all three levels (Figure 1).

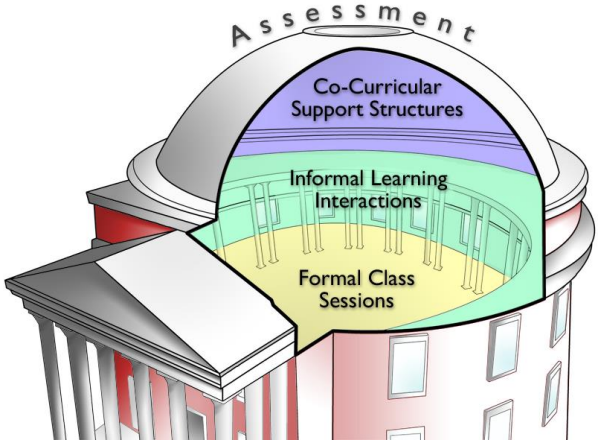


Figure 1 **Elements of a comprehensive learning environment**. While it is crucial that students have access to the instruction of formal class sessions, significant components of student learning also occur via informal interactions outside of class and as the result of student engagement with the co-curricular offerings of the university. Online learning environments should strive to engage students across all three levels.

In the undergraduate *PRODUCED* program developed at the University of Virginia, students connect into their education environment using two university-provided software collaboration tools, a university e-mail account, and the following items that they themselves must provide:

- An up-to-date laptop with a reliable high-speed internet connection (i.e., 1 megabit per second download speeds),
- A computer –based audio solution with microphone and speakers (e.g. headset, desktop speakerphone), and
- Either a scanner or smartphone equipped with an appropriate pdf creation app for rapid generation of digital documents (e.g., CamScanner).

While students in the program may know one another from their earlier studies, there is no requirement that the students be co-located for class sessions or other elements of the program, except for selected lab activities that occur periodically on campus or at regional centers. Rather, the Virginia-based students can participate in the program from any location in the world that offers a high speed internet connection.

The delivery of *formal class sessions* within this online program is supported by a learning management system (LMS) (e.g., Blackboard, Canvas, Moodle, Sakai). Since 2009, sessions have been delivered in a live (synchronous) format using a cloud-based web-conferencing software solution (e.g., Adobe Connect, Blackboard Collaborate, Cisco Webex) where audio and video interaction between on-campus and online students and faculty instructors can occur (Figure 2). To ensure that online students have equitable access to the real-time class sessions and to establish an alternative (backup) communication channel, all class sessions are recorded using the web-conferencing software. Further, a second recording and live one-way audio/video stream of all class sessions is provided to online students using a content capture software tool (e.g. Echo360, MediaSite, Panopto, Tegrity), further ensuring timely, backup online student access to formal class sessions.

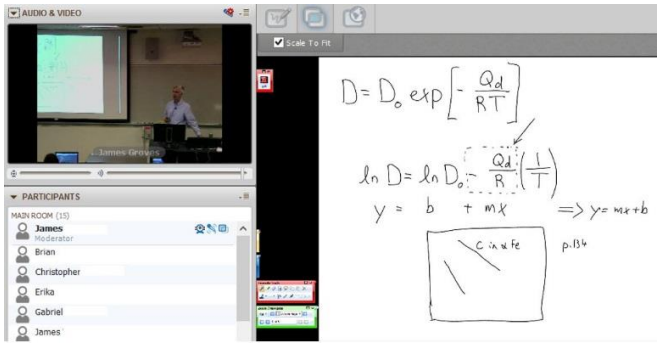
a)  b) 

Figure 2 **Interactive online instruction.** Web-conferencing software, student and faculty microphones, digital inking hardware (e.g., SMART Interactive Whiteboards, Wacom Graphics Tablets), and digital inking software (e.g. PDF Annotator) make it possible to instruct students in classroom settings and online simultaneously. a) The class session as seen on-campus. b) A class session as seen online.

The University of Virginia *PRODUCED* program described here has placed a premium upon synchronous engagement inside and outside of class sessions. This focus upon real-time interaction has several origins:

- Since courses in the program mix face-to-face students with online students and offer the same bachelor's degree to both groups, the university has felt that it is essential to provide all students the opportunity for equitable access to real-time, in-class dialogue with research-active faculty.
- Because the engineering programs of the University of Virginia are of modest size, it has not been feasible to create separate, fully online sections of courses just for online students. Rather, online students have been added into existing course sections where faculty have traditionally delivered live class session with the opportunity for real-time interaction with students.

- Many faculty consider real-time engagement with students to be an essential element of assessing understanding and guiding students to a higher intellectual level. Many want to probe and assess student knowledge and field student questions in real-time so that they can shape instruction accordingly.
- Early on, there was a recognition that online students did not want to be and should not be isolated learners. To succeed, they not only needed connection into class sessions but also the opportunity for substantive interaction with others in their courses and degree program outside of class sessions - to solve homework problems, to resolve misunderstandings of concepts presented in class, and to work on group projects that are a standard element of the undergraduate engineering curriculum. Thus, real-time interaction ability was seen as a key strategy for preventing the development of isolated learners who would begin to feel alienated and powerless.

Within the *PRODUCED* program, the desire to provide for real-time communication and collaboration has led to the adoption of two software tools paid for by university site licenses. For formal class sessions, the program employs a web-conferencing software platform that allows faculty to manage their mixed face-to-face and online classroom environment. The platform:

- Integrates into the university's learning management system,
- Permits online students to join class through a web browser on their laptop,
- Shows the names of the online students to faculty during class,
- Transmits audio and video from the physical classroom,
- Allows faculty to display a computer screen full of course content simultaneously to all students (on-campus and on-line) while making real-time digital ink annotations,
- Provides a mechanism by which online students can raise their hands to ask questions heard in the physical classroom,
- Allows remote students to be seen in class for special activities like student presentations, and
- Makes it possible to organize online students into small groups for "breakout room" discussions.

Despite its many strengths, the platform does not allow for particularly effective interaction between in-classroom students and online students during class sessions, beyond basic audio comments shared back and forth with the whole class via student microphones on the tables in the classroom or plugged into the computers of the online students. Additionally, while the web-conferencing solution conveniently allows regularly scheduled, recurring meetings (e.g., class sessions, faculty office hour sessions) to be set up in advance, the system does not facilitate spontaneous communication as easily. Finally, to access the web-conferencing environment, users must open a web browser, log into the LMS, create a conference session, share the session link (a web address) with other users, and then join the session. Thus, initiation of an online meeting in this environment does require pre-planning and participant coordination.

For *informal learning interactions* outside of class sessions, the program adopted a unified communication system (UCS) in early 2012 (e.g., Cisco Unified Communications, Microsoft Lync) that can connect online students with their faculty, fellow online students, on-campus

students, or others (e.g., alumni) anywhere on the internet. A UCS allows users to know who in their "community" is online at any time (a feature known as "presence") and communicate with those individuals or groups by text, audio, video, or sharing of computer screens. The system also allow groups of users to be defined within the system (by individual users or the university) so that students can quickly see who in a specific class or study group is currently available online (Figure 3). The UCS is a software application that can run continuously "in the background" on a user's computer. Thus, the barrier to spontaneous communication can be greatly lowered in comparison to the web-conferencing environment. When a user wishes to contact others in the UCS environment, they simply switch to the UCS program and initiate contact (e.g., send an instant text message). If a user wishes to temporarily shut off contact from all users, they can log out of the UCS program or post a "do not disturb" status indicator. If a user wishes to block all contact from a single user, the UCS environment makes that possible, allowing users to carve out a "safe" online space without unwanted intrusion.

Finally, *co-curricular support structures* provide online students with access to other important elements of the university education environment through various technology avenues. Co-curricular support structures may include such aspects of the university as library resources, career counseling, academic advising, alumni mentoring, student club activities, and special seminars. In some instances, e.g., access to library resources, online students connect to the university's electronic resources via the same web-browser based avenues employed by all other members of the university community. In other instances, e.g., career counseling and academic advising, the online students use the software tools employed for formal class sessions and informal learning interactions, i.e. the web-conferencing and UCS platforms described above, to connect to support resources.

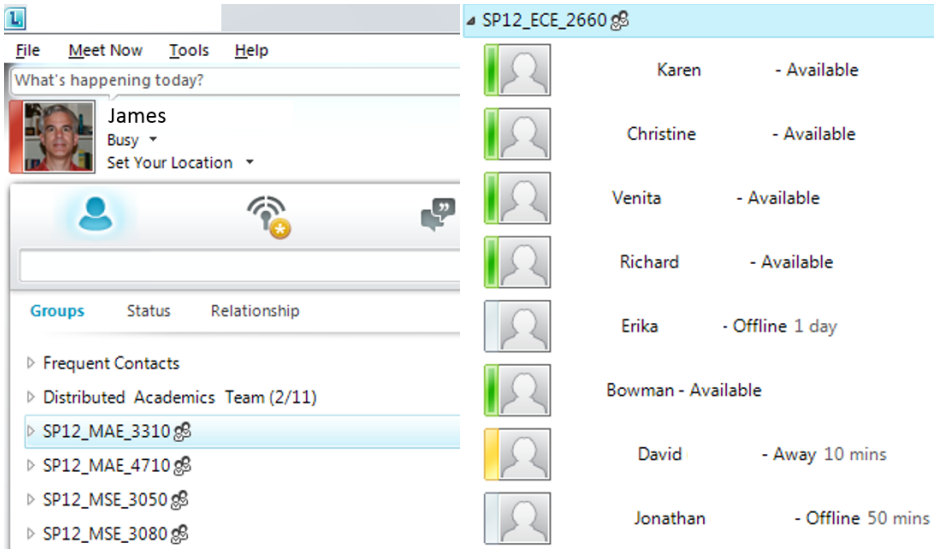


Figure 3 **Support for informal learning interactions.** Unified communication systems allow institutions to set up student groups based upon course enrollment. Students may then add those groups to their listing and see which students in their class are at their computer, any time of day or night. Students may then communicate with those individuals via several communication channels.

To function effectively in the real-time online education environment described here, students enrolled and faculty teaching online must be trained. Online program students are required to attend a two day orientation on campus prior to beginning their first classes in the program. The orientation helps to connect the students face-to-face, verifies that all critical learning environment systems function on the students' individual computers, and provides initial training for students in the use of key online tools. Faculty are offered training in the use of the environment's communication tools in a just-in-time manner. At the University of Virginia, faculty are expected to be research active. They generally wish to compartmentalize their teaching duties into fixed blocks of time, and they simply cannot invest large amounts of time in learning a complex set of online education tools. Thus, at present, their training occurs in a one-on-one setting, during the couple of weeks prior to the start of an academic semester. Then, throughout the semester, staff support faculty during class sessions and at other times as needed.

Student-faculty interactions

Once the online learning environment has been constructed and training has been completed, intellectual exchange can begin, with student-faculty interaction one key to student success.[7] The most important aspects of the student-faculty relationship are the timeliness of exchanges and assessment feedback and the clarity and tone of communication. While timeliness depends greatly upon the individual, timeliness in educational feedback can be facilitated by institutional selection of technologies and processes that facilitate rapid submission and return of student assignments. Communication clarity can be addressed by setting guidelines for online etiquette (i.e., netiquette) and expectations for participation in online discussions.[8] Furthermore, students and faculty should have a common understanding of what can be expected in terms of communication frequency, tone,[7, 8] and, when exchanges relate to student assessment, basis. Any rubrics being used to measure student participation and engagement should be clear.[9]

Although clear ground rules for online communication are important elements in a healthy learning community, they are not sufficient. For instance, instructors who teach face-to-face classes often share anecdotes and personal experiences that engage students during class sessions. The spontaneity and connection of such informality is quite often lost in online courses, even for courses that are distributed synchronously.[12] (The physical separation and subtle delays inherent in most internet-based audio and video systems today prevent the desired, somewhat intimate exchange of informal chat.) Thus, it is important for instructors to find other ways to spark interpersonal connections with online students. In asynchronous online courses, this bond may be created when an instructor shares a web page that presents the instructor on a more personal level. The instructor can also participate in student discussions, providing their own viewpoint, expressing humor, or offering praise. Students can also receive private feedback through emails or direct responses to their discussion posts.[9]

Instructors can play a critical role in establishing the conditions for online student success, by encouraging the development of student community, establishing certain expectations and rules, offering encouragement,[9] and acting as a facilitator and occasional mediator between students.[8] The instructor can initiate student-student bonding by requesting that students provide a short note on a class forum, introducing themselves to other class members.[12] Rather than asserting leadership in online discussions, faculty should adopt the role of communication facilitator,

posing course-related questions for consideration and redirecting conversations if they become too personal or emotionally charged. Assuming the role of a facilitator encourages development of a learner focused course and sets the stage for robust, student driven communication. A class that is learner focused is driven by the experiences and interactions between students and allows students to "construct" their own knowledge and capabilities.[8, 9]

For the recently developed *PRODUCED* program described here, faculty-student interactions are possible both in and outside of class sessions. During class, online students may make comments and ask questions by electronically raising their hand. Raising one's hand online sounds a digital "ding" in the physical classroom and places the online student's name at the top of the list of names of students joining the class session digitally. Once recognized, online students may verbalize their question or comment and be heard by all those in attendance. Separately, a number of faculty have begun to experiment with emerging web-based student response systems (e.g., Learning Catalytics, Top Hat Monocle). These systems allow faculty to pose various question types to students in real time in the physical classroom and online. After students respond with their answers, faculty can display the cumulative class response and discuss concepts. Both of these in class communication channels (hand raising and student response systems) represent substantive interaction channels through which faculty can provide timely feedback to online students.

Outside of class, faculty have tended to steer interactions with online students towards two communication channels: e-mail and the web-conferencing software environment used to deliver class sessions in the program. Experience shows that both faculty and students can be slow to respond to queries sent by e-mail, and students sometimes fail to understand the slightly more formal nature of e-mail communication with faculty, in comparison to text messages they might exchange with friends. So, while often used, e-mail sometimes represents a less than ideal communication channel through which to support online learners.

When communicating with online students in real time, outside of class (e.g., office hours), faculty have shown a preference for holding such sessions in the physical classrooms where they teach or over the telephone. The classroom environment with its online communication tools is familiar to them and easy to use without additional training. The challenge with use of classroom space for office hours is the availability of the classrooms. During the regular workday, classroom availability can be somewhat limited. While the UCS software platform described earlier is available to faculty for "spontaneous" communication with online students, at present, few faculty have shown interest in engaging students in this medium. The primary faculty concern appears to be time. They do not want to invest the time to learn how to use this additional software package. Secondarily, many faculty do not want to try and manage anytime, anywhere student interactions. Rather, given the other demands of their position, faculty want to compartmentalize interactions with students into specific office hours.

Finally, many faculty rely upon teaching assistants (TA) and graders to score homework and test assessments. Assignment materials from online students can be submitted electronically, usually in pdf file format, through the university LMS. TA's or graders can then retrieve the files, grade them using modern tablet and digital ink technology, and return the digital files through the LMS. Thus, if the faculty member provides a solution key in a timely manner and sets the

expectation of timely grading by the TA or grader, students online can receive assignment feedback quickly, at the same time as students on campus.

Student-student interactions

While the importance of student-faculty interactions may be considered largely self-evident, the potential for healthy student-student connections to motivate academic success is often undervalued. In face-to-face settings, student-student interactions include social contacts that occur before, during and after class and in other place-based locations like the gym, dining hall, or dorm. In purely online learning environments, opportunities for these types of informal interactions are largely absent, and online communication (particularly asynchronous communication) is further challenged by the typical absence of non-verbal cues such as facial expression, body language, and tones of voice that convey emotion.[8] Further, students are often less careful about what they say online due to "reduced social awareness".[8] The absence of non-verbal cues and blurred boundaries can lead to negative student-student interactions that cause feelings of alienation[10] and pose a threat to development of and stability in the online community.

As with student-faculty interactions, student-student interactions are strengthened by the articulation of rules and boundaries for communication that help to avoid misunderstandings which could undermine the formation of community development between students.[7, 8] West believes the most appropriate definition of community revolves around the feelings of trust, respect and relationship.[7] Trust and respect can be developed through peer interactions, with faculty playing an important role in constructing safe learning environments for discussion.[8, 9] As students build a community based on trust, respect, interdependence, membership and connectedness, their social and academic needs are met through the group interactions.[10] Then, as members of a strong community they have the ability to direct their experiences, thereby relieving feelings of powerlessness.

During the spring of 2013 an online survey was administered to the students enrolled in the University of Virginia online undergraduate engineering degree program to explore how they currently experience connections to other students and the broader co-curricular environment of the engineering school and to identify student needs and articulate gaps in the program's ability to meet those needs. This survey was seen as an early step towards understanding if the structure of the program learning environment supports student persistence. Nineteen students completed the survey as part of the evaluation project.

Within the survey, online students were asked to gauge their current level of connection to other students and to indicate their level of connection to co-curricular elements of the university environment. All questions in this part of the survey were measured using a 6 point Likert scale as follows:

1 = Strongly Disagree
2 = Disagree
3 = Somewhat Disagree
4 = Somewhat Agree
5 = Agree
6 = Strongly Agree

For this part of the survey, a gap analysis was also performed, comparing the level of student satisfaction with a particular element of student community with the level of importance placed on that element by the student. Results were then calculated in terms of a median score (M), a standard deviation (SD), and a gap analysis (gap – between actual and desired level of connection). Thus for each area explored by this survey section, students were asked to use the Likert scale and rate their level of agreement with statements of this form:

- I feel connected to…
- It is important for me to feel connected to…

The survey revealed the following student connection results:

Connection to online students in the program	M = 4.21, SD = 0.98, gap = 0.68
Connection to on-campus students	M = 2.37, SD = 0.90, gap = 0.21

Survey results indicated that the online students felt much more connected to other online students in the program than to on-campus students studying in the same engineering classes and degree program. The results suggested that while the online students felt somewhat connected to one another, they very much desired greater linkages. Somewhat interestingly, the online students did not feel as strongly about the importance of deeper connections to on-campus students. In general, interactions between online and on-campus students at this time remain low. On-campus students have access to the supportive residential environment and do not feel the need to invest more effort to connect with additional, largely unseen, students online.

The survey revealed the following results related to connections with co-curricular activities:

- Library resources M = 3.84, SD = 1.01, gap = 0.63,
- Library staff M = 3.05, SD = 1.35, gap = -0.32,
- Engineering career services staff M = 3.05, SD = 1.31, gap = 0.84,
- Engineering career services events M = 3.21, SD = 1.62, gap = 0.95,
- Engineering career services resources and services M = 3.68, SD = 1.45, gap = 1.06,
- Engineering school events M = 2.79, SD = 1.44, gap = 1.05.

While all of these results indicate a fairly low level of connection between online students and co-curricular elements of the university, it is important to recognize that online program administrators only began to make a first set of co-curricular resources available to online students during the year before the survey. Prior to that time, the program administrators were focused upon constructing a robust infrastructure for class session delivery. So, the online students answering the survey have not yet been given significant opportunities to engage with co-curricular offerings.

In a second part of the survey, online students were asked to indicate the frequency with which they used certain tools to connect with one another. All questions in this section were measured using the following frequency-based scale:

1 = Several times a day	4 = Once a week
2 = Once a day	5 = Never
3 = Several times a week	

The survey revealed the following ranking of tools for communication and collaboration:

- The UCS tool provided M = 2.32, SD = 1.34
- E-mail M = 2.95, SD = 1.18
- The web-conferencing tool provided M = 3.47, SD = 1.58
- Skype M = 3.74, SD = 1.73
- Google tools like G-chat M = 4.63, SD = 0.60
- Social media M = 4.68, SD = 0.95

The level of adoption of the UCS tool as a primary means of communication among the students in the online program is quite encouraging considering that the tool was first deployed to students just 15 months before the survey and that a number of students enrolled in the program "pre-date" the availability of the UCS tool. Thus, it is reasonable to think that some of those students would have independently identified their own alternate avenues for communication and collaboration. Then, once they began to use those other tools, it is possible that they would have demonstrated some reluctance to shift to the new UCS environment.

Anecdotal evidence does suggest that the UCS environment has proven to be quite attractive to newly enrolled online students in the program, thus helping to reduce feelings of isolation while supporting academic success. One online student who first enrolled in the program in the fall of 2013 recently stated that he feels more connected to his fellow online students than he ever did when he was studying at his community college. At the community college, he would come to campus for class and leave immediately afterwards. He always had to work on homework and to study alone. In the online program, with access to the UCS tool, the student indicates that he values the ability to see which of classmates are at their computers at any time during the day or night and then contact them with a level of interaction appropriate for his needs. Sometimes instant message chat is sufficient to answer a quick question. At other times, a more substantive audio or desktop sharing connection is desired, and the UCS environment quickly delivers such engagement.

Conclusion

As online education continues to grow in popularity, educators should consider designing their online education environments with student engagement and academic persistence in mind. Developing strong student communities can have a positive impact on both. If community is absent, students may feel alienated from their institution and their peers as well as feeling powerless to exert control over their learning experience. A sense of community can be fostered through positive student-technology, student-faculty, and student-student interactions. Online program administrators and enrolled students need to work together to craft an education environment that supports the development of trust and respect so that personal bonds can develop among all those involved with the online program. Early results of efforts to build student community into a synchronous online education program show promise. Indeed, synchronous tools for intellectual exchange appear to offer promise as a way to alleviate community development concerns related to the absence of non-verbal clues and reduced social awareness seen in asynchronous, often text-based communication media. The results also

indicate that more effort is needed to take advantage of the real-time connectivity afforded by emerging technologies.

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Bibliography

1. Allen, I. E. & Seaman, J. (2013). Changing Course: ten years of tracking online education in the United States. *Babson Survey Research Group and Quahog Research Group, LLC.* Retrieved from: http://www.onlinelearningsurvey.com/highered.html
2. U.S. Department of Education (2009). *Evaluation of evidence-based practices in online learning: A Meta-analysis and review of online learning studies*. Retrieved from: http://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf
3. Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, *18*(1), 32-42.
4. Lave, J., & Wenger, E. (1991). *Situated learning. Legitimate peripheral participation.* Cambridge: Cambridge University Press.
5. Johnson, D. W., & Johnson, F. P. (1994). *Joining together: Group theory and group skills.* Boston: Allyn & Bacon.
6. Erika Powell, E. D. (2014). A Performance Approach to Designing and Measuring Career Development Interventions for Online Engineering Students. Dissertation. The University of Virginia.
7. West, R. E. (2010). A student's guide to strengthening an online community. *TechTrends*, *54*(5), 69-75.
8. Palloff, R. M., & Pratt, K. (2007). *Building online learning communities: effective strategies for the virtual classroom.* 2nd ed. San Francisco: Jossey-Bass.
9. Rovai, A. P. (2004). A constructivist approach to online college learning. *The Internet and Higher Education*, *7*(2), 79-93.
10. Rovai, A. P., & Wighting, M. J. (2005). Feelings of alienation and community among higher education students in a virtual classroom. *The Internet and Higher Education*, *8*(2) 97-110.
11. Bocchi, J., Eastman, J., & Swift, C. (2004). Retaining the online learner: Profile of students in an online MBA program and implications for teaching them. *The Journal of Education for Business*, *79*(4), 245–253.
12. Canada, M. (2000). Students as seekers in online courses. *New Directions for Teaching and Learning*, *2000*(84), 35-40.