



A Transdisciplinary Approach for Developing Effective Communication Skills in a First Year STEM Seminar

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Abstract

Many STEM graduates leave school academically prepared in their fields however business leaders have been stating that they often lack the more intangible qualities such as teamwork, critical thinking, communication skills, and the ability to manage interpersonal relations. These are often referred to as "soft skills", yet they are tightly coupled with professional performance. Furthermore, they are all connected to basic communication skills, commonly referred to as oral and written communication, and their close counterparts, listening and reading. Such skills are not only add-ons to a STEM job, they can make the difference between a successful and a failing career, team, or even corporation. In the last decade there have been efforts such as those by the Association of American Colleges and Universities (AAC&U) to advance broad-based systemic innovation to build and sustain strong undergraduate education in the STEM fields.

Our group is in the early stages of an innovative initiative to provide alternative communication and humanities learning environments in STEM higher education. The group consists of faculty from several academic units including liberal arts, libraries, and technology. One of the learning experiences currently being tested involves the tight coupling of all forms of interpersonal communication, and information literacy with technological concepts. These are integrated into a learning experience aimed to develop the capacities of interpersonal communication and social and cultural awareness in a seminar environment.

This paper will describe the design of a seminar learning experience called Culture, Communication, and Digital Narratives. On the surface, its purpose has the appearance of combining oral and written communication with information literacy and technology. However the seminar is much more, promoting storytelling as a way of thinking. Our value proposition is that artistic storytelling can help students learn, create, and communicate. The goals of the learning experience include enabling learners to more effectively discover creative ideas, understand themselves and other people (audiences), and communicate about them in a storytelling fashion, using performative and mediated techniques. As such, we have created a transdisciplinary, student and project-driven learning experience that enables students to communicate more effectively, and function in a professional context.

All activities are structured into modules that combine oral, written, and performative communication. Students are immersed in both classical and contemporary theories and methods of communication. They learn on how to use ethos, logos and pathos-oriented messages, in the manner prescribed by Aristotle. They learn how to use cultural and intellectual meta-thinking for avoiding ethnocentric and biased message production. Students learn about these concepts by doing. They tell stories, engage in ethnographies, critique email correspondence or creating arguments via oral, written, video and auditory production. All projects are evaluated through a continuous process of feedback. We do not use a traditional grading method. Instead, each project contributes to acquiring a specific set of competencies. When the project deliverables demonstrate that the competencies are mastered, students are awarded "badges" that certify mastery. We adopted the successful Open Passport Badging System adapted by our university from the Open Badge Platform initiated by the Mozilla Foundation. We will describe our process of generating communication competencies from AAC&U inspired rubrics, and how these were mapped to learning outcomes, learning activities, and badges in the seminar environment. We will address the flexible strategies needed to manage the notions of time, place, or pace of learning. We will also present our findings from our first cohort, currently immersed in the seminar learning environment. The paper presents our suggestions for improvements of the seminar learning process.

Introduction

Many STEM graduates leave school academically prepared in their fields; however, business leaders have been stating that they often lack the more intangible qualities such as teamwork, critical thinking, communication skills, and ability to manage interpersonal relations^[5,13]. These are often referred to as “soft skills”, yet they are tightly coupled with professional performance and career growth.

Derek Bok has claimed “it is impressive to find faculty members agreeing almost unanimously that teaching students to think critically is the principle aim of undergraduate education”^[6]. However, several recent reports cast doubt on the effectiveness of universities in delivering this goal. For instance, the book *Academically Adrift*, from 2011, claimed 21st century graduates are woefully underprepared for the workforce in regards to these “soft skills”^[4].

Furthermore, these so-called soft skills are all connected to basic interpersonal communication skills, commonly referred to as oral and written communication, and their close counterparts, listening and reading. Such skills are not merely “add-ons” to a STEM job; they can make the difference between a successful and a failing career, team, or even corporation. In the last decade there have been efforts such as Project Kaleidoscope by the Association of American Colleges and Universities (AAC&U) to advance broad-based systemic innovation to build and sustain strong undergraduate education in the STEM fields^[2].

This paper describes the design of a seminar learning experience called *Culture, Communication, and Digital Narratives*. On the surface, its purpose has the appearance of combining oral and written communication with information literacy and technology. However this seminar is much more, promoting storytelling as a way of thinking. Our value proposition is that artistic storytelling can help students learn, create, and communicate. The goals of the learning experience include enabling learners to more effectively discover creative ideas, understand themselves and other people (audiences), and communicate about them in a storytelling fashion using performative and mediated techniques. As such, we have created a transdisciplinary, student and project-driven learning experience that enables students to communicate effectively, and function in a professional context.

Design of seminar learning experience

Over the last fifteen years there have been calls for “rebalancing and redistributing” higher education, and establishing clearer distinctions between “training” and “education”^[9,10]. Our group is in the early stages of an innovative initiative to provide alternative communication and humanities learning environments in STEM higher education. The group consists of faculty from several academic units including liberal arts, libraries, and technology. One of the learning experiences currently being tested involves the tight coupling of all forms of interpersonal communication and information literacy with global challenges facing humanity and technological concepts. These are integrated into a learning experience aimed to develop the capacities of interpersonal communication and social and cultural awareness in a seminar environment.

Culture, Communication, and Digital Narratives aims to provide students with a toolkit for successful communication in contemporary society and the workplace. This integrated course experience invites students to reflect and use diverse ways of communication in the digital era. During one semester, participants were introduced to oral, written, visual and auditory techniques of communication, and documented through various digital media artifacts.

Our value proposition that artistic storytelling can help students think, communicate and aid in their emotional wellbeing is backed by a long history of scholarship. Such seminal articles as K. Egan's "Memory, Imagination, and Learning: Connected by the Story"^[8] argue storytelling is a link to more meaningful understanding. Similarly, Abrahamson's article "Storytelling as a Pedagogical Tool in Higher Education" describes how speaker and listener come together on a deeper "cognitive and emotional" level through storytelling. More recent studies such as Ya-Ting and Wu's "Digital storytelling for enhancing student academic achievement"^[19] compound results that storytelling participants performed "significantly better" than non-participants in terms of "critical thinking and learning motivation"^[19].

Rather than exploring communication only from an oral or written perspective, we approached communication in the context of contemporary technology. We stipulated that all artifacts of communications were "mediated" or "performative." On the one hand, mediated communication is seen as supported in some kind of physical format, for example written word on paper or images on photographic film. We include in this category electromagnetic formats as well, such as digital files. On the other hand, communication is performative when it occurs at one specific moment, like giving a speech or playing a musical instrument.

To help identify and encourage each student's intrinsic motivation, they were steered to the Globaltopia^[11] web site, where they examined the site's "Top 10 Challenges Facing Humanity". Students were asked to research the ten challenges to help them determine what they care about (their passions) and link them to one or more of the challenges. This ongoing encouragement throughout the learning experience was intended to serve as their motivation for topics related to seminar activities.

The student activities in the learning environment were structured into overlapping modules that combine oral, written, visual, and auditory communication in the contexts of mediated and performative communication, thus combining and extending the classic first-year English composition and Fundamentals of Speech classes and extending them to also include information literacy concepts. Students are immersed in both classical and contemporary theories and methods of communication. They learned about various rhetorical techniques of argumentation from both classical sources (such as Aristotle) and more contemporary sources (such as Walter Ong). They learned how to use cultural and intellectual meta-thinking for avoiding ethnocentric and biased message production. They also were immersed into the theories and methods of communicating emotion, and the physiology of visual and auditory communication, involving sources such as Levitin's "This is your Brain on Music"^[15], Nachmanovich's "Free Play: Improvisation in Life and Art"^[17], and Storr's "Music and the Mind"^[18].

Students learned about these concepts by doing - they told stories, engaged in and composed ethnographies, critiqued email correspondence, made films, and overall created arguments and conveyed emotion via oral, written, video, and auditory production. They performed physiological measurements, such as using mobile phone apps to compare their resting heart rate in a quiet room to their heart rate when music was played. Information literacy concepts such as research question identification, mind mapping, search techniques, and proper citation and reference documentation were interleaved, and made a component of all activities and projects.

All projects were evaluated through a continuous process of feedback. A traditional grading method was not used; instead, each project contributed to acquiring a specific set of competencies. When the project deliverables demonstrates that the competencies are acquired, students were awarded "badges" that certify mastery of developing level skills.

Badging

Badging, or microcredentialing, is a process by which students can be evaluated on skills and knowledge at a more granular level than a whole course. In our current educational model, when an employer reviews the transcript of a student who received a B in a class, that employer cannot distinguish whether that student did everything in the course pretty well, or is particularly good at some skills yet unable to complete other tasks¹². The concept with badges, and why there is increasing interest in the potential use in education, is the ability to measure particular skills that are encompassed in a class.

Moreover, badging also works to incentivize students. In Kapp's *The Gamification of Learning and Instruction*^[14], the argument that gamification of education provides both intrinsic and extrinsic motivation is outlined. In this source, it's further outlined that this type of gamification seems "to foster higher order thinking such as planning and reasoning". Hence, badging fits well into our stated goals.

This type of learning is only amplified by the feedback loop a badge system invites. Students all begin their college experience with different backgrounds and levels of learning in written and oral communication. The badge feedback loop is designed to bring students to a solid integration of the communication skills at a developing or foundational level as outlined in the AAC&U VALUE rubrics, which provided the framework for our University's Core Curriculum. The switch to a constant feedback and revision loop is a large cognitive shift for the students, most of whom have come from a tradition of submitting in an assignment, receiving a grade, and moving on to the next task.

This traditional method tends to discourage reflection on learning and continuing to refine work to show a true attainment of understanding of a particular topic. Moreover, badging is intended to signify understanding and mastery. As such, we adopted a schema such that the awarding of a badge represented a grade of "A". The non-awarding of a badge merely means "try again", not failure. Therefore, students who were not awarded badges needed for mapping to a course by the end of the semester would be graded as "incomplete", allowing for extra time. Only students who actively disengaged from the experience and did not submit artifacts would suffer a grade of "F".

To help facilitate and centralize badge development, organization, and stakeholder access, we adopted the successful Open Passport Badging System adapted by our university from the Open Badge Platform initiated by the Mozilla Foundation^[14].

In this first semester, we worked with the equivalency of one badge corresponding to approximately one credit hour of work. Given approximately 3 to 6 learning outcomes for a well-designed class, the learning outcomes can map approximately to one or more competencies (badges). Competencies then, can be associated together to form the basis of mapping to a traditional college course. For example, one of the badges created for oral communication is called "Developing Storytelling". The word "Developing" in the title denotes a foundational level of competency that the badge signifies. The badge focuses on these learning outcomes:

- To improve skills in the composition and delivery of speeches
- To demonstrate oral and nonverbal delivery skills and the ability to interact effectively with an audience
- To develop one's ability to think on his/her feet (improvise) before an audience

Within each badge, one or more "challenges" were created. A challenge roughly corresponds to one or more activities where artifacts were submitted for evaluation by an "expert". In our case experts were composed of faculty instructors, but the Passport Open Badging system provides for the allowing of outside experts, such as industry professionals, to participate. Submitted artifacts can take on many forms,

including quizzes, written assignments, website design, or even full portfolios containing multimedia content. Challenges for the Developing Storytelling badge consisted of

- A Storytelling learning module – attendance and participation in a mini-lecture that could be repeated up to three times
- Preparation and demonstration of a Knowledge Inventory
- A Narrative Mediated Communication
- An Audiovisual Narrative
- An Extemporaneous Speech

The challenges served to address each of the three learning outcomes. The knowledge inventory and mediated communication challenges served to help address the composition of a speech. The learning module helped students understand and practice delivery techniques, while the audiovisual and extemporaneous speech components addressed the students development of improvisation skills while speaking. Students could choose the topics related to their narratives and speeches. This flexibility served the student’s intrinsic motivation and independence.

The learning outcomes from the traditional first year Fundamentals of Speech and English classes provided the basic learning outcomes that form the foundation for the Digital Narratives class (which, in turn, are linked to State transferability requirements). These learning outcomes were used to define the badges for the Digital Narratives seminar learning experience. For our Digital Narratives course we produced 8 badges: 4 for English, 3 for Fundamentals of Speech, and 1 for Information Literacy. In each badge there were 3-5 challenges, totaling 29 challenges across the 8 badges. The parallel construction of the badges to the more traditional classes and credit hour system also facilitated the broader understanding at the university where our learning experiences can map to classes for use on transcripts. In addition, this ability to map to the existing structure enables transferring into and out of the program more easily.

The 8 badges also represented credit hours for core foundational university outcomes, a 4-credit English composition course, a 3-credit hour fundamentals of speech course, and 1-credit hour of information literacy. Typically the information literacy component is hidden within the English course. We extracted it to provide clarity to the students.

Student paced learning

The learning environment consisted of 35 first year, first semester students initially, 33 at the end of the semester, where approximately two thirds had declared majors in Technology and the remaining one third were exploratory studies students. Of the Technology majors, roughly one half were from a single major while the remaining half were distributed across the remaining six majors in our College of Technology. Table 1 illustrates additional demographics.

Table 1: Digital Narratives Seminar Demographics

| | Male | Female | URM | International | Total |
|--------------------|-------------|---------------|------------|----------------------|--------------|
| Students | 27 | 6 | 4 | 5 | 33 |
| Faculty | 4 | 1 | | | 5 |
| Instructors | 1 | 2 | | | 3 |

While the number of faculty participating was high, they were not all together all the time. In most cases there were three of the five faculty attending nearly all the sessions. Instructors were present for only 1.5 hours three times during the semester, and participated in evaluating student submissions. In general, the student to faculty ratio was approximately 11:1, but would often rise to about 16:1.

As mentioned earlier, the concept behind competency-based education is to foster a continuous feedback loop where the students work to produce and revise an artifact until it demonstrates an expected level of competence for a given badge. The learning experience was structured with soft deadlines for the students to submit work, with the idea that the loose deadlines would provide the room for students to create an item of the highest quality without penalty if it is several days past the due date.

As expected by the faculty, students displayed a lack of comfort with a model that allows and encourages growth and learning rather than just measuring current skills. This paradigm caused many of the students to feel like they were failing when artifacts were returned for further refinement or revisions. The back and forth nature of submission, followed by denial with feedback, caused the students a certain amount of stress, as they are accustomed to just receiving a grade for work completed and moving on to the next task. Constant revision and refinement with feedback was a frustration in many cases. Over the duration of the semester many students began to “get it”, engaging with faculty more often and with more focus in an effort to review work and obtain feedback prior to their submission of artifacts.

Figures 1, 2, and 3 illustrate the patterns of student submission of material to meet challenges for different badges during the course of the semester. Initial submissions for a challenge and resubmissions are not distinguished in the graphs. There are some artifacts in the patterns that bear discussion. As can be clearly seen in Figure 1, there are several submission bursts, represented by higher spikes, in the 15-18 submission range at several points in the semester. These predominantly represent student attendance at a few required sessions, each offered at 3 different times during the semester. The attendance was all recorded on a single day and for all students present in a given session, thus creating the scattered submission spikes.

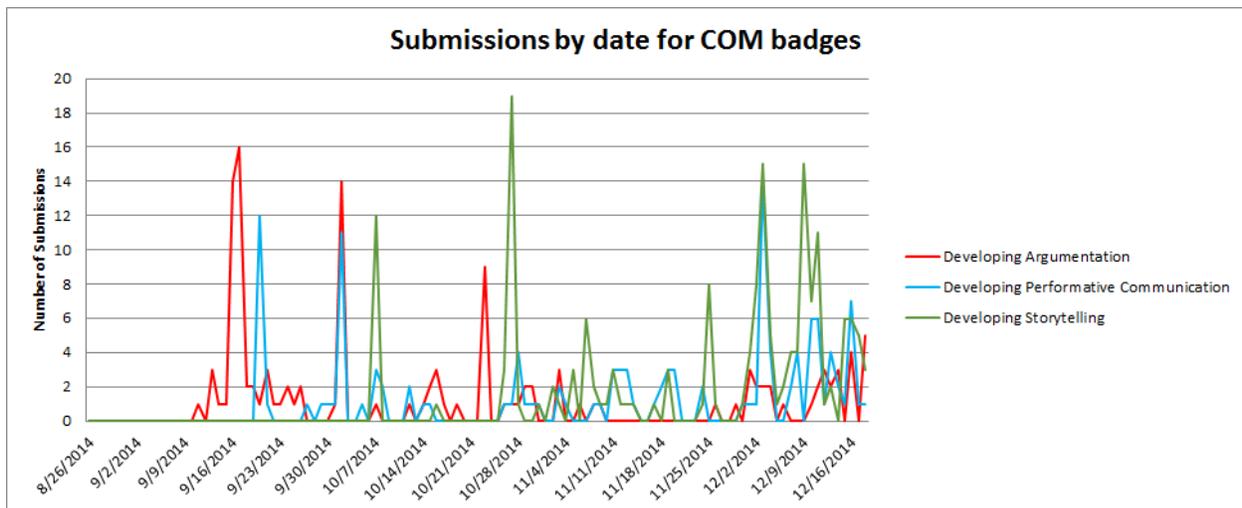


Figure 1: Fundamentals of Speech (COM) Badge Submissions

Figure 2 shows an even more dramatic single burst in submissions. This is accounted for as an administrative decision made among the faculty to do the ‘bookkeeping’ in the badge system in a single afternoon, creating a time when most of the students were all awarded credit for submitting and earning a particular badge challenge in one day. It is also noteworthy to observe that the intensity of submissions increased significantly in both figures 1 and 2 from approximately late November (Thanksgiving) until the end of the semester in late December.

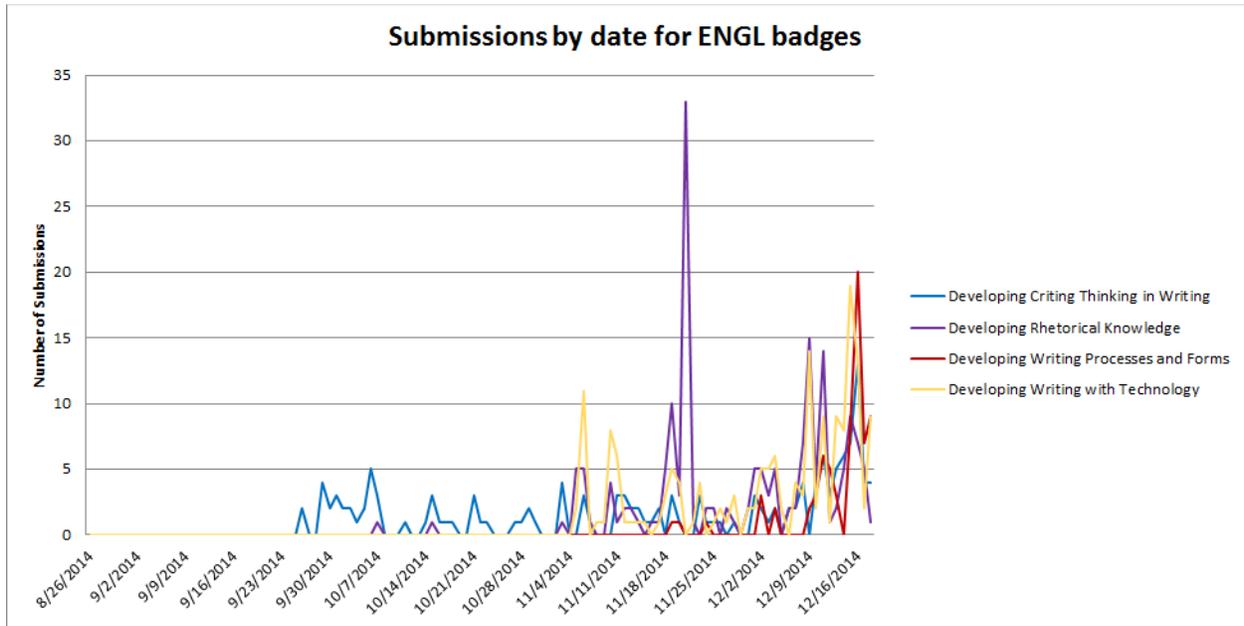


Figure 2: English Badge Submissions

Figure 3 shows a burst of submissions near the beginning of the semester that is not reflected in either Figure 1 or Figure 2. During the first two meetings of the group, there was a hands-on experience and an associated non-credit badge to which challenge artifacts needed to be submitted. The exercise helped the faculty learn more about the students and served to familiarize all of faculty and students alike with much of the functionality within the Passport badge system. This badge was not associated with course outcomes so it was awarded, but not for credit. Figure 3 also reflects the increase in submission intensity for all badge challenges near the end of the semester.

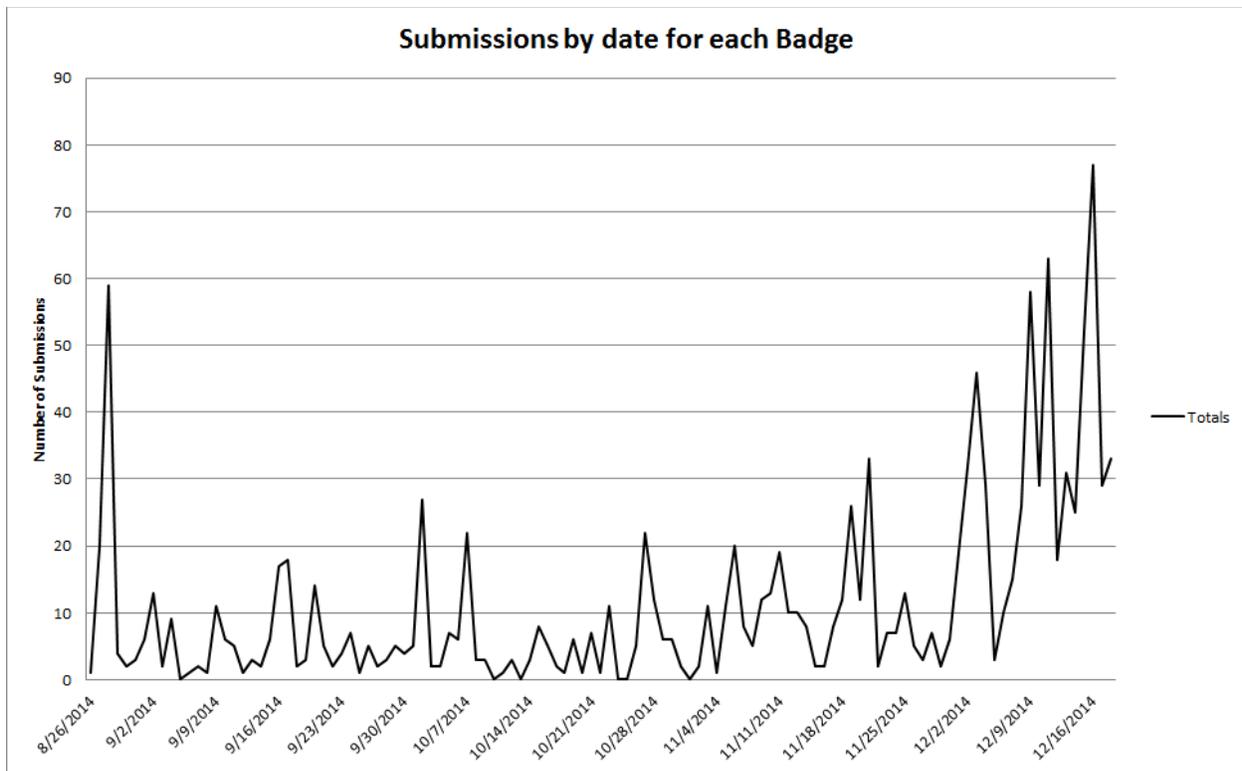


Figure 3: Cumulative Badge Submissions

Observations and lessons learned

What we observed from the submission data is that students interpreted this as not having a deadline or due date and waited to submit much of the work until the end of the semester, and a very real deadline was approaching. This pattern can be seen in Figure 3, the total number of submissions by date over the duration of the semester, where the rising number of submissions as the end of the semester is drawing closer is apparent.

In addition, through time spent in the environment, particularly during unstructured studio times, it became apparent to the faculty that first year students required more scaffolding to the learning experience than we had initially estimated. This was evidenced by a relatively high ratio of incomplete grades (roughly 30 percent for each course) at the end of the semester. Of the 30 percent, only four students have significant work (more than 25 percent of the badge challenges) to complete.

Another phenomenon observed was that written feedback is easily misinterpreted or taken more harshly than intended when written by the faculty member, which causes additional tension in the revision and resubmission process. The need for a more structured use of our studio times in the classroom has been identified, where conversations can be held with the students, rather than the more formal feeling written feedback, particularly when accompanied by a ‘deny’ decision, which is the only option other than accept in our badging platform, does little to help build the students confidence and encourage their continued growth.

The students were asked for feedback on the learning environment and the overall experience several times during the semester. In addition, a small group of the students agreed to be on-campus in the week

before the next semester began to participate in a planning retreat where they reflected on the previous semester and offered opinions on what went well for them and what should be maintained as well as what they would like to see changed or improved.

Not surprising was a request for more firm deadlines and more proactive coaching toward completion of the challenges. This is interesting in that a paradox exists with firm deadlines. The learning paradigm was one of soft deadlines, to the point where students could obtain a grade of incomplete if not finished by the end of the semester. Hard deadlines imply a penalty for non-conformance. Penalties traditionally range from a zero on an assignment, or some percentage point penalty. In a badge system, there are no points, and one either earns the badge or does not. What then, is the penalty for being late? What is the meaning of late when a submission is denied, and feedback given for a subsequent submission? Every student posed with this question immediately understood the paradox. Finally, a clearer alignment of the class projects with the different badge challenges and competencies would benefit the students in understanding the course structure, and the faculty in an ability to consistently point students to the proper resources in response to questions.

Conclusion

Business leaders have been stating that STEM graduates often lack intangible qualities such as teamwork, critical thinking, communication skills, and ability to manage interpersonal relations. This paper describes the design of a seminar learning experience called *Culture, Communication, and Digital Narratives*. The purpose was to immerse first year STEM and exploratory students into a learning experience that extends the integration of interpersonal communication concepts beyond writing and public speaking. Visual, auditory, and information literacy components where students use a variety of technologies are incorporated in a project-based collaborative environment, facilitated by faculty from three distinct areas namely Liberal Arts, Libraries, and Technology.

Besides the tight coupling of different, yet related communication areas, the learning environment paradigm featured a significant dose of student choice to motivate the intrinsic motivation of each learner, guided by the top 10 challenges facing humanity. The hypothesis here was that an intrinsically motivated student will enjoy their projects, spend more time on them, and produce the highest quality artifacts. This was evident in at least half of the class, where others struggled to find or articulate their passion.

The assignment and assessment model was based on competencies rather than courses. University core learning outcomes and established courses were used to map outcomes to competencies, where the work required for mastering each competency was designed to approximate that of a credit hour. This method was chosen to provide feasible mapping between groups of competencies and traditional courses, useful to the institution for transcripting and transferability purposes.

Our exploration of the rate of badge challenge submissions over time yielded interesting insights, especially as the semester neared its end. One statistic we will be exploring further is the number of submissions per badge challenge, per student. In other words, how many times do students make submissions before the challenge is approved and the badge is awarded? Moreover, how does this vary by student and by badge?

The faculty and students learned a great deal - together. What is interesting to us as faculty, and is likely nearly impossible to measure, is the amount of time-management skill and self-awareness we perceived as learned by those students who struggled with the level of independence they had, resulting in incomplete work. We plan to reproduce an environment similar to this again in the fall of 2015, and plan to implement more scaffolding in the form of direction, and proactive design reviews to temper the rate of artifact submissions.

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