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Invited Essay

MOOCs and me

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Abstract: This invited essay explores one emeritus faculty members experience as a student in a MOOC.

Keywords: MOOC, learning, elearning, massive open online course

I recently enrolled in, and completed, a MOOC, partly because I have been following the discussion about them (I have, at the moment, compiled a library of 27 articles, blog posts, and other materials that have appeared since the middle of April), but perhaps primarily because I had volunteered to make a presentation about MOOCs to an organization of which I am a member.[2] Our meeting was in mid-May, and I thought I would be able to talk more intelligently about MOOCs in general if I had some experience with at least one of them.

My plan was to enroll in a course outside my discipline (economics), and in which I was interested, so that I would be able to experience the course as a student, not as someone with a considerable store of knowledge. Unfortunately, given my time frame, I was unable to find such a course that began in early-to-mid April. I wound up in a course that explored the economic development of the world from roughly the mid-18th century to the present.

The course, which began near the end of April, ran through about the end of June. According to an end-of course communication from the instructor, 28,922 people enrolled. During the eight weeks of the course, the instructor presented eleven video lectures, which were subdivided into a total of 63 individual videos, which totaled about 26 hours and 40 minutes of material.[3] In general, each section of the lectures (all 63 of them) had one or more ungraded learning activity for which sample answers were provided.[4] The lectures, which were well-organized, well-sourced, and generally well-presented, were (essentially) a talking head accompanied by Power Point slides. Copies of the slides were available as .pdf documents. Generally, an un-graded learning activity accompanied each video, with suggested answers. According to the end-of-course communication to the class from the instructor, "there were 164,946 viewings" of the lectures, or an average of over 2,600 for each lecture part. In addition we were provided with an extensive (25 page) list of suggested readings, of which over 100 items were available on-line. I obviously do not know how much anyone else read, but (given that I am actually quite interested in this material) I downloaded what was available and have so far read about half of it.

The course also had, for each week's lectures, on-line discussion forums. The forums were created (and their topics determined) by the enrollees; in general, the discussions were wholly among the students, although the instructor and a couple of assistants would add

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[3] In a typical 15 week semester for a class meeting 150 minutes per week, and (in the case of a typical class that I would teach) losing 150 minutes for in-class tests, there would be about 35 hours of class time, to be used for all in-class activity. So this looks to be roughly equivalent in terms of time to a regular semester course.

[4] All this is from the course website.

comments that dealt with issues that the enrollees really could not provide answers for. The discussions were generally civil and well-conducted, although my estimate is that well over half the posts were personal opinions of the posters, often with little support beyond the personal experience of the poster. Most posters did so using their own names, which I think contributed to the civility of the conversations. We were informed at the end of the course that there were 423 discussion threads, with a total of 2,370 posts and 1,413 comments. So the discussions were fairly active.[5] But, as usual, a small number of enrollees accounted for most of the activity. Based on the list of most active discussion forum participants, I calculate that only about 90 people were really active in the forums; they created about 44% of the threads and made about 44% of the posts; the 10 most active posters accounted for about 19% of the posts. (As I note below, only about 500 people completed all of the course activities.) (I don't completely trust this, because this includes people who created 0 or 1 threads and made even a single post. I don't see how it's possible to be less active than that.)

There were three peer-assessed activities; if one submitted a response to the activity, one was expected to grade a minimum of three posts by fellow-students. Many participants graded more than three. Two of these had word limits (activity 2 had a limit of 1,000 words and activity 3 had a limit of 1,500), which were widely ignored.[6] We were provided with rubrics for assessing the work, but I'm not sure that they were detailed enough. Also, we were not provided with examples of what an assessment should look like.[7] Grading was on a 1 (inadequate) to 4 (outstanding) scale; to receive a Certificate of Completion, one had to complete all three activities with a minimum score of 2. While there was clearly a large variance in how people approached grading, most of the feedback that I received was reasonable, and included comments that I agreed with about the strengths and weaknesses of what I submitted.

My judgment is that the course content is similar to what would be provided in a campus—based course, either in-class or on-line. But the assessment of learning was, I think, wholly inadequate for course credit to be awarded for the class in any college or university. The inadequacy of the learning assessment is partly the extremely limited amount of the course material for which assessments were done, but also because of the peer assessment system. As I noted above, my experience with it was fairly positive. But, in fact, the assessment was handled by people who were not fully capable of assessing the validity of the arguments made in the activities. So as hard as people worked, it is unreasonable to expect them to have been able to provide the kind of assessments and feedback that someone with extensive disciplinary knowledge could provide.

And how did the students in the course do? Again, based on the end-of-course information provided by the instructor, out of the (roughly) 29,000 registrants, only 12,917 did ***anything*** in the course, only about 700 completed the first activity, and only about 500 completed the second and third activities. We were told that the average scores on activities 1 & 2 were 2.86 and 3.06, respectively; no data were provided for the third activity. At most, then, the completion rate was somewhere under 2% of registrants and under 4% of those who participated at all. Granted, in a free course with no real payoff at the end (unless you think a

[5] The most active thread appears to have been one of the gold standard (which I initiated), with 112 posts.
[6] My own judgment is that these limits were considerably too strict.
[7] My approach was to list all of the items in each rubric and "score" each assignment of each component of the rubric. I then tried to provide fairly detailed comments based on each part of the rubric. I generally spent somewhere around 30 minutes of each submission that I graded. (I wrote to the instructor to tell him that I thought people needed more guidance on assessing student work, and included a description of what I did, once the course was over. At that time, I also told him why I had been in the class and what my background was.)

Certificate of Completion is a payoff), we can expect a lot of "drive-by" registrants. But it does suggest that encouraging and maintaining effort in such a course will be an even greater problem than it is in campus-developed and campus-run online courses.

What can I take away from my experience in this one course for an assessment of MOOCs in general? First, at the current state of development, attempting to use an existing MOOC as a substitute for a course developed and managed on campus is clearly not a good idea.[8] Based on my experience, I would suggest that, at a minimum, using a MOOC as the basis for a credit-bearing course will require a strong on-campus component—a supervising faculty member on-campus, locally-designed (and graded) learning assessments, locally-operated and staffed discussion sections or on-line discussion forums (depending on the institution, the discussion groups/forums could be staffed by graduate teaching assistants, advanced undergraduate students, or a mix of the two. Whatever the mix, providing adequate training to the discussion leaders seems to me to be an essential component of making this work.) Using a MOOC in this way, of course, will not lead to the sort of cost savings that is one of the strongest lures for university administrators. In addition, even in introductory-level courses, whatever on-line component the course has will need to be updated often; in the case of (for example) an introductory macroeconomics class, annual updates would almost certainly be necessary because the macro economy will get you otherwise. This also reduces any cost savings that may occur. But done this way, I can easily see MOOCs playing a major role in courses now being taught on-campus in large lecture sections. There is, it seems to me, little difference between a talking head with Power Points on video and a talking head with Power Points at the front of a large classroom. Whether this means outsourcing course content (and learning objectives), or keeping control and creating your own MOOC, is the issue, I think. Done correctly, MOOCs may well kill the large lecture class.

It is also clear that, judiciously used, MOOCs might be able to add a dimension to existing courses that continue to meet in classrooms or operate as single-campus online courses. This, of course, will work *only* if the schedule of the MOOC and the class schedule can be synchronized.

An alternative is to take the power of video and online instruction much more seriously than many people seem to do. Indeed, I have yet to see a MOOC that seriously goes beyond an online talking head (but I have not seen even a significant fraction of everything that is currently available.) Alex Tabarrok, one of the creators of a MOOC site emphasizing economics courses, has written that "To take full advantage of the online format, an online lecture has to be different from an in-class lecture. Different mediums demand different messaging."[9] Doing this—finding and incorporating interesting, informative images, sound, and video clips—would surely enhance the educational process. But it would also be likely to increase considerably the cost of producing the videos for an online course.[10]

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[8] Recent commentary on the experience at San Jose State University would suggest that at least one effort to use an existing MOOC as a substitute for on-campus courses has not worked out well http://chronicle.com/blognetwork/tenuredradical/2013/07/f-is-for-failure-or-dont-invest-your-pension-in-moocs-yet/ and http://www.slate.com/blogs/future_tense/2013/07/19/san_jose_state_suspends_udacity_online_classes_after_students_fail_final.html) .

[9] "Why Online Education Works," *Cato Unbound* (http://www.cato-unbound.org/2012/11/12/alex-tabarrok/why-online-education-works). In an ironic twist, the course that Tabarrok and one of his colleagues (Tyler Cowen) developed for their MOOC site (Marginal Revolution University, at http://mruniversity.com/) uses still images with voice-over narration. While the images are often appealing, they do not add information to the process and are *static*.

[10] Such material is often available on publisher websites as supplements to textbooks. My conversations with publishers' representatives suggests that these are expensive to produce (including rights fees) and to keep current).

Finally, I would encourage anyone who wonders about the implications of MOOCs for higher education to enroll in one, participate fully in it, and see how it works, either for something you want to learn about or for your own discipline. It's clear that they are not going away soon, and knowing, from the inside, how they work—and don't work—will be an essentially part of making sure that, however they wind up being incorporated into our lives, it will not be any worse for us than it has to be.

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Challenges of 'Students as Producers' in web 2.0: A reflective account

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Abstract: In reaction to recent calls for Higher Education institutions to invite students to shape and manage their own educational experiences (McLoughlin & Lee, 2007, 2008), increasing numbers of initiatives are engaging students as partners and co-producers of curriculum content. Positioning students as co-producers has great potential to enable them to innovate, share and form communities of interest and networks (Boyd, 2007). Despite enthusiasm for the use of participatory pedagogies, there is little research to show that educational practice is undergoing transformational changes due to these emerging trends (Crook et al., 2008). This article draws on qualitative interviewing to explore the experiences of students involved in Pedagogy 2.0 at a UK university. This was in the form of students creating multimedia content to be shared with peers. Findings suggest that alongside the pedagogical and technological components to be considered, additional monitoring of student attitude and motivation to use Web 2.0 tools for educational purposes is required. The paper also provides suggestions that may help teachers who plan to use similar pedagogies in their classroom.

I. Introduction.

Higher Education (HE) has been undergoing a paradigm shift away from teacher-centered instruction to student-centered learning (Laurillard, 2002) whereby learners construct knowledge for themselves and take more active roles in shaping and leading their own educational experiences (Holmes, Tangney, FitzGibbon, Savage, & Meehan, 2001). Increasingly, universities have started to engage their students as partners in contributing to curriculum design, delivery of learning resources, and researching different aspects of learning and teaching (e.g., Birmingham City University, Students as Academic Partners; University of Exeter, Students as Change Agents; University of Lincoln, Student as Producer). Such initiatives embody the view of learning as knowledge creation (Paavola & Hakkarainen, 2005), which contends that students benefit greatly from constructing knowledge for themselves, for each other, and for subsequent groups of students as a result of interacting with the learning environment and with their peers (Holmes et al., 2001; Neary & Winn, 2009). By becoming partners in creating learning environments, students are able to gain valuable graduate attributes and capabilities that may prepare them for careers and lifelong learning (Committee of Inquiry, 2009). These initiatives seem to influence positively the student experience, culture, and nature of the relationship

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between students and the academic community within which they learn (McLoughlin & Lee, 2008).

Responding to calls for creating student-centered learning environments, many educators harness Web 2.0 applications to empower learners to take more control of their learning processes through producing content for their learning community and exposing learning materials for re-use by others (Anderson, 2007; Cochrane, 2010). For the purpose of this paper, Web 2.0 is defined as an emerging set of web-based communication tools such as web-based communities, hosted services, web applications, social-networking sites, video-sharing sites, wikis, and blogs (Cappelletti, 2010). The appropriation of these pedagogies in online environments has been termed Pedagogy 2.0, which incorporates various networks and resources individuals engage with during knowledge construction, sharing understanding and contributing to joint knowledge creation (McLoughlin et al., 2007).

Despite enthusiasm for the use of Pedagogy 2.0, there is little evidence that educational practice is truly undergoing transformation due to the use of these participatory pedagogies (Crook et al., 2008; Hamid, Chang, & Kurnia, 2009; Kim, Hong, Bonk, & Lim, 2011; Palaigeorgiou, Triantafyllakos, & Tsinakos, 2011). In his critical review, Selwyn (2007) cautions that more careful consideration and rigorous research are required when adopting Web 2.0 technologies in educational settings. Other evidence suggests that the intersection of digital technology and education can be marked by a myriad of issues and tensions (Anderson, 2007; Cochrane, 2010), which is the major focus of the present paper.

II. Literature Review.

Pedagogy 2.0 is seen to hold great potential to transform classrooms into "interactive, participatory, adapting, living organisms of learning and generating content" (Rosen & Nelson, 2008, p.222). Recent contributions to the development of Pedagogy 2.0 have suggested that new learning environments are in line with the view of learning as knowledge creation (McLoughlin & Lee, 2007, 2008). The key concept is that Pedagogy 2.0 provides venues for connections between ideas, learners, communities, and information networks, supported by online environments tailored to learners' personal needs and goals (Cappelletti, 2010). Accordingly, students can easily create multimedia content, share information, and contribute individually and in groups to collective intelligence (McLoughlin & Lee, 2008; Cochrane, 2010). This view of learning claims that students progress significantly more when working cooperatively and sharing ideas with others than when working in isolation (Vygotsky, 1978). For example, social interaction can lead to advanced cognitive development and promote higher academic achievement than individual learning activities (Johnson & Johnson, 1991). As a result of these new learning environments, a new "prod-user" identity (Brown, 2010) is emerging, characterizing students as co-producers of knowledge rather than merely consumers of information.

Despite growing enthusiasm for new technologies in HE, existing empirical evidence of the implementation of Pedagogy 2.0 is ambiguous. On the one hand, literature suggests generally positive results about students' perceptions and enjoyment of using Web 2.0 tools in learning. With their integration into assessment, students valued the digital technology beyond the novelty factor (Lee, Chan, & McLoughlin, 2006; Cochrane, 2005, 2010). These studies claim that students gain a better understanding of subject knowledge and develop transferable skills while using Web 2.0 tools. On the other hand, there is evidence of rather mediocre and compromised use of Web 2.0 tools (Gouseti, 2010). For instance, some studies (Cann, Calvert, Masse, & Moffat, 2006; Cole, 2009; Kerawalla, Minocha, Kirkup, & Conole, 2009) reported that using digital technology as part of subject assessment was not generally popular with or well-received by students. Authors cited a number of factors explaining the low engagement with Web 2.0 applications: mismatch with student expectations; heavily loaded timetable; extent to which student groups were integrated into the overall structure of academic courses; unattractive course design; insufficient support provision. As such, the implementation of Pedagogy 2.0 in formal education is not always successful and occasionally, fails to generate active student participation.

The literature review on the use of Web 2.0 in education has identified a range of issues and tensions in Pedagogy 2.0 classrooms. One key problem is limited knowledge some educators have about Web 2.0 (Grosseck, 2009). A wide number of educators remain skeptical or disapproving of Web 2.0 implementations (Gouseti, 2010). Some writers go as far as to question the ideology of Web 2.0 which they claim has not been seriously evaluated, resulting in the failure of Pedagogy 2.0 (Williamson, 2009). Generally, Pedagogy 2.0 is considered to be insufficiently understood and valued by educators, and is perceived as too difficult to implement in education (Cochrane, 2010) due to the lack of clear solutions to well-understood problems (Ravenscroft, 2009).

Another aspect that appears to influence the successful implementation of Web 2.0 tools is the level of students' digital literacy skills needed to operate in an online environment (Rosen & Nelson, 2008; Beetham, McGill, & Littlejohn, 2009). Recent research has cautioned against Prensky's (2001) premise of 'digital natives' that today's learners are comfortable using Web 2.0 applications (Kennedy et al., 2007; Crook et al., 2008; Rosen & Nelson, 2008). Not all students seem to be as familiar with contemporary technology as is commonly believed (Rosen & Nelson, 2008), with few students employing Web 2.0 for content creation. Furthermore, evidence suggests that students proficient with video games, internet, and mobile phones did not readily transfer these digital skills to other applications to support their learning (Rosen & Nelson, 2008; Grosseck, 2009). Accordingly, students seem to draw a distinctive line between fun and study, a view challenging those who assume that students learn through the same devices as those that entertain them (Hurlburt, 2008). Additionally, research shows that many students appear to lack the competence to navigate, locate authoritative sources of information, and select relevant sources from the abundance of information available (Windham, 2005; Katz & Macklin, 2007).

Another challenge to the uptake of Pedagogy 2.0 is the artificial social environment that some Web 2.0 tools (e.g. class blogosphere, online boards) entail. Although these applications allow students to interact and provide feedback for each other, Hurlburt (2008) argues that it does not follow that students will actively engage in sharing, commenting, and collaboration. She suggests that these environments do not share the spontaneous nature of other social networking applications, seriously undermining student engagement. Moreover, issues such as trust, quality, and safety, related to online settings seem to be crucial to the integration of Web 2.0 tools (Selwyn, 2006; Brown, 2010). Neglect of these important aspects was shown to make learners feel uncomfortable and reluctant to post their thoughts and comments on student-produced multimedia content (Hurlburt, 2008). Equally important is the assessment dimension; attempts to create active learning environments mediated by technology can fail when coursework is not closely aligned with assessment and does not count towards the final grade (Cann et al., 2006; Cochrane, 2010).

As suggested, Pedagogy 2.0 classrooms can be volatile and challenging environments (Hemmi, Bayne, & Land, 2009) due to a range of issues and tensions. Questions arise as to whether the implementation of Pedagogy 2.0 is worth the effort. This paper is concerned with a research project the aim of which was to establish the ways and extent to which the process of involving students as producers of multimedia curriculum content enhanced their understanding of subject knowledge and broader life skills. We describe phase one of the project which sought to identify benefits and challenges experienced by four practitioners and their students of using Web 2.0 tools to create multimedia curriculum content, leading to tentative recommendations for future implementations of Pedagogy 2.0 in phase two of this study.

III. Methodology.

A. Background and participants.

This paper is based on the work of four lecturers who incorporated digital technology into their curriculum designs. The mini-studies were conducted with students previously enrolled on Computing, Accounting and Early Childhood Studies (ECS) at Plymouth University. The lecturers undertook a number of mini-studies during the academic year 2010/11, each concerned with past implementations of Pedagogy 2.0 in a different subject discipline. The aim of this project was twofold. On the one hand, lecturers intended to explore students' experiences of producing multimedia curriculum content as part of their learning. On the other hand, the emerging findings of these interdisciplinary mini-studies were fed forward into a larger-scale project on Pedagogy 2.0 in the following academic year. All four subjects included some form of Pedagogy 2.0 but varied in terms of structure, assessment, and type of exercises used for producing multimedia content.

Second year students enrolled on ECS were invited to attend a one-week study trip to the Gambia, which was a voluntary component of their course. As not all students were able to participate, staff members proposed creating a blog and resource portal where students could upload reflections gathered whilst on the study trip to be shared with the wider student body. Students were offered the choice of using either flip cameras, dictaphones or keeping a journal/diary to document their experiences abroad. For the year under consideration, 15 students participated in the overseas placements.

The Computing curriculum included elements of face-to-face learning (e.g. seminars, practical sessions); eLearning, implemented via the Moodle Virtual Learning Environment (VLE); and project-based learning. Students developed the coursework based on a case study from a local industry partner. This coursework was assessed by the lecturer as well as by peers. The lecturer's assessment contributed 80% to the overall grade, the peer assessment the remaining 20%. Pedagogical principles which underpinned the delivery of the subject were derived from social and communal constructivism (Vygotsky, 1978; Holmes et al., 2001) with elements of chaotic learning, i.e. learning which is playful, exploratory, collaborative and non-linear (Schoenborn & Rees, in press). Fifty 2nd-year students had to develop an I.T. model for an industry contact who was actively involved in the delivery of the subject. Students were required to conduct independent research and group work, create content in the form of wikis uploaded to the Moodle VLE, and run seminars for each other. The lecturer provided substantial support and continuous formative feedback on overall structure and resources.

Finally, one hundred and seventeen 2nd-year students on the Accounting course were asked to produce wikis and podcasts as part of their coursework assessment. The podcast assignment required students to work in pairs, creating a three-minute podcast designed as a revision resource. Wikis were used in two assignments. In the first, student groups of four created a wiki page and presented this resource to the whole class. In the second, students used a wiki to work collaboratively on a chosen topic. This activity involved a peer assessment exercise with students reviewing work on the wiki pages and providing feedback on each other's work via the wiki.

B. Data Collection Procedures.

The mini-studies examined a number of previous evaluations of student satisfaction with curriculum design and more specifically, with the exercises of producing multimedia curriculum content. Furthermore, primary data was collected by a qualitative interviewing technique to explore students' perceptions of using Web 2.0 tools, and challenges they encountered while producing multimedia content. This paper mainly focuses on the experiences of students-as-producers, elicited through qualitative interviewing. Some of the data emerging from the evaluations of student satisfaction are discussed elsewhere (Schoenborn & Rees, in press). The rationale for using interviews is based on their potential for collecting rich data on participants' perceptions, attitudes, and the meanings that underpin their lives and behaviors (Gray, 2004). Kvale (2007, p.7) states that the "interview is a construction site for knowledge," which enabled interviewers to capture students' views and experiences of producing multimedia content and to identify the issues and challenges students had encountered. The one-hour semi-structured interviews focused on discussing what helped or didn't help students to produce the multimedia content. The themes explored through open questions were forms of assessment; the process of learning; the technology; and areas for improvement.

An invitation to participate in interviews was circulated to all students after submission of the module assignments and completion of the course. The timing of this may partly explain the low response rate as many students had already left the campus and might not have had access to their university emails. Altogether, five students volunteered across three subjects: two from Accounting, two from ECS, one from Computing. While the small sample size represents a limitation of this study, being unrepresentative of the student population, the key aim was to explore the experiences of individual students and to gather first-hand accounts, making this a useful exploratory study. By referring extensively to the pedagogical theory (e.g., Vygotsky, 1978; Laurillard, 2002; McLoughlin & Lee, 2008), we endeavored to generate important discussions around Pedagogy 2.0 and to derive practical ideas for enhancing teaching and learning in the Pedagogy 2.0 classroom.

C. Data Analysis.

All recordings were fully transcribed and analyzed using NVivo software. To ensure anonymity, pseudonyms were used. Thematic content analysis was employed to analyze interview transcripts. From this perspective, the textual data was coded and rearranged into topics that were progressively integrated into higher order themes, via processes of de-contextualization and re-contextualization (Howitt & Cramer, 2007). The emerging themes were then applied to all the interview texts in order to classify and compare the important themes and to make inferences (Merriam, 1998).

IV. Findings and Discussion.

Findings suggest that students derived a number of affective, social, and cognitive benefits from producing multimedia content. Data capturing the perceived affective benefits include: experience of "enjoyment" and "satisfaction" with producing wikis, podcasts and/or audio content.

> *I really enjoyed the fact that there were small amounts of assessments constantly and especially in term one all the quizzes and homework I really enjoyed the online learning.* (Alexandra, Accounting)

Alexandra explained that producing "quizzes, the online tasks, the wikis" "all ma[de] it more interesting rather than being talked to for an hour". Henry (Computing) indicated that the assignments provided him with great opportunities for taking control over his learning and re-using the student-produced resources.

He also emphasized that producing multimedia content might have "helped everybody" and instilled "a sense of accomplishment" into students. These students clearly appear to enjoy adopting the role of co-producer of curriculum content, which was a novel, enjoyable and rewarding experience. These and similar findings from other studies (e.g., Lee et al., 2006; Cochrane, 2010) suggest that Pedagogy 2.0 can have positive effects on the motivation of learners and is worth considering.

However, data encompassing the affective dimensions of learning suggests that using Web 2.0 tools to produce curriculum content can be fraught with apprehension and animosity. Anecdotal evidence indicates that not all students favor participatory approaches to teaching and learning. For instance, Henry (Computing) noted that his colleagues seemed to prefer the transmission approaches to participatory pedagogies, which might have affected the effort and time these students had invested in the completion of the given tasks. According to Henry, some students believed that they "shouldn't have to go out and produce the course materials. The course materials should be given to [them]." Besides, students taking Accounting regarded lecturers as the only trustworthy authority to provide feedback and were reluctant to provide and receive peer feedback on student-produced multimedia content. As one student put it:

> *I think that if I was to be paying nearly seven thousand pounds in fees I don't expect someone else paying seven thousand pounds in fees to be assessing me. I would want the University to be doing that.* (Alexandra, Accounting)

Comments like "shouldn't the lecturer be the person marking" were made by these two students. Clearly, there remain students who expect lecturers to deliver all of the subject content and provide credible feedback on their academic performance.

Despite the overall enjoyment of using digital technology in learning, instances remain of students enrolled on these programs being apprehensive about using some of the Web 2.0 tools. For instance, students taking ECS appeared to be reluctant to use digital technology to record and share their learning experiences from overseas placements. Of fifteen students, six used the flip-cameras, only two returning the footage, compromising the development of multimedia resources (Campbell-Barr, Huggins, & Wheeler, 2011). Furthermore, findings suggest that students don't always recognize the value of using specific Web 2.0 applications in learning. For instance, Alexandra reported that while producing the wikis was beneficial to her learning, producing the podcast did not help her with understanding the subject topics. Likewise, John spoke of creating podcasts as an entertaining exercise which required him "to speak into a microphone" rather than engaging with learning. Students seemingly displayed contrasting levels of satisfaction with Web 2.0 applications. This is consistent with other studies (Cann et al., 2006; Cole, 2009) confirming that students do not always find the use of digital technology in learning worthwhile. Notwithstanding, levels of student engagement with Web 2.0 tools may also be attributed to reasons such as poorly designed courses and associated support (Cole, 2009).

This study produced some encouraging evidence for those practitioners who use or plan to implement Pedagogy 2.0 in their courses. As the semester progressed, some students started to recognize the value of the participatory activities and came to appreciate them by the end of the academic year. This was due to students' increasing understanding of the benefits and alignment with the assessments.

> *We just did it [podcasts] to tick a box probably. To be fair even though it still forced us to do some research, but because it's like general information, we didn't believe this will be needed in the exam. […] We were saying was useful in the end* (John, Accounting).

This resonates with findings emerging from evaluation forms given to students enrolled on Computing, which suggested that a larger number of students expressed satisfaction with the course design at the end of the year than at the outset of the program. As Trowler, Saunders, and Knight (2003) point out, change takes time and subtle persistence. Consistent with literature on student academic performance (Prosser & Trigwell, 1999; Ellis & Calvo, 2004), our study demonstrates that students' attitude, expectations and perceptions of Pedagogy 2.0 were crucial to its success. Student apprehension can affect their engagement with novel learning environments and academic performance. According to Selwyn (2007), it is crucial to enter into dialogue with students prior to implementing such innovations to avoid students' resentment of Web 2.0 technology. Other examples of good practice enhancing students' attitudes and motivation towards Web 2.0 tools will be presented in the next section.

Data conveying perceived social benefits highlight the opportunities Web 2.0 applications provide for networking, collaborating and collegial interactions. Students taking ECS reported enjoying working in pairs, which offered a constructive collaborative environment in which they were able to collaborate and fulfill the assignments successfully. Some students spoke of creating study groups to work collaboratively on other assignments so as they "would all try and learn together" (Alexandra, Accounting). This is in line with the findings that emerged from the evaluation forms completed by computing students, which showed that those students who provide positive responses about team work, also tend to provide more positive responses overall.

However, collaboration and co-production of knowledge in groups was no easy task; findings indicate that working in groups to produce multimedia content was one of the biggest challenges, occasionally undermining student engagement with Web 2.0 tools. Although literature shows that small-group work holds great potential to stimulate deeper engagement and learning with subject content through processes of interaction and situated actions (Vygotsky, 1978; Johnson, Johnson, & Smith, 1991; Light, Cox, & Calkins, 2009), not all five students were satisfied with this experience. For collaborative learning groups to be successful, students need to make a paradigm shift from the traditional model - students have often been conditioned since junior school to acquire knowledge from teachers who are considered as key transmitters of knowledge (Johnson & Johnson, 1991). Challenging elements of group work experienced by participants included: reconciliation of conflicting timetables, unequal distribution of roles and contribution, and conciliation of emerging tensions. Some students spoke of adopting authoritative approaches to working in groups to ensure that everyone eventually fulfilled their duties:

> *…it boiled down to me threatening him a month before the hand in "this goes up by the time I come back from x; otherwise, you're in trouble."* (Henry, Computing)

Another problem experienced by students related to group dynamics. Some groups appeared to be unable to resolve their differences as they "didn't get out of the storming phase and producing something actually became an issue for them" (Henry, Computing). Therefore, group dynamics was seen to affect the quality of the produced materials and respectively their academic performance.

> *I spoke to some of my course mates and they had different groups and apparently the combination of people within the group influenced their mark quite dramatically.* (John, Accounting)

Equally important was group size. Students taking the Accounting course noted that the group size of four subverted the group dynamics and success. The distribution and quality of contribution in big groups was perceived as unequal, which generated a feeling of frustration and dissatisfaction. As Alexandra explained: "it was just a frustrating process and it felt like I was wasting a lot of my time fixing other people's slackness". These suggestions challenge the existing literature that argues that smaller groups of three or four are the optimal size, in which participants are guaranteed to have opportunity to contribute equally (Light et al., 2009) and avoid the free-rider phenomenon, in which one or two students contribute less to the task yet take credit for the work (Wang & Burton, 2010). Arguably these experiences may be considered as powerful stimuli to learning as students were exposed to different conflicts that needed addressing (Anderson & Boud, 1996), yet they were not always equipped to handle them. As a result of these apparent issues, three participants reported occasionally experiencing negative affective states such as frustration, disappointment, and decreased motivation. Comments like "most of the time I wanted to smack certain members of the group" and "for me it [group work] just didn't work" were fairly common among participants. These negative emotions may have affected the collaboration activities and in turn led to differences in their perceptions of usefulness and actual use of Web 2.0 tools. Similarly to findings of the study by Naismith, Lee, and Pilkington (2011), this study found that groups working collaboratively on producing multimedia content were often ineffective, failing to generate collaborative actions. Although these issues are characteristic of other learning contexts, for Pedagogy 2.0 to work successfully, lecturers ought to address the nature of academic emotions students may experience when working in groups on producing multimedia content. Otherwise, intense negative emotions, like anxiety, frustration and insecurity may affect student learning and lead to lower performance (Astin, 1984).

Data capturing cognitive benefits suggest that all participants developed understanding of subject knowledge by gaining alternative perspectives on the main topics. Exercises in producing multimedia content helped some students to revise their work in preparation for final examinations.

> *This [wiki] was useful definitely because again it was part of the exam so we practiced a lot with it and we had to use some resources and we had to use some books like the best way of analyzing balance and the reports and yes it was good.* (John, Accounting)

Findings also indicate that students acquired valuable technological skills. As it turned out, not all research participants were familiar with using digital technology to produce wikis and podcasts and operating flip-cameras. Only one student seemed to be comfortable with using these tools, stating that "technology [was] pretty straightforward, everybody can use it and everybody knows how to use it" (John, Accounting). Other students "were very reluctant to use it [Web 2.0 tools] initially" (Jane, ECS). Jane and June (ECS) felt that not all students were fully aware of the flip-cameras' functionality, which might have restricted their engagement with recording experiences during their placements abroad. Consequently, students less knowledgeable about digital technology learnt how to use them during the course supported by the lecturer and relevant documentation.

Furthermore, positioning students as producers and reviewers of each others' content enabled them to enhance their critical thinking skills. For instance, as part of the Computing and Accounting study areas, students were required to provide feedback on some of the multimedia content. Thus, they articulated evaluative judgments about the quality of the learning materials, which led them to either re-use or discard resources in light of perceived quality. Similar comments to: "there was fourteen reports and if you see a poor piece of work you just take only a little bit of that" and "wiki you can prove quantity but there were gaps in the quality, there were holes" were articulated by several students.

Overall, our study reveals limited re-use of student-produced materials. In contrast to literature indicating re-use of learning materials as a distinguishing feature of Pedagogy 2.0, most students in this study reported only little re-use of content in their learning and/or in preparation for final examination. The data analysis suggests that the main barrier to re-using student-produced content was lack of trust in the quality of such content. The three students with access to student-produced materials were critical of its quality and "didn't trust the input from the other students", being concerned that "if [they] listened to other people and they'd done wrong" then they would have produced mediocre work. This seems an under-researched area, requiring further attention to identify ways to stimulate the re-use of student-produced curriculum content.

Another barrier to the re-use of student-produced materials was the timing of activities. For instance, Henry (Computing) believed that the assessment episodes of student-produced content were untimely, because "there were people who left everything to the end and that interfered with the other groups as they didn't have access to their wiki stuff." Students perceived the tasks of producing multimedia content as more effective when they aligned closely with the final examination. As one student explained:

> *That worked really well having it [wiki] where it was and I think if we had had it any earlier it would have been forgotten by the time you come to the exam, but in the exam it was almost... it was so fresh still.* (Alexandra, Accounting)

In contrast, the tasks set up at the outset of the academic year were perceived as less influential for the preparation of the final assignment. Furthermore, the lack of navigational tools (interface) posed serious challenges when navigating through the sheer volume of documents. John felt overwhelmed: "I just sometimes thought, my goodness where do I have to start? At the end of the day you are just losing track." Alexandra added: "It wasn't flowing, it wasn't you know it was all quite bitty and you had to jump between the report into the different sections and I found that quite frustrating." This resonates with Naismith et al. (2011), who suggest that some students are unwilling to use wikis to design learning resources because of an insufficiently intuitive interface for linking files. These findings imply the necessity for a user-friendly approach to organizing the student-produced content to ensure that Web 2.0 tools encourage and facilitate student learning rather than puzzle them.

Our study shows therefore that the implementation of Pedagogy 2.0 can be a complex process holding both great benefits and challenges.

V. Implications for Pedagogy 2.0.

Regular research group meetings allowed lecturers to discuss and to explore their own observations and perceptions as well as previous evaluations of student satisfaction. Above results complemented with the lecturers' reflections on the overall process have important implications for Pedagogy 2.0. These suggestions are well substantiated by the literature on pedagogy in Higher Education and digital education (Vygotsky, 1978; Cochrane, 2010).

A. Reshaping students' attitude and motivation.

Our study argues for reshaping students' attitudes and perceptions of participatory pedagogies. Harnessing and incorporating Pedagogy 2.0 into HE requires a shift in the culture of students from being passive recipients of learning to active agents managing their own educational experiences. As other educationists (e.g., Vygotsky, 1978; Holmes et al., 2001; Laurillard, 2002), we believe that students need to develop a strong sense of responsibility for their own learning and regard their program as a collaborative venture with their teachers and peers. By positioning students as partners or co-producers in the delivery of education, students can gain skills valued by employers (e.g. digital skills, team work, communication, problem-solving skills) and a sense of accomplishment, whilst institutions can benefit from new perspectives and resources. This shift is possible only if students are supported throughout this process, gradually developing skills and strategies by providing appropriate assistance or 'scaffolding' to ensure they develop a sense of worth and trust in their abilities. This aligns with Vygotsky's thinking on the *zone of proximal development* (ZPD) and with Brown, Collins, and Duguid's (1989) *cognitive apprenticeship model* that proposes three distinctive stages "model," "coach," and "fade" to assist novices' learning.

Reshaping students' attitudes to and perceptions of participatory pedagogies is closely related to the level of motivation and academic emotions students experience in learning. Bruinsma (2004) states that apart from cognitive factors, motivation and emotion significantly influence educational outcomes. Students need to become aware of the importance of participatory tasks in order to generate positive emotional responses and produce valuable multimedia content. Students in this study, who saw value in creating content either because of the high-stakes (assessment) or task similarities to those in real-life professional situations, were more likely to invest effort and time in achieving the learning outcomes and, importantly, displayed satisfaction with this approach to learning. This study contends therefore that for Pedagogy 2.0 to be successful in formal education, great attention should be paid to methods for motivating and engaging students as co-producers of curriculum.

Possible ways to encourage this culture shift emerging from the study:

- Fostering a culture of collaboration and co-construction where students value each others' views;
- Illustrating the potential of participatory pedagogies by including views of alumni and industry;
- Transparent integration of participatory pedagogies into course criteria and assessment;
- Gradually increasing the extent of student involvement underpinned by continuous support and feedback (based on the principles of ZPD);
- Introducing students to Web 2.0 tools through the use of demos, guidelines,

examples;
- Using an incentive system (e.g. competitions, award ceremonies, student conferences on outcomes and/or products);
- Well-timed tasks and assessment episodes;
- Using authentic tasks (e.g. case studies provided by industry contacts);
- Providing guidelines and exemplars of previous years' student-produced multimedia content;
- Modeling group work.

B. Strengthening the re-use of student-produced materials.

This study emphasizes the importance of encouraging students to re-use student-produced materials. Research participants tended not to re-use the produced resources in learning and in preparation for the final examination.

Further suggestions emerging from this study:
- Development of user-friendly navigation tools and interface;
- In-session opportunities for sharing student-produced content;
- Modeling the re-use of produced materials in learning;
- Regular feedback from lecturers and peers on the quality of student-produced materials;
- Use of social recommendation mechanisms (e.g. rating systems of uploaded information).

These recommendations add to the body of research (Collis & Moonen, 2008; Cochrane, 2010) exploring the critical success factors in incorporating Pedagogy 2.0 in teaching and learning.

VI. Conclusions.

This study suggests that students derived a series of benefits from engaging with Web 2.0 tools to create multimedia content. However, the active learning practices mediated by Web 2.0 tools were not without challenges and issues. There is a serious concern that 'techno-centric' assumptions could obscure the fact that many students may not be capable, willing, or entirely comfortable using Web 2.0 applications in their learning, as shown by the disappointing outcome of the experiments in the ECS course. It is imperative not to assume that the incorporation of digital technology supports the process of knowledge construction, sharing, understanding, and joint knowledge creation (McLoughlin et al., 2007) and automatically leads to active student engagement. Instructing students to produce multimedia content in an online environment may not in fact generate collaborative activities, active participation, understanding and re-use of learning resources. Essentially, the study calls for a judicious approach to implementing Pedagogy 2.0 if it is to be successful. Efforts should be made to introduce students to Web 2.0 tools and participatory pedagogies and to assist them through the process of creating and re-using learning resources with a focus on monitoring student attitude and motivation to use Web 2.0 tools for educational purposes.

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Undergraduate students' perceptions of electronic and handwritten feedback and related rationale

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Abstract: Some instructors, besides awarding grades, provide comments/feedback on students' assignments. Views of students on feedback help frame effective and efficient teaching and learning. It is important to delve into this topic. In the 2013 academic year, all undergraduate students at a Midwestern university were invited to complete a survey to share perceptions of which feedback form they preferred: handwritten or e-feedback and related rationale behind their preferences. Their rationales were given in the categories of the following five themes: accessibility, timeliness, legibility, quality and personal. The data were analyzed quantitatively and qualitatively, and show that the majority of the respondents preferred e-feedback. With respect to the rationale, more respondents and higher ratings overall were given to e-feedback for timeliness, accessibility, and legibility. Although more respondents overall favored e-feedback, the ratings were higher in handwritten feedback for its quality and personal themes. Age and class standing are positively associated with students' desire for feedback in general and for e-feedback. However, there was a negative association between students' GPA and feedback in general and e-feedback. In this article, addressed are also limitations, educational implications, and future research suggestions.

Keywords: feedback, electronic feedback, handwritten feedback, instructors, students

I. Introduction.

Feedback is information that fosters deep learning (Denton, Madden, Roberts, & Rowe, 2008; Higgins, Hartley, & Skelton, 2002). It is a vital component of effective and efficient teaching and learning in higher education (Ackerman & Gross, 2010; Ball, 2009; Hounsell, 2003; Matthews, Janicki, He, & Patterson, 2012; Parkin, Hepplestone, Holden, Irwin, & Thorpe, 2012). Good teaching is represented by helpful comments on students' assignments (Ramsden, 2003). With the rapid development of technologies, some instructors have shifted the way they provide feedback from a conventional handwritten approach to a technological format; specifically typing feedback and delivering it electronically. Students' views on feedback help frame both effective and efficient instruction and learning in higher education (Denton et al., 2008; Higgins et al., 2002; Parkin et al., 2012). It is important to know students' perceptions of feedback,

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including handwritten and electronic feedback (e-feedback) (Ackerman & Gross, 2010; Carless, 2006; Higgins et al., 2002). Therefore, a survey was conducted at a regional campus of a large Midwestern university during the academic year 2012 to 2013. The purposes of this survey study were to explore the perceptions of undergraduate students regarding two forms of feedback: e-feedback and handwritten feedback and to explore the reasons behind the students varied preferences. The research questions underlying this study were "What do undergraduate students prefer: handwritten feedback or e-feedback?" and "What are their related rationale?"

A. Theoretical Framework.

Students desire to receive feedback, as it could help better their learning (Hyland, 2000). However, feedback needs to be easily accessible to students. Accessibility is a general expectation of students in the millennial generation (Morrissey, Coolican, & Wolfgang, 2011). A survey study conducted by Di Costa (2010) found that accessibility was mostly recognized by the students as a component in defining useful feedback. Bridge and Appleyard (2008) and Sadler (2010) noted students appreciated the permanence and safety of feedback that could be accessed electronically. In contrast, Chang et al. (2012) found one reason given by the handwritten feedback supporters was that they were able to easily access feedback conveniently through professors in class. That is, students did not need to rely on computers to access feedback.

Besides accessibility of feedback, timeliness has been identified as an important element in benefiting student learning. The National Union of Students (NUS; 2008) survey found students were unhappy with the timing of their feedback. Although students want feedback that is constructive, they have a strong preference for feedback that is prompt (Scott, 2006) and timely (Ferguson, 2011). If feedback is received late, it becomes useless to students, as many students have already moved on (Denton et al., 2008). To receive feedback early, it seems electronically delivered feedback gets the majority of student support (Chang et al., 2012). When Bridge and Appleyard (2008) asked students to consider the issue of online feedback, 88% reported that they favored online feedback because they were able to receive it faster than in the more conventional format of hand delivery. Bai and Smith (2010) cited the automated nature of e-learning as contributing to the benefit of timely feedback.

When feedback is typed rather than handwritten, feedback is readable. Denton et al., (2008) reported that students considered legibility a feature that would significantly improve the feedback they received. Therefore, legibility is a significant element in supporting student learning (Ferguson, 2011). (Price, Handley, Millar, & O'Donovan, 2010) reported students' general criticism of feedback was mainly due to illegible writing. Illegible feedback makes it unclear, leaving students both disappointed and frustrated, which are also supported by the study conducted by Chang et al. (2012).

In aiding students to learn, feedback also needs to be constructive and helpful. The content needs to be understood by students. Feedback should also enable students to know what and where their attention is needed and whether or not their work is on right track. Furthermore, allowing students to engage in revisions according to received feedback is beneficial to students as well. All the above is the operational term of quality. According to the National Union of Students (2008), students are dissatisfied with the quality of feedback. Case (2007) also identified poor and low quality feedback as issues in the feedback students received. When considering the quality of online instruction, Yang and Durrington (2010) found quality of instructors' feedback as the aspect mentioned most often in student course evaluations. When time and quality were considered as competing aspects of feedback, students were happy to wait a little longer for feedback if quality increased (Chang et al., 2012; Ferguson, 2011).

Quality feedback also needs to contain language that is positive and relational, which may help establish the relationship between instructors and students. When such feedback is received, students may think their professors care about their learning. Time and effort spent in providing feedback on students' assignments is appreciated by students. Students are thus likely to read feedback and, in turn, better their performances. All the above is the operational term of *personal* in terms of feedback. Krause and Stark (2010) found that feedback is most useful to students when it is perceived to be personal. Students responding to Ferguson's (2011) study want feedback to be both positive and personal. When the tone of feedback is overly negative, students often feel that instructors do not care about their learning (Price et al., 2010). Without feedback that is personal, students may view assignments as mere products, leaving them feeling alienated and disengaged (Di Costa, 2010; Mann, 2001; Price et al., 2010). With respect to feedback that is personal, one interesting finding by Chang et al. (2012) was that respondents who supported handwritten feedback perceived that type of feedback as more personal than those who supported e-feedback. The handwritten supporters also recognized that handwritten feedback enabled them to have close rapport with their instructors.

Accessibility, timeliness, legibility, quality, and personal, as have been mentioned above, are the five themes identified by Chang et al. (2012) through a prior study in the academic year 2011-2012. Two hundred and sixty students from the School of Education at the university participated in the study. The study was intended to explore what form of feedback that the students preferred, handwritten or electronic, and related rationale behind their preferences. In term of e-feedback, it was defined as all feedback that was delivered to students electronically. As the result of the study, Chang et al. (2012) found that the majority of the participants (68%) preferred e-feedback while 32% preferred handwritten feedback. When considering rationale for preferring e-feedback, 38% of the respondents enjoyed its easy accessibility. Thirty percent of students favored timeliness and 16% supported its legibility. Not as many e-feedback supporters mentioned quality (10%) and personal (1%) aspects as they did for timeliness and legibility. In contrast, there were many more handwritten feedback supporters who endorsed quality (40%) and personal (32%). Fewer students favored handwritten feedback for accessibility (25%), and timeliness (3%). No handwritten feedback supporters indicated legibility as a rationale. The present study further explored the two aspects: What form of feedback did the students prefer: handwritten or electronic feedback? And what was the related rationale?

II. Methods.

A. Participants.

All undergraduate students at a Midwestern university were invited to participate in a survey asking about handwritten and e-feedback and the related rationale. Of the approximate 7,200 students, 763 undergraduate students responded, with a return rate of almost 11%. Out of the 763 respondents, those respondents who skipped questions are noted in the results. Almost twice as many female as male respondents preferred e-feedback (n = 475) over handwritten feedback (n = 273). The predominant age range was 18-24 (n = 423). Class standing for the most part was evenly distributed. The predominant GPA range was 3.01-4.00 (*n* = 470) and the College of Liberal Arts (CLAS) had the most respondents (*n* = 301) (see Table 1).

B. Instrument.

The online survey was hosted on Survey Monkey and was used to collect data. The survey questions were modified and revised from the previous study to obtain more valid information with students of the entire campus. In other words, based on the five themes: *accessibility*, *timeliness*, *legibility*, *quality*, and *personal*, which were derived from the previous study (Chang et al., 2012), the present study expanded and extended each of the themes with a few corresponding items on a 7 point Likert scale. For example, there were four factors under the theme of *accessibility*: (a) *allows me to get information easily,* (b) *allows me to receive and send information conveniently*, (c) *allows me to ask questions easily* and (d) *makes me feel secure to receive feedback from the professor*. The survey instrument consisted of thirteen closed-ended questions with multiple factors in each and four open-ended questions.

Table 1. Demographics in terms of handwritten and e-feedback feedback preference.

	Handwritten		E-feedback		Blank		Total	
Variables	*n*	%	*n*	%	*n*	%	*n*	%
Gender								
Male	74	35.24	135	63.98	1	0.47	210	100
Female	199	36.18	340	61.93	10	1.82	549	100
	273	36%	475	62%				
Age								
18-24	180	42.55	239	56.50	4	0.95	423	100
25-34	53	29.78	122	68.54	3	1.69	178	100
35-44	26	26.26	71	71.72	2	2.02	99	100
45-54	11	25.58	31	72.09	1	2.33	43	100
55+	5	27.78	12	66.67	1	5.56	18	100
	275	36%	475	62%				
Class Standing								
Freshman	74	46.84	81	51.27	3	1.90	158	100
Sophomore	74	43.27	95	56.21	2	1.18	171	100
Junior	62	32.80	125	66.14	2	1.06	189	100
Senior	65	27.20	170	71.13	4	1.67	239	100
GPA								
3.01-4.00	161	34.26	302	64.26	7	1.49	470	100
2.01-3.00	78	36.62	134	62.91	1	0.47	213	100
1.01-2.00	4	25.00	12	75.00	0	0	16	100
0.00-1.00	1	100	0	0	0	0	1	100
Unknown	31	56.36	23	41.82	1	1.82	55	100

School								
Arts	23	34.33	42	62.69	2	2.99	67	100
Business	31	27.68	80	71.43	1	0.89	112	100
Education	57	43.18	74	56.49	1	0.76	132	100
CLAS	118	39.20	181	60.13	2	0.66	301	100
Health	34	28.81	85	71.43	1	0.84	120	100
Technology	12	44.44	14	51.85	1	3.70	27	100

Note. Percent ranges refer to the partitioned group or *n*. Also, some of the *n*s do not add up to 763 as some respondents skipped questions.

C. Procedure.

After the Institutional Review Board approval, the survey link was sent out to all undergraduate students who were in attendance at the university via an email invitation. On Survey Monkey, the students were first prompted with a study information sheet, which informed them of the purpose of the study, ensured confidentiality and also made it clear that participation was voluntary. If potential respondents agreed to participate, they continued on to complete the survey. All potential participants received a first follow-up letter electronically two weeks after the initial invitation letter was sent out. A second follow-up letter was emailed to all potential participants two weeks later. The study was closed two weeks following the second follow-up letter.

D. Data Analysis.

To answer the research questions of whether the undergraduate students preferred e-feedback or handwritten feedback, nonparametric and parametric tests were utilized. SPSS 20 was used to answer why either of these options was preferred over the other. A crosstabs procedure, using the Chi-square test of independence was used to analyze the nominal variables. A Chi-square test of independence measures the degree to which a sample of data comes from a population with a specific distribution (Bakerson, 2009; Mertler & Vanatta, 2005; Rosenberg, 2007; Stevenson, 2007). It tests whether the observed frequency count of a distribution of scores fits the theoretical distribution of scores. This issue was addressed through the use of the Pearson's Chi-square procedure (Bakerson, 2009, Mertler & Vanatta, 2005, Rosenberg, 2007). Independent *t*-tests were conducted to compare feedback preference for all factors under the five themes; accessibility, timeliness, legibility, quality, and personal (Charmaz, 2000; Creswell, 2002). Correlations of demographic variables, with feedback preferences, were run to establish patterns in the variables (Cresswell, 2002). In addition all responses to open ended questions were analyzed with respect to their justifications or preferences for handwritten or e-feedback providing a purposeful examination of detailed actual experience (Cresswell, 2002).

III. Results and Discussion.

A. Preference for the form of feedback.

With respect to the first research question: "What do the participants prefer: handwritten feedback or electronic feedback?" it was found that the majority of the participants (*n*=476, 63.3%) preferred e-feedback (see Figure 1). The studies conducted by Chang et al. (2012), Denton et al. (2008), and Parkin et al. (2012) also yielded similar findings in which more students preferred e-feedback than handwritten feedback.

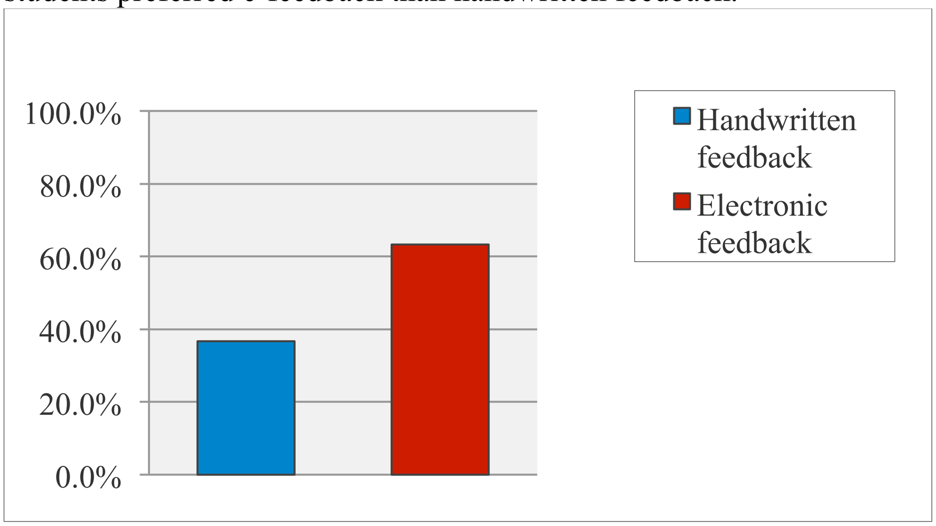

Figure 1. Feedback preference.

B. Degrees of preferences for both forms of feedback.

In addition to a question on preference, the respondents were also asked to rate the degree of preference for e-feedback and handwritten feedback in general, and then for all factors under the five main themes; accessibility, timeliness, legibility, quality, and personal. Table 2 details the results of the question concerning what degree a respondent preferred: e-feedback or handwritten feedback. Whichever the preference by the respondents, handwritten or e-feedback, these respondents also rated their preferred feedback form higher than the other.

Table 2. T-tests comparing how much preference for handwritten and e-feedback feedback based on choice of feedback.

	n	*Mean*	*SD*	*t*	*df*	*p*
Preference for Handwritten						
Handwritten	276	1.95	1.01	-24.596	745	0.00
E-feedback	471	4.46	1.51			
Preference for E-feedback						
Handwritten	274	4.33	0.921.39	29.33	748	0.00
E-feedback	476	1.86	0.92			

Note. Likert scale 1 = very much prefer to 7 = not preferred at all, the lower the mean the stronger the preference.

C. The usefulness of two forms of feedback.

The respondents were also asked to rate the degree of usefulness of each form of feedback (see Table 3). When the respondents preferred handwritten feedback, they also thought handwritten feedback was more useful than e-feedback. When the respondents chose e-feedback as their preferred form, they rated e-feedback as much more useful than handwritten feedback.

Table 3. T-tests comparing usefulness of feedback.

	n	*Mean*	*SD*	*t*	*df*	*p*
Usefulness of Handwritten						
Handwritten	275	1.644	0.878	-16.147	748	0.000
E-feedback	475	3.324	1.591			
Usefulness of E-feedback						
Handwritten	274	3.518	1.435	20.127	747	0.000
E-feedback	476	1.787	0.916			

Note. Likert scale 1 = very useful to 7 = not useful at all, the lower the mean the stronger the preference.

D. Accessibility.

There were four factors under the theme of accessibility: (a) *allows me to get information easily,* (b) *allows me to receive and send information conveniently*, (c) *allows me to ask questions easily* and (d) *makes me feel secure to receive feedback from the professor*. Irrespective of the respondents' preferred feedback form, there was a statistically significant difference in the perceptions of each of the factors under this theme between handwritten feedback supporters and e-feedback supporters. That is, when the respondents chose handwritten feedback as their preferred feedback form, they rated all factors more strongly than those who preferred e-feedback (see Table 4). When the respondents chose e-feedback as their preferred feedback form, they rated all factors under e-feedback more strongly than the same factors under handwritten feedback (see Table 5). Overall, however, these respondents gave higher ratings to e-feedback than to handwritten feedback regardless of preferred feedback form (see Tables 4 & 5).

Table 4. T-tests comparing accessibility factors for e-feedback feedback.

	n	*Mean*	*SD*	*t*	*df*	*p*
(a) *Allows me to get information easily*						
Handwritten Preference	270	2.722	1.595	13.858	736	0.000
E-feedback Preference	468	1.511	0.773			
(b) *Allows me to receive and send information conveniently*						
Handwritten Preference	269	2.100	1.307	9.668	733	0.000
E-feedback Preference	466	1.380	0.703			
(c) *Allows me to ask questions easily*						
Handwritten Preference	269	2.877	1.815	9.770	734	0.000
E-feedback Preference	467	1.803	1.164			
(d) *Makes me feel secure to receive feedback from the professor*						
Handwritten Preference	267	3.240	1.664	12.912	729	0.000
E-feedback Preference	464	1.882	1.167			

Note. Likert scale 1 = strongly agree to 7 = strongly disagree, the lower the mean the stronger the preference.

Table 5. T-tests comparing accessibility factors for handwritten feedback.

	n	*Mean*	*SD*	*t*	*df*	*p*
(a) *Allows me to get information easily*						
Handwritten Preference	274	2.449	1.465	-17.526	728	0.000
E-feedback Preference	456	4.568	1.648			
(b) *Allows me to receive and send information conveniently*						
Handwritten Preference	271	3.989	1.623	-10.838	518	0.000
E-feedback Preference	454	5.286	1.447			
(c) *Allows me to ask questions easily*						
Handwritten Preference	266	2.872	1.680	-12.335	579	0.000
E-feedback Preference	454	4.504	1.770			
(d) *Makes me feel secure to receive feedback from the professor*						
Handwritten Preference	268	1.720	1.206	-14.100	718	0.000
E-feedback Preference	452	3.489	1.832			

The justifications provided by the e-feedback supporters for (a) *allows me to get information easily* include, “I'm always online, always even on my phone so it makes things easier for me.” “[N]o matter where you are, you usually have access to the internet therefore you can get it anywhere at any time.” Denton et al. (2008) and Parkin et al. (2012) found similar data. They found that technology enabled students to access their grades and feedback at a time and place of their choosing. In commenting on (b) *allows me to receive and send information conveniently*, some e-feedback supporters wrote, “Easily accessible as it only requires one or two clicks of the mouse.” “Very helpful because I can log on whenever it is convenient for my schedule to check on things.” Similarly, conveniently receiving and sending information with the use of the Internet was concluded in Chang (2011) and Chang et al. (2012). Students recognized and appreciated the flexibility and convenience that technology could provide in facilitating their learning (Denton et al., 2008; Parkin et al., 2012).

In contrast, handwritten feedback supporters had their own reasons to support (a) *allows me to get information easily* and (b) *allows me to receive and send information conveniently*. The respondents justified, “It does not require a computer to read.” To some students, finding a computer and/or logging on a computer required an effort. A student noted, “If it's an email or electronic, I have to take the time to log in to the computer, which at home is slow and in a dark corner.” The rationale given by the handwritten feedback supporters is consistent with the studies conducted by Chang (2011) and by Chang et al. (2012), handwritten feedback was independent of the Internet, which made student learning convenient. To avoid redundancy, the discussion of (c) *allows me to ask questions easily* will be made in section of Personal.

With respect to why e-feedback supporters supported (d) *felt secure to receive feedback from professors*, here are some of the explanations: “I don't have to worry about losing it!” “It's nice that you can always go back to refer to it when it's saved online.” Yet, the handwritten feedback supporters contended, “Does make me feel secure with having the actual feedback in my hands.” “This is also good for keeping me secure because I can always keep and lock the feedback from it being deleted.” Even though Chang et al. (2012) identified and supported this category, few other studies have examined this category. Therefore future research is warranted for better facilitating student learning.

E. Timeliness.

There is only one factor under the theme of timeliness: (e) *[Feedback] allows me to receive feedback fast*. On this factor, there was a statistically significant difference between the views by the handwritten feedback supporters and those by the e-feedback supporters. When the respondents chose handwritten feedback as their preferred feedback form, they rated timeliness more strongly than those favoring e-feedback. When the respondents chose e-feedback as their preferred feedback form, they rated timeliness more strongly than those favoring handwritten feedback. Overall, however, these respondents' ratings for e-feedback were stronger than for handwritten feedback regardless of preferred feedback form (see Table 6).

Table 6. T-tests comparing timeliness theme for handwritten and e-feedback.

	n	*Mean*	*SD*	*t*	*df*	*p*
Handwritten (e) feedback allows to receive feedback fast						
Handwritten	266	3.624	1.581	-12.220	570	0.00
E-feedback	451	5.135	1.631			
E-feedback (e) feedback allows to receive feedback fast						
Handwritten	267	2.277	1.461	8.927	731	0.00
E-feedback	466	1.504	0.883			

Note. Likert scale 1 = strongly agree to 7 = strongly disagree, the lower the mean the stronger the preference.

Regardless of the respondents' preferences for the two forms of feedback, it is apparent that they rated e-feedback as timelier than handwritten feedback. The mean difference of views on timeliness is notably large (see Table 6). Similar findings were determined in the reports by Chang et al. (2012) and Dennen, Darabi, and Smith (2007). When feedback is delivered electronically, students do not have to wait until next class or another week, as a student wrote, "…I don't have to wait a week to hear back on how well I did or what I need to improve on." Another student pointed out, "If I receive feedback that is very late, I usually disregard it because it is irrelevant." The findings are consistent with Parkin et al. (2012), who found that if students did not receive feedback in time for it to be meaningful germane to a task assessed, the relevance of the feedback could thus be reduced. Feedback needs to be timely to appropriately promote student learning (Chang et al., 2012; Dennen et al., 2007; Di Costa, 2010; Ferguson, 2011; Parkin et al., 2012; Rowe & Wood, 2008).

However, from the perspectives of those who supported handwritten feedback, timeliness did not seem to be a concern. One respondent rationalized that feedback that was regularly delivered in class would enable students to predict when they could receive feedback from instructors: "With handwritten feedback, you know when you can expect to receive it (i.e. in class or other scheduled meeting time)." Another reason behind not being concerned about timeliness is the view many handwritten feedback supporters, even some e-feedback supporters, had that the delayed return of feedback is due to instructors spending time reading students' work, as a student put, "It takes longer to get a handwritten feedback … because the Professor took the time and effort to read it [your work]." Thus, feedback could be shaped by individual student assignments as a means of individualized instruction (Chang et al., 2012). As such, the respondents perceived that they were likely to receive detailed and constructive feedback, as some commented, "I am willing to wait longer for and prefer to wait for detailed handwritten feedback as opposed to electronic feedback." "If constructive feedback given, time isn't too much a factor." "It's okay if they take a little longer because the quality is better." Chang et al. (2012) and Ferguson (2011) had a similar finding that students would be willing to wait longer for quality feedback.

Throughout the entire survey, neither those students who preferred e-feedback nor those who preferred handwritten feedback specifically indicated the size or type of assignments in relation to timeliness. In other words, none mentioned about to what extent timeliness is based on the size or type of assignment: a longer assignment might be turned around slower than a shorter assignment. It could be easily understood that short essay can be more quickly evaluated than a longer paper. Therefore, there is no particular answer to this issue. Nonetheless, feedback that is received untimely is not helpful in deepening or maximizing student learning (Chang et al., 2012; Dennen et al., 2007; Di Costa, 2010; Ferguson, 2011; Parkin et al., 2012; Rowe & Wood, 2008).

F. Legibility.

There were two factors under the theme of legibility; (f) *[Feedback] enables me to read the feedback* and (g) *[Feedback] enables me to understand what the professor writes*. There were statistically significant differences between the perceptions by the handwritten feedback supporters and those by e-feedback supporters. When the respondents chose handwritten as their preferred feedback form, they rated both factors under the theme of legibility more strongly than those e-feedback supporters did (see Table 7). The same holds true for the respondents who chose e-feedback as their preferred feedback form. These respondents rated the two factors of legibility under e-feedback more strongly than under handwritten feedback (see Table 8).

Table 7. T-tests comparing legibility factors for handwritten feedback.

	n	*Mean*	*SD*	*t*	*df*	*p*
(f) *enables me to read the feedback*						
Handwritten Preference	266	2.959	1.510	-11.912	716	0.000
E-feedback Preference	452	4.522	1.800			
(g) *enables me to understand what the professor writes*						
Handwritten Preference	267	3.079	1.450	-12.404	717	0.000
E-feedback Preference	452	4.601	1.675			

Note. Likert scale 1 = strongly agree to 7 = strongly disagree, the lower the mean the stronger the preference.

Even though there are statistically significant differences within each factor, overall more students preferred e-feedback on both of these factors, and gave higher ratings regardless of their particular feedback preference (see Tables 7 and 8). Chang et al. (2012), Denton et al. (2008), Ferguson (2011), and Price et al. (2010) reported similar findings. Common justifications provided by the respondents include, "Since it is typed, it is legible [,] [i]f their spelling and grammar is good at least." "… electronic feedback wins in this category [legibility]." Denton et al. (2008) and Parkin et al. (2012) found that many students were likely to read or use feedback if it was returned to them in a typed and legible format. Chang (2011), Chang et al. (2012), and Ferguson (2011) also confirmed the finding that typed feedback enabled students to read feedback without difficulty. With respect to (g), *[Feedback] enables me to understand what the professor writes*, to some respondents, e-feedback, even if it is typed, does not make sense to students and is full of spelling errors, it is of little use, as a respondent expressed, "You will always be able to read typed [feedback], but that doesn't matter if [it] is not necessarily comprehensible and more subject to misspellings." On the contrary, if feedback's quality was good, the respondents were willing to take time to decipher it. A student put it this way: "If the quality of what is written is high enough, student time to making out the writing is worth it." The linkage between legibility and quality appears to suggest that students care about their learning and hope to act on feedback to better their work (Chang et al., 2012; Ferguson, 2011). However, further research is needed for a deep look at this factor.

Table 8. T-tests comparing legibility factors for e-feedback feedback.

	n	*Mean*	*SD*	*t*	*df*	*p*
(f) *enables me to read the feedback*						
Handwritten Preference	267	1.846	1.316	6.707	728	0.000
E-feedback Preference	463	1.324	0.788			
(g) *enables me to understand what the professor writes*						
Handwritten Preference	265	1.996	1.242	5.886	726	0.000
E-feedback Preference	463	1.495	1.021			

Note. Likert scale 1 = strongly agree to 7 = strongly disagree, the lower the mean the stronger the preference.

G. Quality.

There were seven factors under the theme of quality: *[Feedback]* (h) *offers constructive criticism or comments,* (i) *is helpful,* (j) *allows me to understand the content of the professor's comment,* (k) *allows for revisions and improvement,* (l) *provides detailed information that I would like to know in text,* (m) *provides detailed information that I would like to know at the end of paper, and* (n) *allows me to feel and touch the feedback, which is conducive to my reading and understanding.* There were statistically significant differences between the views by the handwritten feedback supporters and those by the e-feedback supporters on all the factors of quality. That is, when the respondents chose handwritten feedback as their preferred feedback form, they rated all factors more strongly than those by e-feedback supporters (see Table 9). The same holds true for those who chose e-feedback as their preferred feedback form. These respondents rated factors of quality under e-feedback statistically more strongly than under handwritten feedback (see Table 10). However, overall, more respondents rated factors of (h) and (n) under handwritten feedback higher than those under e-feedback (see Tables 9 & 10).

Table 9. T-tests comparing quality factors for handwritten feedback.

	n	*Mean*	*SD*	*t*	*df*	*p*
(h) *offers constructive criticism or comments*						
Handwritten Preference	268	1.679	1.126	-9.792	718	0.000
E-feedback Preference	452	1.799	1.659			
(i) *is helpful*						
Handwritten Preference	267	1.588	1.098	-10.137	717	0.000
E-feedback Preference	452	2.741	1.656			
(j) *allows me to understand the content of the professor's comment*						
Handwritten Preference	267	1.970	1.214	-10.962	716	0.000
E-feedback Preference	451	3.268	1.695			
(k) *allows for revisions and improvement*						
Handwritten Preference	265	1.951	1.228	-10.375	712	0.000
E-feedback Preference	449	3.229	1.770			
(l) *provides detailed information I would like to know in text*						
Handwritten Preference	266	2.139	1.382	-9.426	711	0.000
E-feedback Preference	447	3.333	1.770			
(m) *provides detailed information I would like to know at the end of a paper*						
Handwritten Preference	263	1.658	1.036	-10.914	708	0.000
E-feedback Preference	447	2.904	1.672			
(n) *allows me to feel and touch the feedback, which is conducive to my reading*						
Handwritten Preference	265	1.676	1.258	-11.655	707	0.000
E-feedback Preference	444	3.205	1.902			

Note. Likert scale 1 = strongly agree to 7 = strongly disagree, the lower the mean the stronger the preference.

Handwritten feedback supporters perceived that if the feedback was handwritten, the quality of handwritten feedback was always higher than that of e-feedback. A student said, "Handwritten feedback from my courses has been consistently higher quality and more thought out comments than any electronic feedback I have received." Most handwritten feedback supporters were also in sync with the notion that handwritten feedback was "more apt to explaining mistakes." When feedback enabled students to see and understand their mistakes, it is likely that students perceived such feedback as high quality. Therefore, handwritten feedback was helpful and comprehensible, and enabled students to know specifically where further improvement was needed. In addition, when instructors write feedback by hand, various colors of pens would be used for different purposes, as a respondent explained, "Some teachers use different colored ink which helps distinguish whether the written comment refers to a mistake or simply a constructive comment. An example would be red ink for errors like [grammar]. Blue ink could mean a [constructive] comment or constructive [criticism]." Chang et al. (2012) found that the handwritten feedback supporters appeared to have attached much greater importance to the feedback that was more detailed and specific than feedback that was typed and sent electronically.

Table 10. T-tests comparing quality factors for e-feedback feedback.

	n	*Mean*	*SD*	*t*	*df*	*p*
(h) *offers constructive criticism or comments*						
Handwritten Preference	263	2.970	1.604	8.656	725	0.000
E-feedback Preference	464	2.070	1.180			
(i) *is helpful*						
Handwritten Preference	265	2.608	1.580	8.053	727	0.000
E-feedback Preference	464	1.819	1.057			
(j) *allows me to understand the content of the content of the professor's comment*						
Handwritten Preference	264	3.136	1.549	10.844	727	0.000
E-feedback Preference	465	2.039	1.159			
(k) *allows for revisions and improvement*						
Handwritten Preference	263	2.875	1.492	8.024	721	0.000
E-feedback Preference	460	2.078	1.148			
(l) *provides detailed information I would like to know in text*						
Handwritten Preference	261	3.111	1.561	8.787	719	0.000
E-feedback Preference	460	2.174	1.259			
(m) *provides detailed information I would like to know at the end of a paper*						
Handwritten Preference	259	3.290	1.567	9.676	714	0.000
E-feedback Preference	457	2.230	1.310			
(n) *allows me to feel and touch the feedback, which is conducive to my reading*						
Handwritten Preference	261	4.667	1.817	8.708	715	0.000
E-feedback Preference	456	3.384	1.943			

Note. Likert scale 1 = strongly agree to 7 = strongly disagree, the lower the mean the stronger the preference.

Many handwritten feedback supporters also show their propensity toward handwritten feedback by rationalizing their disapproval of e-feedback. One respondent noted, E-feedback "[i]s usually based on a scale rather than the professor leaving actual comments." Miscommunication is another reason for many handwritten feedback supporters to feel disinterested in e-feedback. A respondent wrote, "It is particularly hard to fully understand nuance via electronic communication. [Thus], miscommunication is so easy." A lack of non-verbal cues could easily lead readers to misinterpret or misunderstand instructors' intended comments or messages (Chang, 2011). In terms of caring for student learning, the respondents felt that e-feedback did not show the sincerity of professors: E-feedback was "[n]ot always the best advice because it seems like they just threw it together." These reasons indirectly convey that e-feedback is not useful and does not allow students to improve their learning.

E-feedback supporters offered a different rationale for preferring all factors of quality. From their perspectives, e-feedback was specific and offered useful explanations: "I've noticed that most of the electronic feedbacks are more in-depth in their explanations and reasons." Parkin et al. (2012) echoed that the participants in their study felt that online feedback was thoughtful. Additional reasons given by e-feedback supporters include, "The clarity I receive from electronic feedback has been better than written. I suspect that is because thoughts can be edited and organized in such a way that handwritten examples do not allow." Parkin et al. (2012) also reported that their respondents recognized editing and revising feedback could become fairly easy to tutors with the use of electronic tools. Apparently, technology has made teaching more effective, as instructors are able to edit and reorganize feedback that has been composed. In contrast, instructors who chose to write feedback by hand did not seem able to do so frequently and conveniently. An e-feedback supporter commented, “Handwritten comments tend to be abbreviated more often and leaves you occasionally wondering if you missed something or if you correctly understand the abbreviations.” Decoding abbreviations and wondering whether the resulting work matched the instructor’s intended meaning were fairly uneasy to the respondents and could generate a sense of uncertainty. Such feeling and emotional status could plausibly become the reasons for some respondents to support e-feedback. However, these aspects were not found by the studies conducted by (Chang, 2011) and by (Chang et al., 2012). As such, an investigation could be warranted to further the understanding of how to facilitate student learning via assessment feedback.

The qualitative data given above might help point to specific, detailed, clear, thoughtful, and comprehensible feedback that was generally desired by the respondents, as it could offer information for improvement. In other words, the data showed that irrespective of their particular feedback preferences, the respondents viewed that handwritten feedback could provide constructive feedback. This might explain why more respondents, in general, gave higher ratings to handwritten feedback than e-feedback on (h) *offers constructive criticism or comments* than to e-feedback.

H. Personal.

There were four factors under the category of personal: *[Feedback]* (o) *allows me to establish rapport with my professor,* (p) *encourages me to read feedback,* (q) *shows that the professor cares about me, and* (r) *makes me appreciate my professor's time and attention.* When the respondents chose handwritten feedback as their preferred feedback form, they rated all factors significantly more strongly than those by e-feedback supporters (see Table 11). The same holds true for those who chose e-feedback as their preferred feedback form. These respondents rated all factors under electronic feedback significantly more strongly than the same factors under handwritten feedback (see Table 12). However, overall, more respondents rated factors of (q) and (r) under handwritten feedback higher than those under e-feedback (see Tables 11 & 12).
One of the main reasons for handwritten supporters to support handwritten feedback may be that “[h]andwritten feedback … always seems personal …” as a respondent stated. Commonly felt by the respondents is that e-feedback appears to distance instructors from students psychologically (Chang, 2011), as some students noted: “There seems to be a distance between you and the professor if all feedback is just electronic.” The respondents explained, “Electronic is usually more of a summary…” “… they … just copy and paste a generic statement.” Similarly Chang et al. (2012) found that “… sometimes electronic feedback feels generic and impersonal” (p. 12). As such, if feedback is handwritten, it would be difficult for instructors to “duplicate” feedback, as a respondent pointed out, “I feel like an instructor is much less likely to copy and paste when the feedback is handwritten.” If feedback is copied and pasted on a student’s assignment, the student would be made to“[a]lmost feel as if I’m simply a part of a mass email that is sent out to a lot of students.” This is implicit that instructors care very little about student learning, if e-feedback is delivered in this fashion. Therefore handwritten feedback seems a good-to-fit candidate for instructors to show care about student learning, as a respondent remarked, “I think that having a professor hand write their comments not only shows that you[‘re] not just another number but that they actually care about your improvements in their classes.” This might also explain why overall the respondents in the present study gave higher ratings on

the factors of (q) *shows that the professor cares about me, and* (r) *makes me appreciate my professor's time and attention,* irrespective of their particular preferred feedback forms. In fact, the respondents' view of care rendered by instructors had already been expressed in the section of *timeliness*. That is, handwritten feedback supporters were willing to wait a bit long to receive handwritten feedback, because they perceived that instructors took time to provide thoughtful and constructive feedback, which demonstrated that their academic enhancement was cared by the instructors.

Table 11. T-tests comparing personal factors for handwritten feedback.

	n	*Mean*	*SD*	*t*	*df*	*p*
(o) *allows me to establish rapport with my professor*						
Handwritten Preference	265	1.751	1.114	-9.940	710	0.000
E-feedback Preference	447	2.953	1.772			
(p) *encourages me to read the feedback*						
Handwritten Preference	265	1.381	0.871	-10.945	710	0.000
E-feedback Preference	447	2.651	1.765			
(q) *shows that the professor cares about me*						
Handwritten Preference	263	1.464	0.923	-9.164	707	0.000
E-feedback Preference	446	2.498	1.686			
(r) *makes me appreciate my professor's time and attention*						
Handwritten Preference	264	1.337	0.778	-9.007	707	0.000
E-feedback Preference	445	2.256	1.546			

Note. Likert scale 1 = strongly agree to 7 = strongly disagree, the lower the mean the stronger the preference.

In this sense, handwritten feedback seems to have a tendency to make students feel personally connected with instructors. "[H]andwritten feedback seems more human than electronic feedback," commented a respondent. Chang et al. (2012) also reported that when all feedback was received electronically, it became easy for a student to feel like a number and that when feedback was handwritten it would encourage students to ask instructors for clarifications of comments. This can also address (c) *allows me to ask questions easily* in the section of *Accessibility*. When feedback was written by hand and delivered in class, asking instructors questions becomes quite easy. "Handwritten feedback makes it more welcoming to ask the professor questions about their feedback face-to-face and encourage building a student-instructor relationship with the instructor," commended a respondent. Chang et al. (2012) echoed that it was convenient to approach instructors for explanations if feedback was delivered in class. Easy and immediate responses from instructors also represent gestures that instructors care about students' improvement.

Asking instructors questions face-to-face could promote a positive relationship between instructor and student, which seemed, in turn, to encourage students to read feedback. Otherwise, reading feedback is unlikely to happen, as a respondent shared, "[M]y professor does not get to know me this way …, if it can be all uniform and not unique to each student, the connection is not there so reading the "comments" is much less likely to happen." It is apparent that students' emotions, derived from the relationship between instructor and student, plays a very important role in student learning. "The personal relationship between a professor and myself is very important to me." "I love to feel the connection between the professors," remarked the respondents. Di Costa (2010) and Rowe and Wood (2008) also reported that students wanted instructors to consider their feelings; they wanted instructors to be empathetic and understandable.

Table 12. T-tests comparing personal factors for e-feedback feedback.

	n	*Mean*	*SD*	*t*	*df*	*p*
(o) *allows me to establish rapport with my professor*						
Handwritten Preference	262	4.053	1.780	9.777	718	0.000
E-feedback Preference	458	2.769	1.647			
(p) *encourages me to read the feedback*						
Handwritten Preference	261	3.874	1.914	14.769	717	0.000
E-feedback Preference	458	2.109	1.280			
(q) *shows that the professor cares about me*						
Handwritten Preference	260	3.862	1.804	10.461	714	0.000
E-feedback Preference	456	2.540	1.516			
(r) *makes me appreciate my professor's time and attention*						
Handwritten Preference	261	3.671	1.860	11.240	715	0.000
E-feedback Preference	456	2.318	1.342			

Note. Likert scale 1 = strongly agree to 7 = strongly disagree, the lower the mean the stronger the preference.

Some e-feedback supporters disagreed with their peers and believed that e-feedback had its capability to establish rapport with professors. They defended that e-feedback was “[m]ore one on one [than] the classroom,” and “… was speaking directly to me.” In view of e-feedback supporters, e-feedback was “[m]ore personal.” The findings are consistent with Rowe and Wood (2008) that students requested feedback to be more personal, as it could motivate student learning and guide students in the right direction.

I. Correlations among demographic factors.

The second research question: “What are their related rationale?” was also examined through correlations of demographic variables. Table 13 shows there were positive correlations among students’ ages and feedback preference. It means that the older the students were the more they preferred feedback. The finding is consistent with the findings by Chang (2011) and Chang et al. (2012). In addition, a positive correlation was also observed among class standings and feedback preference. This means the higher class standing, the more the students desired for feedback. This finding is incongruent with the reports by Siew (2003) and Chang et al. (2012). In regards to GPA, however, GPA and feedback preference were negatively correlated. This means that those whose GPA was between 1.00 and 2.01 craved for feedback more than those whose GPA ranged between 2.01 and 3.00. This finding is inconsistent with the reports by Chang (2011) and Chang et al. (2012) that the higher GPA the respondents had, the more eager they wished to receive feedback. However, further research is needed as there seemed more respondents whose GPA ranged between 3.01-4.00 (62.4%) than those GPA between 2.01 and 3.00 (28.1%), 1.01-2.00 (2.1%).

In terms of preference for a particular form of feedback, a crosstabs procedure, using the Chi-square test of independence, revealed there were no statistically significant differences between the observed and expected frequencies on the variables of interest. The results failed to reveal a statistically significant difference in terms of gender, $\chi^2(2, 752) = 3.543$, $p = 0.170$

Table 13. Feedback correlations among demographic variables.

	Gender	Age	Class Standing	GPA	College	Feedback Preference
Gender	1.000	-.088*	-.041	-.033	-.020	-.003
Age		1.000	.272**	-.050	.008	.147**
Class Standing			1.000	-.258**	-.044	.165**
GPA				1.000	-.005	-.072*
College					1.000	-.004
Feedback Preference						1.000

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

between handwritten and e-feedback. This means that regardless of gender there was no preference between handwritten or e-feedback. However, the Chi-square test of independence indicated a statistically significant difference, $\chi^2(5, 752) = 16.792$, $p = 0.005$ among age. This means the older students were, the more preference they had for e-feedback. The Chi-square test for independence also indicated a statistically significant difference, $\chi^2(3, 746) = 21.020$, $p = 0.000$, among class standing. E-feedback was preferred by seniors 72.3%. Juniors also preferred e-feedback 66.8%. For freshmen and sophomores the preference for e-feedback was about even.

A crosstabs procedure, Chi-square test of independence, also revealed a statistically significant difference $\chi^2(4, 752) = 13.511$, $p = 0.009$ among GPA respondents. In the 3.01–4.00 GPA group, 65.4% preferred e-feedback. Among GPA respondents in the 2.01–3.00 GPA group, 63.4% preferred e-feedback, while GPA respondents in the 1.01-2.00 GPA group preferred e-feedback 75.0% of the time.

There was statistically significant difference $\chi^2(5, 751) = 11.719$, $p = 0.039$ among colleges as well. The biggest preference difference was found in the College of Health Sciences with 71.4% of these respondents preferring e-feedback. All other colleges preferred e-feedback as well, although the differences were much smaller.

J. Educational implications.

The findings offer useful insights of the respondents on their preferred feedback form and the related rationale behind their preferences. As such, it is time for instructors and concerned administrators to start contemplating how to compose/or develop and deliver feedback, be it handwritten or e-feedback, in order to genuinely facilitate student learning. To be more specific, it is time to make changes to ways to develop and deliver e-feedback to bolster its quality and personal attributes. It is time to make changes to ways to develop and deliver handwritten feedback to better its timeliness, accessibility, and legibility. The need for change also implies that a form of feedback may not matter much if feedback, be it handwritten or e-feedback, is useful and beneficial to student learning and/or contains all the five themes. Therefore, in providing feedback, instructors need to "engage with students, consider their responses and offer individualized challenges" (Rushoff, 2013). Perhaps, basic training or professional development for instructors would enable them to establish a better understanding of what kind of e-feedback, for example, is needed by students. In addition the delivery style impacts student learning, as a student pointed out, "The few times I have received feedback in these ways [electronically] (especially through annotations), I found it [e-feedback] immensely helpful. As such, I think this problem is more of one of education on the part of professors; if they are aware of this method of giving feedback and how to provide it in this way, then maybe they would be more likely to do so. Professor training would be very helpful." Professional training converging on how to provide and deliver feedback, be it handwritten or e-feedback, is of great significance.

K. Future research.

This study demonstrated that both handwritten feedback and e-feedback supporters appeared to clearly hold their own positions. To facilitate student learning via assessment feedback, future research would be useful to examine specifically what content of handwritten feedback is desired by respondents and, when and how instructors deliver this feedback to students. The same is necessary for the examination of e-feedback supporters' views. Further research may also be focused on if "a hybrid approach" to providing and sending feedback to students is helpful from the students' point of view, e.g. Tablet PC or iAnnotate PDF on iPad. These approaches would allow for handwriting and delivering feedback electronically. Or future research may need to be focused on the following question: "Do students prefer feedback provided with the use of VoiceThread, the software that allows for recording feedback orally and delivering it electronically? In addition future research may look into whether or not feedback provided through various electronic means, such as email, webs, Oncourse, phones, etc., would result in different students' perceptions or even in different impact on their learning. Interested others could also delve into to what extent e-feedback or handwritten feedback could really improve teaching and learning.

L. Limitations.

The following limitations were identified (1) Even though the survey instrument was modified and improved from the previous study, 2% of the respondents thought the survey was a bit too long. Thus, it might be the case that some respondents might not be able to complete the survey in earnest or honestly convey their insights. (2) This survey was conducted at the beginning of the spring semester. It might be that some students had not had much experience receiving or reading feedback. (3) It might be that some respondents' perceptions might not fully reflect their views taken into consideration that they might not comprehend certain survey questions and/or might be distracted by their surroundings when the survey was being taken. (4) Lastly, since there was no clear definition of e-feedback given, it might bear on the answers of the respondents to some survey questions. Nonetheless, with a large number of the respondents involved in this study, the findings could still make useful contributions to teaching and learning in higher education, generating a stimulating topic for the best interest of students.

IV. Conclusion.

Feedback preferences of undergraduate students at a Midwestern university were explored with regards to handwritten feedback or e-feedback and the rationale behind these preferences. It was found that about two thirds of the respondents preferred e-feedback. However, each group of supporters appeared to hold their explicitly distinct reasons for their perceptions in terms of the five themes: accessibility, timeliness, legibility, quality, and personal. Despite their differing views, it appears that irrespective of their distinctive preferences, ratings for favoring handwritten feedback under some factors of quality and personal were stronger than for e-feedback. Likewise, there were stronger ratings and more respondents, regardless of their distinctive preferences, supporting e-feedback for its timeliness, accessibility, and legibility. The justifications that backed up their expressed preferences could also explain why there were higher ratings for usefulness of handwritten feedback than that of e-feedback. In addition, the respondents' various perceptions with respect to e-feedback were also found to be positively correlated with age and class standing and negatively correlated with GPA: Those whose GPA is between 1.01-2.00 favored more feedback than those whose GPA was between the range of 3.01–4.00 and that of 2.01–3.00.

The findings indicate that the majority of students long for assistance from instructors to better their learning via assessment feedback. It is important for instructors to be mindful when providing feedback on students' assignments in terms of what, why, how, and when. Since feedback offering has been recognized by literature to have significant effect on student learning (Case, 2007; Chang, 2011; Ferguson, 2011; Krause & Stark, 2010) and fundamental in supporting and regulating the learning process (Ifenthaler, 2010). It is time for all faculty concerned with effective student learning to understand more about the provision of feedback via the assessment process. Awarding a single grade is not welcomed by students and is not conducive to improving learning. Students do desire to receive feedback (Chang, 2011; Siew, 2003). However, the feedback should truly help advance their learning.

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Using iAnnotate to enhance feedback on written work

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Abstract: This paper discusses an iAnnotate feedback model used by the authors to comment on written work in first-year writing courses. We show that the use of iAnnotate, like other emergent technologies, mitigated a number of issues that regularly undermine high-quality feedback (such as the time it takes for instructors to write detailed comments and the challenge for students to read illegible handwriting or to keep track of hard copies of their papers). Yet, we contend that our feedback model goes beyond these practical benefits and, more importantly, enhances student learning. Specifically, we argue that it aligns instructor and student standards, elucidates for students the different types of comments instructors make (and clarifies that they ought to prioritize some comments over others), helps students and instructors identify recurrences and patterns of comments (thus also helping students and instructors diagnose general writing strengths and weaknesses), and conditions students to engage with feedback not only as a justification of their grade, but as a launching point from which they can develop as thinkers and writers. The success of this feedback model is partly attributable to the features of iAnnotate and partly attributable to the classroom complements we designed as part of the feedback model.

Keywords: feedback; assessment; e-assessment; technology; technopedagogy; e-learning tools; iAnnotate; visual learning; writing instruction

I. Introduction.

If you ask instructors what the most dreaded or onerous part of teaching is, "grading papers" is the response that nearly always tops the list. Instructors complain that providing extensive feedback takes time, time that is in short supply for those who are teaching a full load, who have an active research agenda, and who are expected to perform service to the institution. When they find out that their feedback has gone unread by students,[3] many instructors become embittered and exchange careful, detailed remarks for simpler notes or just grades (Wojtas, 1998; Higgins, Hartley, & Skelton, 2001).

In this paper, we propose a feedback model that attempts to alleviate some of the issues of grading commonly registered by instructors. Specifically, we aimed to create a feedback model that students understand to be a valuable component of their learning process and that instructors perceive to be worth the time and effort they expend. After a brief overview of pedagogical scholarship on feedback (including the recent introduction of emergent technologies to enhance feedback), we describe our use of iAnnotate in four writing courses at Occidental College from 2011-2012, we explain how our use of the application addresses persistent

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[3] Duncan (2007) argues that students tend to read instructors' comments only if the grade they receive is misaligned with the grade they expect to have earned, while Wojtas (1998) found that students do not read the comments "if they disliked the grade."

complaints from instructors and students, as well as how our use of the application aligns with the best practices detailed in scholarship on feedback.

II. Pedagogical scholarship on feedback.

There is no shortage of scholarly literature on feedback. Some scholarship focuses on how instructors can most effectively structure their feedback, while other scholarship focuses on how to motivate students to engage feedback in a meaningful way. With regard to the former, consensus has emerged around the characteristics of high-quality feedback:

1) It is seamlessly aligned with the articulated goals and standards of the assignment (Nicol & Macfarlane-Dick, 2006; Duncan, 2007; Hounsell et al., 2008; Sadler, 2010).
2) It focuses on the most important learning objectives, leaving aside lower order concerns (Black & Wiliam, 1998; McNeill, Gosper, & Xu, 2012).
3) It is returned in a timely manner while the material is still fresh in students' minds (Cowan, 2003, Hepplestone et al., 2011).
4) There is a required mechanism through which students reflect on and respond to the feedback, increasing the likelihood that students will incorporate suggestions in future assignments (Carless, 2006; Hepplestone et al., 2011; Carless et al., 2011).

While there is broad agreement on the features of high-quality feedback, scholars acknowledge that this sort of feedback is exceedingly time- and labor-intensive for instructors. Moreover, scholars contend that there are barriers to students' understanding or apprehension of even high-quality feedback. First, instructors and students hold different perceptions about the purpose and function of feedback. While students understand comments to be merely a justification of the grade they earned, instructors also understand their feedback to be another opportunity in which to (re)teach the material or to offer advice on how students can develop their skills as logicians or writers. The misalignment of feedback's function—dubbed "feedback" versus "feedforward"—leads to students' misuse or lack of use of high-quality feedback (Bjorkman, 1972; Mutch, 2003; Rust, O'Donovan, & Price, 2005; Nesbit & Burton, 2006; Weaver, 2006; Lizzio & Wilson, 2008; Poulos & Mahony, 2008; Irons, 2008; Burke, 2009; Draper, 2009; Walker, 2009; Sadler, 2010; Price et al., 2010).

Second, it is a challenge for students to interpret instructors' comments because we offer different types of comments. For instance, we write critiques of students' ideas or writing skills alongside conversational responses to their ideas alongside suggestions for further reading or research (Mutch, 2003). We expect students to engage differently with different types of comments, yet we rarely make these expectations explicit nor do we train students in how to properly engage different types of comments. Students, thus, tend to treat all comments the same: as criticisms of their work that justify the grade they were awarded. Additionally, faculty include a range of comments that they would hierarchize: lower-order comments (e.g., grammatical problems, flawed prose, etc.) versus higher-order comments (e.g., problems with argumentation, reasoning, and marshaling evidence). Yet, again, we rarely explain to students how to rank the importance of different comments and thus, to our disappointment, students tend to focus their revision work on less important—but more easily fixable—issues, ignoring the bigger problems (Mutch, 2003; Weaver, 2006).

Third, instructors struggle to find the balance between providing highly individualized comments, careful instructions for revision, and advice for future development (i.e., enough feedback so that students have a clear understanding of what is going wrong), while also avoiding so much feedback that students are left overwhelmed and paralyzed, not knowing where to start addressing this whirlwind of comments (Monroe, 2002; Higgins, Hartley, & Skelton, 2002; Nicol & Macfarlane-Dick, 2006; Miller, Linn, & Gronlund, 2012).

Within the past several years, a new set of scholarship on feedback using emergent technologies has taken steps toward addressing some of the obstacles to high-quality feedback.[4] Some studies have argued that new technologies offer a more efficient workflow that reduces the amount of time and effort expended by instructors. As Heinrich et al. (2009) put it:

> ...e-tools can make a real impact on efficiency: providing documents, easily accessible to all involved, anytime and anyplace; accepting assignment submissions, managing deadlines, recording submission details, dealing with safe and secure storage; returning commented-on assignments and marks to students; storing and if necessary exporting class lists of marks. Using e-tools for these tasks frees up time that can be used for focusing on quality feedback.

Heinrich et al. (2009) agree that instructors have found Learning Management Systems (LMS) to be efficient ways to manage the submission of student work since the LMS automatically records late work and ensures that student work remains secure.

Other studies propose that instructors compile a bank of commonly-used comments that they can simply cut, paste, and tailor to each individual paper, saving much of the time it would ordinarily take to write the same comments again and again. This time-saving measure enabled them to provide more feedback to students in large courses and to spend their time tailoring their stock remarks to individual students' work (Brown, Bull, & Race, 1999; Heinrich, 2007; Irons, 2008; Heinrich et al., 2009).

Instructors are also able to return work in a timelier manner (not needing to wait until class to hand deliver in person hard copies of their feedback); this timeliness increases the probability that students will read and value our comments (Denton, 2001; Cowan, 2003, Hepplestone et al., 2011). Electronic feedback is also more legible to students, which means students are no longer required to ask us during office hours to decipher illegible comments; e-comments decrease the chance that they would simply ignore remarks they could not read on their own (Denton, 2001; Denton et al., 2008).

Heinrich et al. (2009) report that using technologies, such as the Track Changes feature in Microsoft Word, makes it possible to embed links to additional readings or resources into the comments, directing students' further engagement with the material. These sorts of comments shift the culture of feedback from a means to simply justify the grade to a dialogic engagement between student and instructor that is presumed to continue beyond the individual paper or assignment (e.g., Irons, 2008; Carless, 2006; Price et al., 2010; Carless et al., 2011).

Finally, electronically submitted and commented-upon work facilitates better assessment of student progress over time. When working with hard copies, an instructor would have to make copies of hand-written comments and create an easily navigable file system for those hard copies. Electronic papers with embedded electronic comments can be stored and catalogued more easily so that instructors can track the progress of students' work over the course of the semester (Heinrich et al., 2009).[5]

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[4] The new technologies discussed in this literature include general software programs (e.g., Microsoft Word Track Changes, Google.docs), Learning Management Systems (e.g., Moodle, Blackboard), and specialized applications or assessment tools (Markin, Turnitin, GradeMark, Re: Mark, MarkTool, Adobe, and iAnnotate).

[5] Moreover, instructors interested in assessing their own assessment practices have at their disposal an easily navigable set of papers with their comments (Heinrich et al., 2009).

This paper adds to the scholarly conversation about the pedagogical benefits of emergent technologies. We show that the use of iAnnotate, like other emergent technologies, enhances the efficiency of instructor's workflow, reduces the time it takes to return papers, and provides students with more legible feedback. Yet, we contend that our feedback model goes beyond these practical benefits and, more importantly, enhances student learning. Specifically, we argue that our feedback model aligns instructor and student standards, elucidates for students the types of comments we make (and helps them prioritize some comments over others), helps students and instructors identify recurrences and patterns of comments (thus also helping students and instructors diagnose general writing strengths and weaknesses), and conditions students to engage with feedback not only as a justification of their grade, but as a launching point from which they can develop as thinkers and writers. In what follows, we show that the success of this feedback model is partly attributable to the features of iAnnotate and partly attributable to the classroom complements we designed around the feedback model.

III. Approach.

Beginning in Fall 2011, Occidental College's Center for Digital Learning + Research and the Center for Teaching Excellence co-sponsored several cohorts of Faculty Learning Communities that explored the pedagogical uses of the iPad. At that time, the authors of this paper began to use iAnnotate to grade student writing in four first-year writing-intensive seminars.[6] Although iAnnotate has received much praise on blog posts, such as *ProfHacker* on the *Chronicle of Higher Education* website, for being an easy, portable, paperless way to annotate and share documents, not enough attention, we contend, has been paid to the pedagogical benefits of the application.[7] After a brief description of the features of iAnnotate and how we used the tool in our writing courses, we will discuss in detail how our feedback model enhanced student learning.

iAnnotate PDF is a productivity application from Branchfire that is available on the iPad and Android tablets.[8] iAnnotate includes a palette of tools to annotate a document, including the ability to highlight, underline or strikethrough, type or write notes (in the margins or in collapsible balloons), and to bookmark. For commonly used annotation, iAnnotate enables users to create stamps (text or symbols) that can be imprinted on the document with a single click from the tool bar.[9]

We found the stamps feature to be exceedingly useful when commenting on student writing. Since we tend to evaluate papers on the same criteria—the criteria laid out in our grading rubrics—we tend to write the same sorts of comments on every paper we grade. The stamps feature of iAnnotate, therefore, enabled us to save an inordinate amount of time writing marginal comments. We simply created stamps for our commonly used comments, such as: "you need to make your reasoning more explicit," "good, careful reasoning," "nice use of evidence," "you need to interpret/analyze your evidence," "clarify the point of this paragraph," "nice

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[6] While our focus has been exclusively on using iAnnotate to write comments on student papers, the application has been widely adopted in academic iPad pilot programs at Stanford University, Massachusetts Institute of Technology, and the University of Michigan, among others. The application's uses in these academic contexts range from annotating course readings, to taking notes on class PowerPoint presentations, to sharing documents and working collaboratively.

[7] See, for example, Jones (2010) and Sample (2011).

[8] At the time of publication, iAnnotate retailed for $9.99.

[9] iAnnotate has many default stamps, comments such as "excellent" and "good job," etc., as well as symbols such as check marks, smiley faces, and exclamation points. We found these comments to be far too vague to be useful and thus we quickly created our own stamps.

guidepost," "awkward prose," "citation needed," etc.[10] After the initial time and labor it took to set up the stamp system, the process of inserting a stock comment with a single click made the feedback process much faster.

In this way, the stamps mimic the "comment bank" suggested by Irons (2008) and Heinrich et al. (2009). Yet, because the color of the stamps are adjustable, we sorted our individual comments into the categories we used on our rubric—argument, structure, use of evidence, writing style/prose, and mechanics—and then assigned a different color to each category of comments. For instance, comments related to argumentation were colored blue, comments related to evidence were colored green, comments related to organization and structure were colored orange, and so on (See Figure 1). In this way, students could easily see how our comments mapped onto the rubric and onto broader areas of thinking and writing.

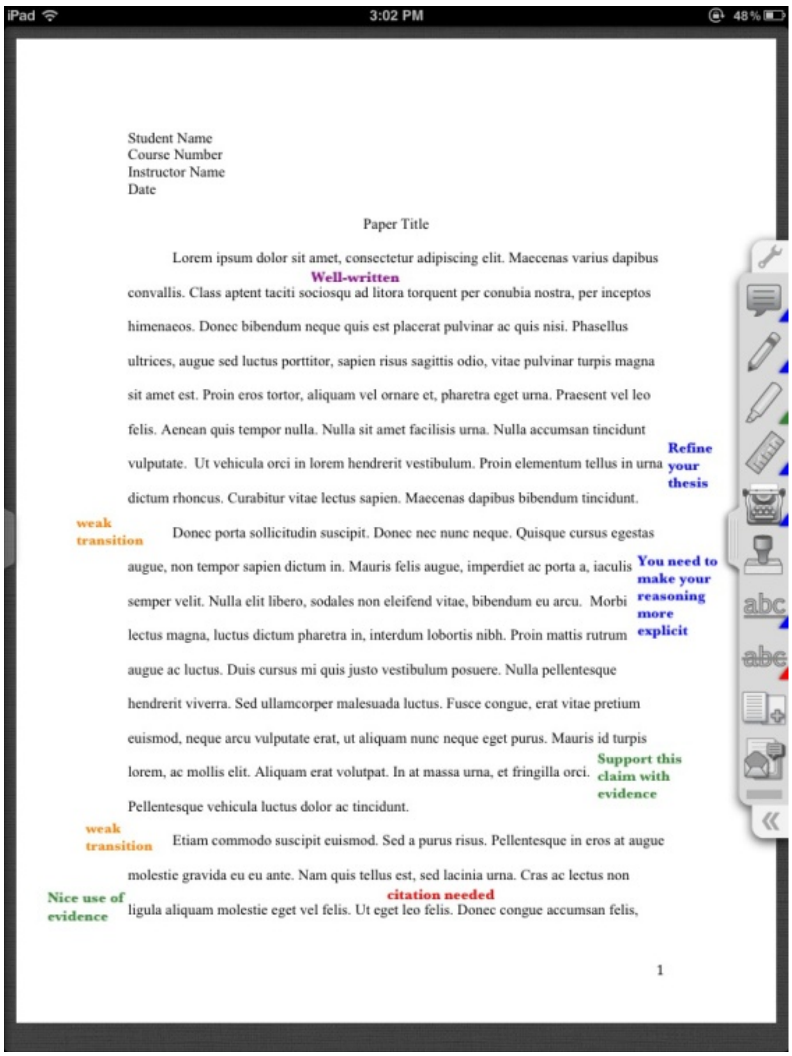

Figure 1. Example of student paper with instructor comments.

Further, we used other features of iAnnotate to demarcate different types of comments. As noted above, we used our custom stamps to mark strengths and weaknesses in terms of

[10] For a catalog of our custom stamps, see Appendix A.

argument and writing. Still more, we used the checkmark stamp (✓) to acknowledge a good point and collapsible balloons (that included lengthier comments) to converse with students' ideas and arguments (See Figure 2).

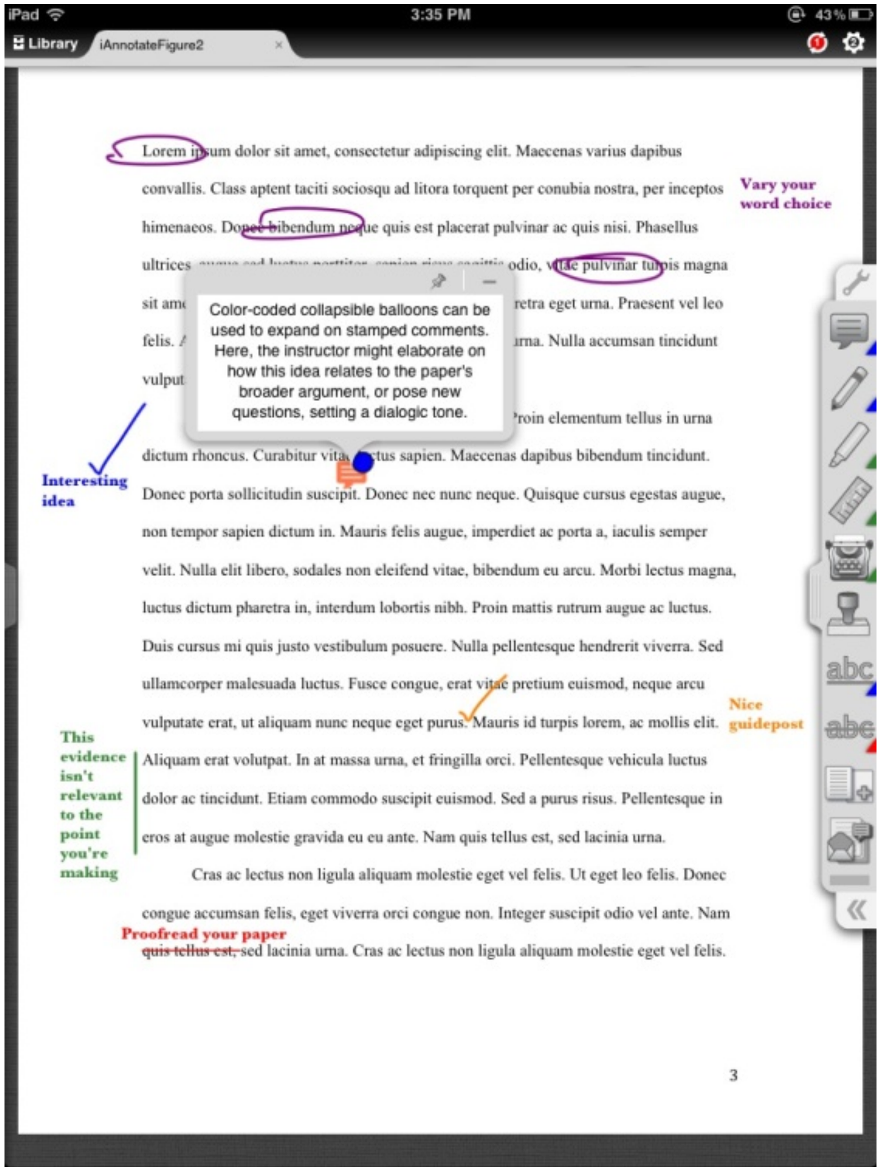

Figure 2. Example of student paper with additional iAnnotate markup.

In addition to these types of annotation in the margins of the paper, we included comments at the end of the paper. Here we interpreted the comments above. We pointed students back to the check marks that indicated where they succeeded and we elaborated on *why* these were particularly successful moments. We directed them to remarks made in collapsible balloons and tied together our engagement with their ideas in one synthetic remark. Finally, we identified the strengths and weaknesses of their argument and writing by drawing their attention to visual patterns of comments: recurring stamps or recurring colors. For instance, if their paper was littered with positive blue comments and negative orange comments, we could praise them for their exceptional argumentation and encourage them to work on their organization. In this way, our summative remarks at the end of the paper provided students a key to deciphering the marginalia above.

IV. Teaching Method.

Although our summative remarks gave students a road map to decipher our comments on their papers, we found that we also needed to spend time in class talking about our feedback method. That is, this feedback model needed to be carefully integrated into a writing course in such a way that students: 1) understood the goals of the method and how those goals aligned to the standards and objectives of the assignment/course; 2) understood how to interpret and use our feedback; and 3) were required to reflect on and incorporate feedback into subsequent writing assignments. In this section, we will discuss these classroom complements to our written feedback.

A. Aligning Student and Instructor Expectations.

As scholars have long demonstrated, in order for students to benefit from feedback, they must understand the standards on which they are being evaluated, the feedback must make clear how their performance measures up to those standards, and the feedback must offer suggestions on how they can move steadily closer to achieving those standards on subsequent work (Sadler, 1989; Nicol & MacFarlane-Dick, 2006). In order to align our students' expectations with our own, in class we introduced the color-coded rubric (See Figure 3) on which their work would be assessed and showed them a sample paper marked up using iAnnotate. We explained how sets of comments lined up with categories of the rubric and we urged students to pay attention to the colors of our comments in order to discern broader writing strengths and weaknesses. We also used this in-class orientation to delineate between higher and lower order comments, again corresponding to the color-coded rubric (e.g., explaining that blue comments on argumentation are more significant than red comments on mechanics). We provided this orientation on both the first day of class and again when we distributed and discussed the first assignment. Moreover, on our course sites, we posted the rubric and a description of and key for our iAnnotate feedback model so students could reference these materials on their own time as well.

Once students had completed their first draft, we devoted several class periods to writing workshops, pertaining to aspects of the rubric (e.g., one day each on use of evidence, structure and organization, thesis, prose, introductions, and conclusions). In each workshop, we circulated a handout that used language on our rubric and that would show up later in our customized stamps. This synchronization between the writing instruction, rubric, and stamps created a consistent message to students about our standards, promoted transparency in how student work would be assessed, and conditioned students on how they should be evaluating their own work during the pre-writing and drafting phases and in peer review sessions.

B. Navigating, Interpreting, and Using Feedback.

As mentioned above, scholars have found a persistent misalignment between instructors' and students' perceptions of the purpose of feedback. While students tend to read feedback only as a justification of their grade, instructors hope students learn—about course material or about their skills as thinkers and writers—from their comments. Moreover, although instructors offer a

	"A" Paper	"B" Paper	"C" Paper	"D" Paper	"F" Paper
Argumentation	• Excels in responding to assignment, and demonstrates mastery of course concepts and materials • Thesis presents a clear, focused, and compelling argument • Paper recognizes the complexities of its argument throughout the analysis	• Responds appropriately to the assignment, demonstrates clear understanding of course concepts and materials • Good argument, clearly articulated in thesis, though might need refining • Begins to acknowledge the complexities of its argument	• Doesn't fully respond to the assignment, demonstrates some misunderstanding of course concepts and materials • Paper has a weak argument, thesis is too general • Fails to acknowledge other views	• Doesn't respond appropriately to the assignment, disconnected from course concepts and materials • Argument is unclear, thesis is weak • Thesis too vague or general to be nuanced or complicated	• Does not respond to the assignment, displays no familiarity with course concepts or materials • No identifiable argument or thesis
Evidence & Support	• Argument is thoroughly supported by strong, specific, and appropriate evidence • Evidence is clearly introduced, analyzed and connected to the argument	• Paper's argument is supported by relevant evidence, though not always the strongest or specific quotations • Analysis of evidence needs further development	• Paper's argument is supported by limited evidence that is only occasionally relevant • Relevance between argument and evidence are somewhat unclear	• Evidence is insufficient, misconstrued or misrepresented • Unclear relevance between evidence and argument	• Argument is based on little to no evidence • Relevance between evidence and argument is absent/incorrect
Structure	• Paper flows logically to craft a cohesive argument • Paragraphs clearly guide the reader through a progression of ideas • Uses transitional sentences to develop strong relationships between ideas	• Generally well-constructed flow of ideas • Paragraphs are ordered thoughtfully, each paragraph relates to central argument • Transitional sentences create a logical progression of ideas	• Paper jumps from one idea to the next, lacking a clear structure • Occasional connection of ideas between paragraphs • Simple sequential rather than transitions based on logic	• Paper wanders from one idea to the next, making it difficult to distill the argument • Limited connection of ideas between paragraphs • Paragraphs may lack topic sentences or connection of ideas	• Lacking organization and coherence • Disjointed connection of ideas between paragraphs
Style	• Displays a unique critical voice • Style fits the paper's audience • Chooses words carefully, for their precise meaning • Demonstrates thorough and thoughtful editing and revision	• Displays a clear critical voice • Style is conscious of paper's audience • Uses words effectively, if too generally at times • Demonstrates revision and editing	• Displays a critical voice that is generic or bland • Style only occasionally displays awareness of paper's audience • Sentence structure and word choice frequently too unfocused, wordy or confusing • Minor revisions and editing	• Critical voice is unclear • Style isn't appropriate for paper's audience • Simple, awkward, or monotonous sentence structure and word choices • Minimal revisions and editing	• Lacking critical voice • Unaware of paper's audience • Many awkward sentences and misused words • No evident revisions or editing
Mechanics & Citations	• Almost entirely free of spelling, grammar, and punctuation errors • All sources are cited correctly and completely	• May contain a few spelling, grammar, or punctuation errors, but they don't impede understanding • Sources cited correctly and completely	• Several spelling, grammar, or punctuation errors that distract the reader • Minor citation errors	• Contains many spelling, grammar, or punctuation errors • Incomplete citations	• Pervasive spelling, grammar, or punctuation errors • Missing citations

Suzanne Scott & Kristi Upson-Saia • Sample Writing Rubric • Occidental College
(Writing rubric color-coding matches grading in iAnnotate)

Figure 3. Color-coded Rubric.

variety of types of feedback (e.g., criticisms of specific ideas, conversational engagement with ideas, comments on broader writing skills, etc.) and although instructors expect students to engage differently with each type of comment, students have a hard time distinguishing these different kinds and levels of feedback. In short, students need to be trained to understand how we expect them to read and use our feedback.

After returning their first paper, we devoted classtime to reminding them how to navigate our feedback: we explained the difference between stamps, checkmarks, and discussions in the collapsible balloons. To this we added a discussion of what we viewed to be the purpose and function of feedback and of how they ought to engage with each type of comment. We clarified that feedback was useful to justify the grade they received, but to do more than just that. We explained that they should use some feedback—our stamps that, in aggregate, pointed out broad areas of writing strengths and weaknesses—to inform their reflection on their broader writing and revision process and to modify their current process of drafting and revising. Further, we explained that they should use other types of feedback—our comments in collapsible balloons that engaged their ideas—as an attempt to point out areas in which students' ideas need to be corrected or developed. This might mean that students need to review course material that they did not understand sufficiently or that we are encouraging them to continue to pursue an interesting line of inquiry in a subsequent paper. Our aim was to reorient students to the range of ways they might use our feedback, thus maximizing the value of our comments for them as well as for us. While any instructor could teach students to use even traditional feedback in this way, we found that the palette of annotation tools in iAnnotate—namely, the ability to color-code the stamps and to vary the look of our comments—made it easier for us to visually represent these different kinds and types of comments and to coach students on how to engage differently with each.

C. Reflection.

Although instructors are regularly disappointed that students do not make good use of their careful feedback, recently several scholars have observed that students are seldom, if ever, required to engage with instructor feedback. These scholars urge instructors to require some sort of assignment in which students read and reflect on feedback given to them (Weaver, 2006; Hepplestone et al., 2011; Carless, 2011). Following this advice, we required students to reflect on and respond to our feedback in two ways. At the end of the semester (directly before they began work on the final paper), students had to compose a short written reflection on all of their papers to date in the course. They were to compose a self-assessment that identified broad areas in which they did well and poorly, noted areas in which they had improved over the course of the semester, and devised strategies for continuing to work on areas in which they were persistently weak. Then we met with students in one-on-one conferences to discuss their ideas for their final paper, as well as to talk about their research, writing, and revision process as it related to the strengths and weaknesses identified in their reflection.

V. Findings.

Because this was an informal and limited pilot program, our findings are grounding in (1) the instructors' assessment of students' development over the course of the semester; (2) students' written self-assessments;[11] (3) anecdotal student feedback in one-on-one conferences; (4) student feedback collected in course evaluations;[12] and (5) for one of the four courses, pre-semester and post-semester surveys.[13] We have divided our findings into three subsections. First, we enumerate how our feedback model enhanced student learning. Second, we discuss some of the more practical benefits of this feedback model for students and instructors. And finally, we present issues that arose and offer suggestions on how they might be resolved in future iterations of this feedback practice.

A. Enhancing Student Learning.

This feedback model had several immediate benefits to student learning. For clarity, we have broken down these learning benefits in a way that most clearly delineates them; we recognize, though, that these are artificial categories. In practice, we saw many intersections between these

[11] With sixteen students enrolled in each class, we had a total of sixty-four course self-assessments.
[12] With sixteen students enrolled in each class, we had a total of sixty-four course evaluations.
[13] After teaching three courses using our feedback model, we gave two surveys to gather both quantitative and qualitative data about students' attitudes toward feedback in general and to our feedback model specifically. The pre-semester survey was designed to assess students' exposure to and preferences for hand-written or electronic comments, to assess how students' use feedback (if at all) in subsequent writing assignments, and to help us design the in-class framing of our feedback model. The post-semester survey was designed to collect student responses to our feedback model to help us identify issues and refine the model in subsequent courses. Both surveys were optional, with thirteen of sixteen enrolled students completing both, and were composed of a mixture of multiple choice, ranked/scaled options, and open-ended elaborations or justifications of their responses.

categories. First, we found that, in comparison with prior students in our first-year writing courses, these students had a better understanding of our standards and expectations. Because the stamp system was aligned with our grading rubric and with the writing workshops—in terms of verbatim language and color-coded categories—our standards were repeatedly enforced and linked to visual cues.[14] Students' self-assessments demonstrated that they had absorbed our standards as a vast majority of them used our own categories and language to discuss their primary strengths weakness and to make a concrete plan for improvement. For instance, one student remarked that the many green stamps that read "you need to interpret/analyze your evidence," "this evidence isn't relevant to the point you're making," and "insufficient evidence: add more/greater range to substantiate your point" visually clarified that the student had trouble marshaling evidence. The student wrote in her self-assessment, "I need to work on interpreting evidence to create a better dialogue between sources and my own ideas. When writing I will often pull in quotes I find last minute without really thinking about how well they substantiate the point I'm trying to make. In preparation for my term paper, I plan on writing out a detailed outline and mapping out each specific point/quote from sources that I want to use to make sure they're relevant and explicitly linked to my argument." Another student noted that it was abundantly clear that he was not guiding his readers through the stages of his argument since "every paragraph in every paper has a 'you need a better transition here' stamp next to it!" Although we did not instruct students to use our categories during peer-reviewing sessions, we regularly overheard them offering feedback to their peers that mimicked the categories and language of our rubrics.[15] One student even began bringing her own set of colored pens to peer-review sessions to replicate the colored taxonomy of the rubric when writing comments on her classmates' papers.

Second, we found that our feedback model taught students (especially first-year students who were unfamiliar with college-level writing and feedback) how to read and rank their instructors' comments. Students reported that they were able to understand that we offered different types of comments, each with distinct purposes, because they were visually distinct in the margins of their papers.[16] Moreover, students understood the relative importance of our comments. Because dissecting voluminous and uniform marginal comments is challenging for students, color-coding distinguishes visually higher-order concerns from lower-order concerns. When students made reference to writing style or mechanical issues in their self-assessments, their language clearly conveyed an understanding that these were lower-order concerns. For example, one student wrote in her self-assessment: "As for silly spelling and grammar mistakes, this has always been a weakness because I do not put enough emphasis on the editing process. I think it will help me if I print out my essay, read it aloud a few times, and really go through it with a fine comb to avoid these silly mistakes." On the contrary, they also clearly understood argument and structure to be most salient; one student wrote on her self-assessment: "Before this

[14] Somewhat unexpectedly, this overt alignment to keep the rubrics, writing workshops and stamps cleanly aligned forced us to be more focused and consistent.

[15] It was also apparent that, in peer-reviewing sessions, students offered more pointed feedback. In past classes we both struggled to get students to be more hard-hitting and direct with their peers. We had chocked this up to their hesitance to criticize their classmates, but we have come to realize that some of their hesitation stemmed from the fact that they simply did not understand sufficiently the standards of assessment and thus were unable to marshal those standards in their evaluation of their peers' work.

[16] Although our papers had the same amount of marginal notes as prior papers, the systematization of the notes—and our explanation of the system—made it easier for students to navigate or, put differently, made it so that students were not overwhelmed (a common problem that plagues overly commented-upon papers; Monroe, 2002; Higgins, Hartley, & Skelton, 2002; Nicol & Macfarlane-Dick, 2006; Miller, Linn, & Gronlund, 2012).

class I spent a lot of time editing the spelling and grammar. I now know I need to spend that time on more important things like my argument." This new ability to navigate comments has extended beyond our initial pilot program, with students reporting to us that, even after moving into courses that employ more traditional feedback, they are more easily able to parse and prioritize comments.

Third, students and the instructors were better able to identify patterns of writing strengths and weaknesses. In the past, when writing hand-written comments on papers, we did not flag every instance of a particular writing flaw. For instance, if a paper had weak transitions throughout, we would simply note the first instance and alert the student that this was a problem throughout (with a note that read something like "here and throughout" or "this is a pervasive problem"). With iAnnotate, however, the ease of the stamp feature allowed us to mark *every instance*. The repetition of stamps within a student's paper—and still more the repetition across multiple assignments—alerted students to look beyond any given instance or beyond any given assignment to see more clearly the larger issues with their writing. One student, for example, remarked that he had never really paid attention to his transition sentences, or fully understood the impact they had on how the reader understood his (otherwise compelling and thoughtful) argument until he saw a barrage of orange "weak transition" stamps appearing all over his work. Here, the student not only identified a primary weakness, but also gained a greater understanding of how one structural element impacted the strength of his paper overall. As instructors, we noted that students who routinely received the same stamped comments on their first few assignments seemed to resolve these issues more quickly than students in the past. Taking the aforementioned student as an example, by the time he submitted his final paper outline, he was including rough transition sentences that he planned to refine in subsequent drafts.

The ability to see patterns of writing strengths and weakness was helpful not only for the students, but for the instructors as well. While consulting with students on an upcoming paper, we could glance quickly at the color-coded comments to be reminded of the areas on which students excelled and on which they needed work. We found this ability to track very quickly students' strengths, weaknesses, and progress to save an inordinate amount of time[17] and it made our conferences with students much more specific and productive.

Fourth, our feedback model allowed us to visualize the relationship between categories on our rubric, and thus between elements of writing. For example, a paragraph that was marked up with multiple comments in blue and green clearly expressed to students the connection between their presentation and analysis of evidence and the strength of their argument. By visually representing these two writing elements in tandem, students perceived how they were integrated and interdependent.[18] For example, in her self-assessment one student connected one of her strengths as a writer (identifying strong and appropriate evidence) with one of her weaknesses (analyzing and leveraging that evidence to substantiate her argument): "Although I am able to choose evidence properly, I am weak at times at fully analyzing the evidence at the highest level of detail. At times I will make broad claims and fail to fully unpack these claims by analyzing more carefully my evidence, which is necessary to make a more thorough and persuasive argument in my paper."[19]

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[17] Although most of the discussion about iAnnotate's benefits in terms of efficiency have centered on the time saved during grading, we found the time saved reviewing prior papers to be far weightier.

[18] We found it easiest to discuss these sorts of interconnections with students one-on-one. Some students, especially those with less preparation in writing, were focused on working on one or two writing issues and simply not ready to think about these more sophisticated interrelationships between elements of writing.

[19] Again, this is evidence of a student adopting the language used in the rubric and stamps: "unpack this claim."

Fifth, students began to understand and value feedback as more than merely justification of the grade. Because we placed an emphasis (early and often) on how to most effectively read and rank comments with an eye towards refining their arguments and writing, our feedback model functioned to reshape students' attitude toward feedback. Several students who admitted to rarely revisiting, much less revising, their written work in prior courses reported that our feedback model helped them view comments not as punitive remarks to be consumed once and then forgotten, but as a multi-layered conversation about their ideas and about their development as critical thinkers and writers. Other students, some whose prior instructors used the Microsoft Word's Track Changes feature to comment on their work, remarked that they began to see comments as more than edits to be "resolved" without further reflection on broader writing issues that transcended the particular assignment.[20]

B. Practical Benefits.

The students responded positively to our feedback system not only because they learned about themselves as writers and were able to more quickly progress as writers, but also for more pragmatic reasons. They considered improved legibility and increased accessibility to be useful. Many students admitted that, in the past, they simply did not read comments when the handwriting was illegible and that they regularly misplaced hard copies of graded papers. Because iAnnotate obviated issues of legibility and made "losing" a paper an impossibility (even if the email containing the annotated PDF was deleted, another copy of their paper with full comments was just an email away), students had no legitimate excuse not to read their instructors' comments. In fact, even those students who claimed that our feedback model had not fundamentally changed the way they engaged with different types or kinds of comments noted that having all of their papers digitally accessible made them more likely to revisit their written work.

Further, iAnnotate streamlines instructors' grading workflow to maximize efficiency; the practical benefits are five-fold. First, is the portability and extended battery life of the tablet (the device on which most instructors use iAnnotate). Second, is the easy, paperless submission and return of student work, using iAnnotate's built-in ability to sync with Dropbox or built in email function. Third, toolbars can be customized to include the instructor's most frequently used tools and stamps and easily adapted to any course and/or paper topic. Fourth, integrating other free apps further facilitates the process (e.g., we used Dragon Dictation to dictate and transcribe the summative comments at the end of the paper; some devices, like the iPad 3, now offer direct dictation into iAnnotate). Finally, as noted above, quick accessibility to color-coded stamps makes it faster and easier to track students' writing problems and progress.

C. Issues and Troubleshooting.

Despite our overall satisfaction with our feedback model, we encountered three significant issues. First, some students had trouble remembering which colors corresponded to which category of the rubric when they did not have the rubric directly in front of them. When surveyed at the end of the semester, students suggested that we include a stamp at the top of every paper

[20] On Microsoft Word creating the impression of "teacher as editor," see Michael J. Faris' blog post, "Using iAnnotate to grade": http://blogs.tlt.psu.edu/projects/ipad/2010/10/using-iannotate-to-grade.html

that could function as a key to the taxonomy. iAnnotate would also allow instructors to easily insert the full, color-coded rubric at the end of each paper.

Second, we encountered some technical difficulties. Students noted that sometimes the colors were lost when they printed their annotated papers using campus printers whose default was black-and-white. Instructors should stress that students need to read comments electronically or need to print them in color. Another small group of students mentioned that, depending on the program they used to open the annotated PDF (e.g., Adobe Reader or Preview, iBooks, iAnnotate, DocsToGo), some colors were more legible than others. Before implementing this feedback model, instructors should investigate which colors and programs are most legible on the programs available at their institution and they should advise students to use those programs to read their annotations.

Finally, some students reported a lack of "personal touch" associated with the use of e-assessment tools. In our pre-semester survey, the vast majority of the respondents indicated that the majority of their written work in High School had been graded by hand (85%). On the survey several students remarked that, while they did not find any fundamental difference between handwritten and electronic comments in terms of content, they generally perceived handwritten comments to be more "personal" and they claimed to "connect" with it more despite issues of illegibility.[21] As more than one of these students acknowledged, however, their preference likely also stemmed from the fact that they were simply accustomed to handwritten comments. Yet this perception is not insignificant as Chang et al. (2012) discovered that students' perceptions of personable feedback is interconnected with their perceptions of quality feedback; in other words, students think that the care associated with taking time to hand-write comments correlates with students' perception that caring professors offer higher quality feedback and thus they take that feedback more seriously.[22] One way instructors might temper these concerns is to create handwritten comments (rather than text stamps) in iAnnotate by using a stylus though this might result in issues of illegibility, especially given complaints about the lack of precision of styli, and obviates the practical benefits of saving time for the instructor. Alternatively, instructors might also choose to use a new feature of the latest version of iAnnotate: audio comments. Instructors can pepper the paper with audio comments of up to 60 seconds each. In addition to mitigating concerns about "impersonal" feedback, audio files might also create a more expressly dialogic form of feedback (and could stand in for the collapsible balloons as we used them).[23]

VI. Conclusions.

We found it interesting that the students who responded most positively to our feedback model were the strongest and weakest writers in terms of the elements of writing emphasized on our rubric. On the one hand, students who entered the course with a strong grasp on writing fundamentals reported that this feedback model helped them pinpoint very nuanced aspects of their writing (within broader categories) that needed improvement. On the other hand, our weakest students, who frequently self-identified as visual learners, found the feedback model especially well-suited to their learning style, enabling them to visualize their writing strengths

[21] This finding corroborates student preferences for a "human aspect" to feedback found in Budge (2011) and students' aversion to e-assessment because it is impersonal, as reported in Ferguson (2011), Scott (2006), and Morgan and Toledo (2006).

[22] This study finds that students prefer e-assessment for its accessibility, legibility, and timeliness, while they value handwritten feedback as higher-quality because of its personability.

[23] On using iAnnotate's audio feature to make grading more personal, see Doug Ward's post on ProfHacker: http://chronicle.com/blogs/profhacker/grading-with-voice-on-an-ipad/40907

and weaknesses. Specifically, the color-coding enabled them to compartmentalize writing issues and to more systematically approach revisions, tackling one category at a time. So, in the end, we were surprised, yet pleased, to find that our feedback model addressed existing educational and learning inequities.

In addition to speaking to students with differing educational backgrounds and learning styles, we believe that this feedback model could be productively applied across courses, disciplines, and institutions within minimal adaptation. In our small liberal arts college environment, where class sizes are relatively small and there is a premium placed on the professor-student interaction, iAnnotate functioned to help enrich these interactions by focusing and concentrating our engagements around our learning objectives. The e-assessment tool kept students' and instructors' attention firmly trained on a limited set of writing elements and on students' development as thinkers and writers. When considering how this system might be applied to different courses or different institutional contexts, particularly those with much larger enrollments or those in which student work is graded by a rotating instructors or teaching assistants, the benefits of this feedback model become even more apparent. In particular, for the former, this model would enable instructors to offer more detailed feedback than would be ordinarily possible given the size of their classes. For the latter, this model would create coherent, unified standards that could be used by various graders, providing more consistency for students, thus improving the chance that students—now with a clearer sense of what is going wrong—could develop as writers.

Appendix A: List of customized stamps

Argumentation	interesting idea develop this idea further good, careful reasoning you need to make your reasoning more explicit you need to make explicit each stage/layer of logic in this argument imprecise reasoning unpack this claim strong thesis, complex argument refine your thesis your intro is lacking a thesis
Evidence	nice use of evidence you need to interpret/analyze your evidence you need to introduce your evidence this evidence isn't relevant to the point you are making insufficient evidence: add more/greater range to substantiate your point support this claim with evidence
Structure	strong transition weak transition clarify the point of this paragraph clarify how this paragraph contributes to your overall argument nice guidepost
Style	awkward prose well-written/nicely-put vary your word choice vary your sentence structure

	unpack this sentence—too long, too many ideas this language is vague, specify does this word convey precisely what you mean? consider your audience
Mechanics	incomplete/improper citation citation needed proofread your paper sp.

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Fostering collaboration and learning in asynchronous online environments

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Abstract: This case study, based on social constructivist learning theory, analyzed the quality of interaction and learning taking place during asynchronous discussions in a graduate level course by focusing on the types of instructional strategies employed to foster discussion. Qualitative and quantitative procedures were used to analyze knowledge construction processes based on previously conducted research that provided a set of indicators for replication in coding and comparison of results. The role of facilitator was closely monitored in relation to the quality of responses in regard to knowledge construction in order to determine the types of instructional strategies best suited to draw students into online discussions that are constructivist, collaborative approaches to building knowledge.

Keywords: constructivist learning; collaborative learning; online learning; computer-mediated instruction

I. Introduction.

Online and blended learning has grown significantly in recent years. Spurred by the increased interest among faculty in designing effective learning experiences, this rapid growth requires a focus on the types of instructional strategies that will best serve as effective tools to draw students into online discussions that are constructivist, collaborative approaches to creating meaning. While significant research has been conducted on the quantitative nature of online discussion participation (Henri, 1992; Harasim, 1993; Hillman, 1999), far more research should focus on what happens to learning within this environment (Schrire, 2006).

The asynchronous online discussion environment offers unique opportunities for students and instructors. Since participation is not required at a specified time, or during a structured must-be-present-window, students have the luxury of time in order to write and even re-write their responses. Without specified time constraints, students can take time to review posts, reflect on the direction they wish to move the discussion, and at their discretion, end or begin new discussion strands (De Wever, Schellens, Valcke, & Van Keer, 2006; Pena-Shaff & Nicholls, 2004). This careful deliberation and articulation of ideas has the potential to improve students' writing and thinking skills. Most importantly, this makes an online discussion a collaborative, reflective activity (Pena-Schaff & Nicholls, 2004) that is characterized as dialogic in nature (Schrire, 2006). Such interactions hold interpersonal significance and highlight the importance of learner interaction in view of knowledge construction. "The need to articulate one's own argument in this type of text-based environment encourages students to engage in analytical and reflective action. This process helps students construct purposeful arguments and transmit them

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to an audience" (Pena-Shaff, Martin, & Gay, 2001, p. 65). Careful analysis of such interactions can help determine whether or not they facilitate critical thinking and encourage the process of knowledge construction.

Within a traditional face-to-face classroom, instructors often spend time preparing students for and guiding students through appropriate, effective discussions, incorporating a variety of strategies based on the pace of the class, the reactions of students to the content and one another, and a general reading of body language and other non-verbal cues. Such discussion techniques in the face-to-face classroom are not readily transferable to the online environment. "Without having face-to-face interaction, the absence of nonverbal cues and contextual information, it is a formidable task to elicit participants' sense of social presence in a learning community with only text based asynchronous discussion board communication tools" (An, Shin, & Lim, 2009, p. 751). New pedagogical approaches must be developed and honed.

A variety of instructional strategies can be applied to encourage student learning online—especially those activities for online and blended learning in an asynchronous environment. Graduate students bring another dimension to this environment as they enter with a level of confidence gained from more life experiences and an eagerness to share that learned-in-the-trenches knowledge. They often bring an eagerness to serve in a more active role in the online environment, allowing for the instructor to become a less dominant presence. Assigning roles is a common means of generating meaningful discussion and knowledge construction (DeWever, Van Keer, Schellens, & Valcke, 2010; Baran & Correia, 2009). According to Baran and Correia (2009), it is helpful to allow for student-led facilitation strategies to overcome the challenges of instructor-dominated facilitation. An instructor as the center of discussion has the potential to create what Rourke & Anderson (2002) describe as an "authoritarian presence" (p. 4). For many instructors, it is necessary to experience a paradigm shift wherein student-dominated discussions replace instructor-dominated facilitations. According to Harasim (1990), the key differences between online and face-to-face discussions are time and place dependence, and the richness and the structure of communication. Discussion techniques frequently used by instructors in the face-to-face setting have to be modified in order to facilitate discussion in the electronic forum. Finding the most effective pedagogical approach for the online environment can be a challenging task.

The classroom setting allows for the careful development of a community of learners. This same sense of community can and should be developed in the online environment. Interaction among students in a discussion forum helps them apply and integrate new knowledge in the course of engaging in group interaction (Wang, 2010). As students construct meaning through interaction with others, they are participating in a community of learning (Rourke, Anderson, Garrison, & Archer, 2001). According to Palloff and Pratt (2007), "The learning community is the vehicle through which learning occurs online. It is the relationships and interactions among people through which knowledge is generated" (p. 15). The importance of dialogue is founded on principles of social constructivist theory. Social constructivists consider individual learning as socially mediated, incorporating such principles as active learning, self-reflection, authentic learning and collaborative learning. Learning is collaborative in nature; group settings can further foster learning (Schrire, 2004). Asynchronous online environments can provide students with opportunities such as self-reflection, elaboration, and in-depth analysis of course content, allowing for purposeful construction of knowledge (Pena-Schaff & Nicholls, 2004). Rourke and Anderson (2002) assert the importance of online discussion as an essential activity for co-constructing knowledge since "explaining, elaborating, and defending one's position to others forces learners to integrate and elaborate knowledge in ways that facilitate higher-order learning" (p. 3).

The level of interaction helps result in learning. Dennen and Wieland (2007) indicate, "Learners must interact in some particular ways, engaging with each other and course material at deep (as opposed to surface) levels, which lead toward negotiation and internalization of knowledge rather than just rote memorization of knowledge" (p. 283). According to Andresen (2009), it is important for instructors to make asynchronous discussions successful. In order for this to occur, two important components must be carefully considered: the role of the instructor and how to achieve deeper/higher learning. The work of De Wever, Van Keer, Schellens, and Valcke (2009) indicates that a significant positive impact of assigning roles to students can be achieved, particularly if the role assignments occur early in the instructional period. Facilitation becomes a shared responsibility among instructors and students. According to Baran and Correia (2009), the majority of research focuses on instructor facilitation strategies and only a limited number of researchers have examined the use of facilitation strategies in peer-facilitation contexts.

The online environment presents itself as a critical tool for constructing, representing and mediating discussions between students. Facilitating learners to elaborate their knowledge in peer discussions and acquire multiple perspectives on a topic can be achieved through the assigning of roles. Roles assigned to students have the potential to increase knowledge construction through social negotiation outside the confines of the brick and mortar classroom. Simply placing students in groups does not automatically bring about collaborative learning or effective interaction. A purposeful instructional design, building on collaborative learning environments must focus on embedding certain amounts of structure, such as setting clear goals and defining the tasks (DeWever et al., 2009). In the case of this study, the purposeful instructional design included specific facilitation requirements for each of three discussions under investigation.

The purpose of this study was to determine the impact of various facilitation strategies on constructing knowledge and increasing collaboration in the asynchronous online discussion environment. An analysis of the interactions within online discussions designed as part of a hybrid delivery of instruction was completed in order to characterize successful student-led facilitation strategies in asynchronous discussions.

A. Framework.

The guiding framework for this work is learning as social construction of meaning. According to social constructivist theory, when students are presented with learning environments that encourage active participation, interaction and dialogue, they become opportunities to create meaning from new experiences (Jonassen, Davison, Collins, Campbell, & Bannan Haag, 1995). A constructivist theory suggests that learning is more effective when students are given opportunity to discuss ideas, experiences and perceptions with their peers.

> Based on the constructivist framework of learning, educational environments should provide activities and opportunities for students to articulate and reflect on the content under study, to negotiate meaning with the self (reflective activity) and with others, and to apply the knowledge learned in real life situations. In this manner, learning becomes an active process in which individuals create meaning by analyzing, discussing and

> experiencing new situations and applying new concepts. (Pena-Shaff & Nicholls, 2004, p. 245)

Rourke and Anderson (2002) conclude that from a social constructivist perspective, online discussions create opportunities for students to construct meanings together and integrate new knowledge into their prior experiences. The asynchronous online discussion environment provides the context and tools for students to engage in meaningful learning experiences. "Theoretical models of collaborative learning consider the discourse in a computer conference as both reflecting and shaping the cognitive processes" (Schrire, 2006, pp. 52-53). Schrire (2006) goes on to note that the cognitive processes are of a social nature in that they arise out of, and contribute to, the interactions among the participants.

B. Choosing a methodological approach.

Early research on online learning focused on the quantifiable variables; however, the early 1990's brought an increased emphasis on the aspects of quality of learning and learning interaction (Henri, 1992; Hillman, 1999; Pena-Shaff, Martin, & Gay, 2001). Creating a study that moved beyond the quantifiable variables was important to this researcher in developing strategies appropriate and effective in the online environment. Qualitative research, from a philosophical perspective, is based on a view that there are "multiple realities" (Schrire, 2006, p. 52). Mason (1992) recommends the use of content analysis in studies on computer conferencing. Additionally, Merriam (2001) asserts that the performance of a content analysis within the case study framework allows a study to move from mere description to meaningful interpretation. Content analysis is not only compatible with the case study approach (Schrire, 2006) it also provides the basis for interpretation in context (Cronbach, 1975). This study, different from a yes or no question-and-answer approach frequently associated with quantitative research, develops around what Merriam (2001) describes as a focus on *what* happens in a given context, *how* the events take place and *why* they occur. A case study approach incorporating both qualitative (participation levels, percentages of indicators covered) and qualitative (content analysis of discussion posts) design proved the most effective approach for this study. The application of three different treatments in the form of facilitation approaches provided an opportunity for comparison between discussions. Finally, using the Knowledge Construction Category System previously developed by Pena-Schaff and Nicholls (2004) allowed for a comparison to their study regarding the creation of knowledge in the online setting.

II. Methodology.

A. Context.

This study took place in the context of a graduate level course at a comprehensive university in the Midwestern USA. The Master of Science degree program, housed in the university's College of Education and Human Services, includes a 3-credit required course focused on the theoretical background of educational systems in the United States. The degree program was designed for any students seeking increased formal and informal leadership skills in pre-kindergarten to 12th grade (Pk-12) settings, higher education institutions, non-profit organizations, or any other systems focused on education and leadership. The hybrid nature of the course incorporates both face-to-face and online components, with students meeting on campus every other week and in the online environment during the opposite weeks. Also known as a blended course, this approach combines face-to-face instruction with computer mediated instruction as an alternative to the traditional delivery model. Such blending has been found to contribute to both achievement and student satisfaction (Roblyer & Wiencke, 2004) and has become an increasingly popular delivery model in higher education (An & Frick, 2006; Ng & Cheung, 2007). This study focused on the analysis of knowledge construction in online class discussions.

B. Participants.

The course under study during the Spring 2012 semester included 17 women and 7 men (n=24). All 24 successfully completed the course. The researcher served as the instructor of the course. All 24 students were Pk-12 teachers, counselors or library media specialists seeking a Master of Science degree. Eleven of the participants were also seeking Pk-12 administrative licensure.

C. Discussion Assignments.

Throughout the semester, there were six online discussion sessions. The first discussion assignment focused on introductory statements from participants. This was meant to provide some instruction on using the Desire2Learn (D2L) discussion features and comfort in navigating this particular platform. D2L is the university-adopted platform serving multiple functions, one of which is its online learning environment. The final two discussions focused on group project progress. The study, therefore, focused on the discussion assignments in weeks 4, 6 and 8 of the 14-week semester. Each of these discussion assignments was different in regard to the type of facilitation required. The week 4 discussion treatment was a loosely structured (non-facilitated) approach. The week 6 discussion required each student to facilitate a specific topic within the broader discussion. The week 8 discussion treatment was a single volunteer serving as facilitator for the overall discussion. Each discussion assignment was open for a 10-day window.

During face-to-face instruction time, information was provided to students regarding quality posts. Handouts to further clarify were also provided (See Appendix A). Students were placed in groups of four for each discussion. Group membership changed with each discussion. The instructor monitored the online discussions, providing comments and feedback during face-to-face classroom time but not directly participating in the online group discussions. The purpose of the study was to analyze the quality of interaction and learning taking place during asynchronous discussions by focusing on the types of instructional strategies employed to foster knowledge building in a collaborative online environment. Using three different discussion techniques allowed for comparison of the three in terms of levels of participation and depth of knowledge construction.

D. Data collection and analysis.

Both quantitative and qualitative approaches were employed to describe and analyze levels of participation, interaction, and meaning construction. The quantitative data included the total number of messages posted for each treatment, the percentage of overall messages posted per treatment, and the percentage of knowledge construction posts per the work of Pena-Shaff and Nicholls (2004). The administrative functions of D2L were used to note frequency of participation and threads of interactions; however, since paragraphs were the unit of measure for this study, that data was of far less importance than the content of the messages. The qualitative data of this study consisted of the content analysis of the three discussion assignments. Content analysis was conducted on the transcripts of the discussions each week under study. Rourke and Anderson (2004) suggest that instead of developing new coding schemes, researchers should use schemes that have been developed and used in previous research, fostering replicability and the validity of the instrument (Stacey & Gerbic, 2003; Hannafin & Kim, 2003). This study, therefore, utilized the coding schema developed by Pena-Shaff, Martin, and Gay (2001) and further modified by Pena-Shaff & Nicholls (2004). Using the existing category system, or set of indicators, allowed for coding and categorizing of discussions and the opportunity for comparing results to the patterns identified in the work of Pena-Shaff and Nicholls (2004). As the previous study already revealed the types of posts that could be identified as knowledge building, the current study used those findings to better identify the strategies that could be identified as knowledge building. The codes and descriptions of this model can be viewed in Table 1.

The discussion transcripts from the three selected discussion assignments were coded by the instructor/researcher. An initial coding was completed for each week under study. As a follow-up at the end of the data-collecting weeks, a second coding of the messages was conducted to check for ambiguity in the coding. Paragraphs were chosen as the unit of analysis. Each discussion contribution reflects a level of social construction knowledge. These levels were determined by applying the Pena-Shaff and Nicholls' Knowledge Construction Category System and Indicators. Each message (paragraph) received one code. When a message was comprised of multiple levels of knowledge construction, the most prominent was assigned. For example, when a student provided clarification of a previous statement but went on to provide interpretation of the discussion topic, the more prominent or more elaborated upon indicator was assigned.

Table 1. Knowledge Construction Category System and Indicators[2]

Category and Description	Indicators
Question: Gathering unknown information, inquiring, starting a discussion or reflecting on the problems raised.	+ Information seeking questions + Discussion questions + Reflective questions
Reply: Responding to other participants' questions or statements.	+ Direct responses to information-seeking questions + Elaborated responses that include information sharing, clarification and elaboration, and interpretation
Clarification: Identifying and elaborating on ideas and thoughts.	+ Stating or identifying ideas, assumptions and facts + Linking facts, ideas and notions + Identifying or reformulating problems + Explaining ideas presented by -using examples -describing personal experiences -decomposing ideas -identifying or formulating criteria for judging possible answers or to justify own statements (Making lists of reasons for or against a position) -arguing own statements -defining terms -establishing comparisons

[2] Pena-Shaff, J. & Nicholls, C. (2003). Analyzing student interactions and meaning construction in computer bulletin board discussions. *Computers & Education, 12*, 243-256.

	-presentation of similarities and differences -listing advantages or disadvantages -using analogies -identifying causes and consequences
Interpretation: Using inductive and deductive analysis based on facts and premises posed, making predictions and building hypotheses. Includes reflection and analysis when originating from the clarification point.	+ Reaching conclusions + Making generalizations + Predicting +Building hypothesis + Summarizing + Proposing solutions
Conflict: Debating other participants' point of view, showing disagreements and information in previous messages, and taken to an extreme, friction among participants.	+ Presenting alternative/opposite positions (debating) + Disagreements + Friction
Assertion: Maintaining and defending ideas questioned by other participants by providing explanations and arguments that defend original statements.	+Re-statement of assumptions and ideas + Defending own arguments by further elaboration on the ideas previously stated
Consensus Building: Trying to attain a common understanding of the issues in debate.	+ Clarifying misunderstandings + Negotiating + Reaching consensus or agreement
Judgment: Making decisions, appreciations, evaluations and criticisms of ideas, facts and solutions discussed as well as evaluating text orientation and authors' positions.	+Judging the relevance of solutions + Making value-judgments + Topic evaluation + Evaluating text orientation and authors' position about the subject being discussed
Reflection: Acknowledging learning something new, judging importance of discussions topic in relation to their learning.	+ Self-appraisal of learning + Acknowledging learning something new + Acknowledging importance of subject being discussed in their learning
Support: Establishing rapport, sharing feelings, agreeing with other people's ideas either directly or indirectly, and providing feedback to other participants' comments.	+ Acknowledging other participants' contributions and ideas + Empathy: sharing of feelings with other participants' comments ("I felt the same way…") + Feedback
Other: Includes mixed messages difficult to categorize and social statements.	+ Messages not identified as belonging to a specific category + Social comments not related to the discussions: greetings, jokes, etc. + Emotional responses

Table 2. Total numbers and percentages by treatment.

Treatment	Total number of Paragraphs Posted	Percentage of Paragraphs Posted	Percentage of PKCC Paragraphs Posted
#1	212	31.5	64
#2	340	50	69.1
#3	124	18	87
Total Paragraphs	676		

As was the case in the Pena-Shaff and Nicholls (2004) study, content analysis was used to identify the most common patterns of discourse. The category system previously developed and applied in that study was applied to the current study. According to Pena-Shaff & Nicholls (2004), "Statements of *clarification, interpretation, conflict, assertion, judgment* and *reflection* appear to be most directly related to the process of knowledge construction" (p. 252). For discussion purposes, this researcher has labeled these six indicators as primary knowledge construction categories (PKCC). Treatment one, or a loosely structured (non-facilitated) approach, included a total of 212 paragraphs posted (see Figure 1). Of these 31.5% of the overall 676 posted during the study weeks, 64% were coded as PKCC posts.

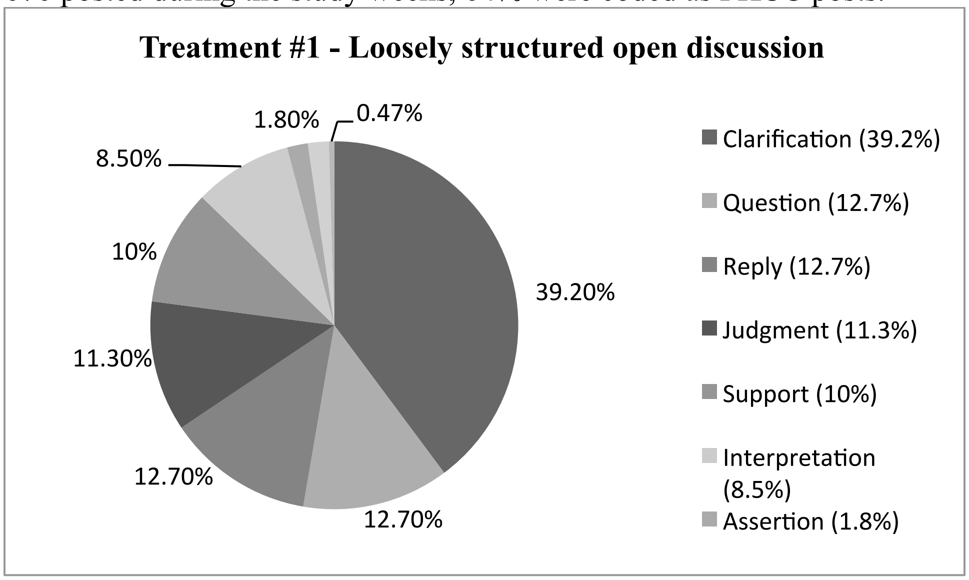

Figure 1. Percentage of Knowledge Construction in a loosely structured open discussion.

Treatment two, where each student was required to take responsibility for facilitating a specific topic within the overall discussion, consisted of 340 posted, or 50% of the total posts under study. This treatment generated 69.1% of PKCC posts (see Figure 2).

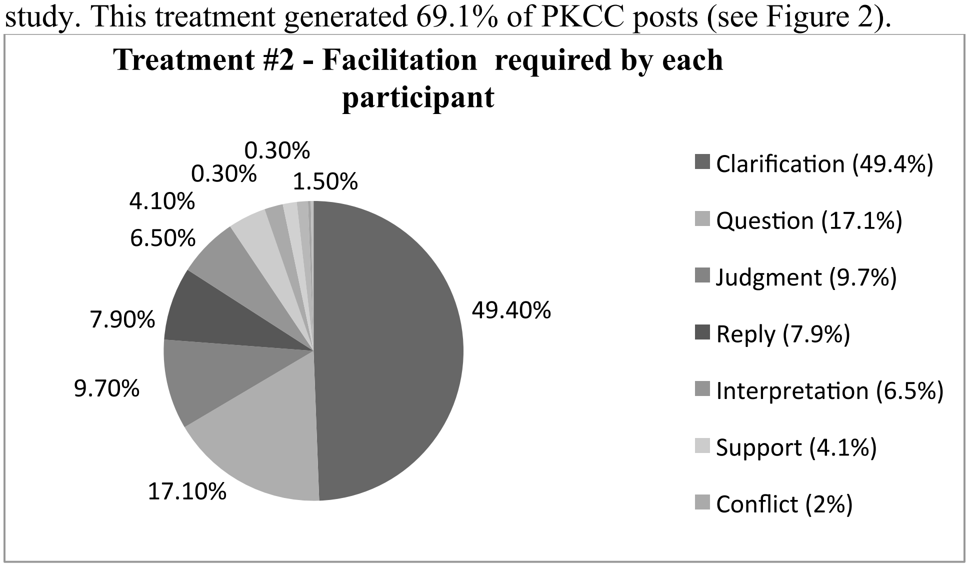

Figure 2. Percentage of Knowledge Construction with required facilitation.

The final treatment, where an individual in each discussion group volunteered to serve as facilitator for the length of the discussion, generated a total of 124 paragraph posts. This small number, only 18% of the total study posts, also generated the highest level of PKCC posts with 87% falling into the categories identified by Pena-Shaff and Nicholls (2004) as knowledge construction categories (see Figure 3).

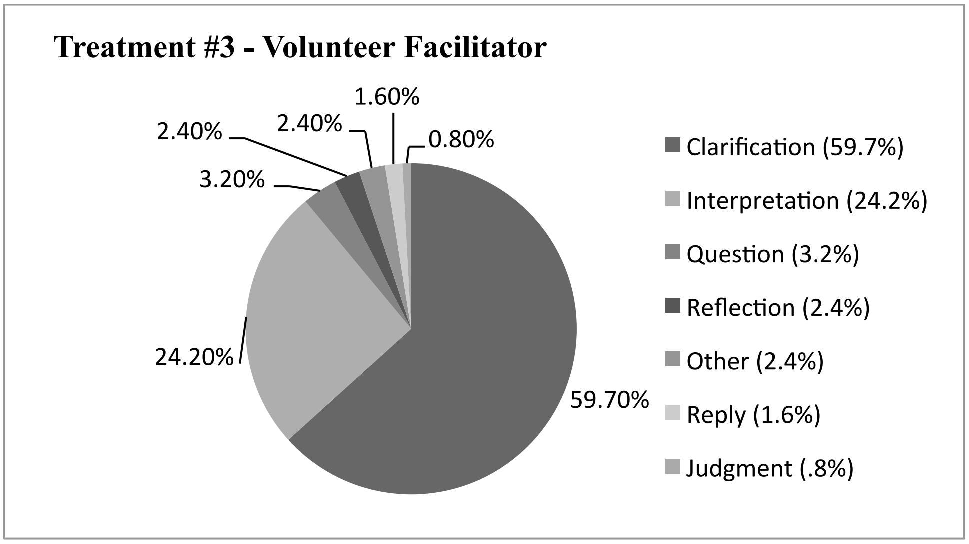

Figure 3. Percentage of Knowledge Construction with a Volunteer Facilitator.

IV. Discussion.

This small-scale case study provided a great deal of information regarding the role of facilitation in a graduate-level hybrid delivery course. According to Andresen (2009), "The primary difficulty in making any assessment of an asynchronous discussion forum is the huge volume of data that are available to be assessed…" (p. 252). Despite the small number of participants in this study, there was a "huge volume" of data, with a total of 676 paragraphs to be coded. Had the volume been low, this researcher would have felt uncomfortable making generalizations in regard to the facilitation types as knowledge construction contributors.

Hew, Cheung, and Ng (2009) conducted a study to determine what motivates students to contribute to student-facilitated discussions. Their findings indicated that 66% of the study participants agreed or strongly agreed that familiarity with the discussion facilitator motivated them to contribute more frequently to message postings. The findings by Hew, Cheung, and Ng clearly address the impact of the hybrid nature of a course versus a fully online version. The face-to-face sessions provide opportunity for community building that carries over into the electronic environment. Activities conducted in face-to-face settings to build community likely contributed to the strong online presence found in this study. The significant volume of data may be directly attributable to the learning community previously built.

Another study relevant to the findings of the current study was conducted by Baran and Correia (2009) where, similar to the current study, the researchers used three separate facilitation treatments, conducting each as a separate mini-case. Each case represented a different facilitation experience in their search to discover whether peer facilitation strategies could be used to overcome the challenge of instructor-led facilitation, enhance the sense of a learning community and encourage students' participation. What they found in their study was that regardless of the type of peer-discussion facilitation, whether highly structured, inspirationally facilitated, or practice-oriented, peer facilitation can help generate innovative ideas, motivate students to participate actively and provide an atmosphere for involvement and commitment. Also relevant was that it did not matter if the group sizes or memberships changed; all three treatments promoted meaningful dialogue, produced high levels of participation, and included quality conversation. The current study found the same to be true.

As noted earlier, previously developed indicators served the critical role of providing categories of knowledge construction. Content analysis was used to identify the most common patterns of discourse, just as was done in the Pena-Shaff and Nicholls (2004) study, and the category system indicators were applied to the data. In their work, Pena-Shaff and Nicholls determined six categories as indicators of knowledge construction. In the current study, those six categories were evaluated in each of the three treatments to determine levels of knowledge construction. A volunteer facilitator during a group discussion generated the highest level of PKCC posts, providing insights into discussion strategies that support learning in the online environment. In addition to the six indicators labeled as PKCC (clarification, interpretation, conflict, assertion, judgment and reflection), Pena-Shaff and Nicholls identified secondary levels of indicators in relation to knowledge construction.

Questions, according to Pena-Shaff and Nicholls (2004), also indicate that students are trying to make sense of and understand topics being discussed. While quality reflective questions can certainly serve this purpose, this study found questions to be generally overused in terms of simple discussion generation. During treatment two, facilitation was apparently defined by students as generating questions in order to start and/or continue an online discussion. This is not necessarily counterproductive, except that several questions were raised without any follow-up to them by other discussion participants. In fact, 17 questions were raised during the second discussion period (treatment two) without any response.

Of the categories identified, clarification statements formed 48% of the total (676) paragraphs. This means that students spent a great deal of time explaining and elaborating upon their ideas. Pena-Shaff and Nicholls (2004) had similar results. They noted, “Although in many cases clarification statements began as messages either questioning or responding to previous messages, they tended to become reflective monologues in which students focused more on explaining their own ideas, perspective and beliefs than on addressing specific points in others’ contributions” (p. 257). The following represents an example of this type of message:

> That's a good question! I think I would have a ‘senior’ teacher who has bought into a school-wide system give a little presentation to the teacher who has not yet bought in. Obviously, we want to make the teacher understand why we are implementing a system and to be able to see the benefits. I think having another co-worker explain the situation may make the teacher more receptive. Also, I think the Administrator should make unscheduled ‘visits’ to all classrooms. This is not to look for any problems or issues, but rather to keep current with curriculum and classroom tendencies in all grade levels.

Interpretation statements, including inferences, conclusions, discussion summaries, generalizations, hypothesis building, and suggesting solutions to problems stated represented, overall, just 10% of the statements; however, this category also showed the greatest amount of change between the first two discussion treatments and the third: Treatment one: 8.5%; treatment two: 6.5%; treatment three: 24.2%. This indicates that in the first two treatments, students did not provide a summary of ideas presented in a discussion thread. In the third discussion, with a single facilitator, this increased significantly.

Conflict was almost non-existent in the discussions. Despite this researcher spending time in class assuring students that a healthy discussion can include disagreements with one another, and facilitating such disagreements in the face-to-face setting, students were loath to disagree in the online format with a mere 1.4% labeled as such. Conflict has the potential to enhance discussion through a quality debate. This, however, was absent from the three discussions analyzed. Equally low in number (1.1%) were statements of assertion. This seems to indicate that very few students replied to messages that challenged ideas they had presented in previous messages.

It appears from this analysis that the treatment applied to each discussion influenced participation levels as well as knowledge construction. Based on the categories established by Pena-Shaff and Nicholls (2004), when discussion was left as an open forum without facilitation, less knowledge construction occurred. Participation levels were, of course, much higher when all students were required to facilitate some portion of the discussion (treatment two); however, the PKCC stayed very close in percentage to when no facilitation occurred (treatment one). The greatest level of PKCC occurred when a student served as a facilitator of the discussion, as was done in treatment three. The participation level declined for this treatment (only 18% of all paragraphs posted throughout the entire study period), but the overall quality of the discussion in terms of knowledge construction was far greater with 87% of the paragraphs posted falling into the PKCC categories. Gilbert and Dabbagh (2005) offer one possible explanation for this significant difference between the treatments. In a study examining the impact of highly structured versus less structured discussions, Gilbert and Dabbagh found that participation levels were higher when specific facilitator guidelines were provided. This was certainly the case in the current study as guidelines were carefully spelled out for treatments one and two, those with the highest participation levels, but far less structured in the third treatment where participation dropped. A sample of discussion postings and their codes can be found in Appendix B.

Some limitations of the study must also be noted. Benefits certainly exist in using a previously-developed coding scheme. Clearly, this allows for comparison and replication. Pena-Schaff and Nicholls (2004) provide a variety of samples and examples to further clarify and define indicators; however, limitations exist. There is still the limitation of one researcher closely using the work of another without being able to fully guarantee reliability as it is impossible for the exact interpretation of terms, indicators and samples. Also, the student sample is very small so it is difficult to make broad generalizations based on the results. Finally, the researcher knows the students quite well, even serving as their program advisor as they complete their graduate degree. This potentially increases the possibility of bias as it is difficult to completely extricate the role of researcher from the role of course instructor.

V. Conclusions.

This small-scale case study appears to support what other researchers have reported. Online discussion forums have great potential to encourage critical thinking and the process of knowledge construction. The use of specific strategies to better encourage that potential is critical. Finding ways to build community in the classroom setting that can be carried to the online setting is important. Additionally, appropriate tasks, clear guidelines and defined facilitator expectations also increase the likelihood of success. According to Andresen (2009), "Knowledge construction only occurs because of careful planning: clear, well-defined, well-crafted questions and discussion topics. Without such planning and subsequent guidance, only lower levels of cognitive engagement will occur" (p. 252). The assignment of facilitation roles in this study showed an increase in the types of interactions believed to lead to increased knowledge construction. More specifically in this study, having one participant volunteer in the role of facilitator led to the greatest increase in knowledge construction. Keeping groups small appears to optimize participation also, with group sizes of four being utilized in the current study. "Interaction among course participants helps them apply and integrate newly gained knowledge in the course of engaging in group activity" (Wang, 2010, p. 832).

Unlike the findings in many online discussion studies, low participation was not a factor. Students participated far beyond the minimum requirements and expectations. Using activities in the classroom to encourage collaboration seemed to carry over into the online environment. Had students not been given such opportunity to become a learning community face-to-face, it is likely they would not have been so willing to participate at the same level in the online setting. As Pena-Shaff and Nicholls (2004) found, courses that include online discussion as a supplement to regular class meetings need to carefully integrate this activity into the overall course design "so students see it as integral to the class and not as a disassociated activity" (p. 263). An appropriate follow-up study might include the specific activities that are most effective in creating this environment.

Similar to other studies, students clearly did not go back to follow conversation threads as frequently as this researcher would desire. It is quite evident by the low number of conflict, consensus building and assertion statements that students usually did not return to a discussion thread after posting a question, clarification or interpretation. This researcher believes more work needs to follow on methods of motivating or challenging students to a greater extent so that discussions are not so much reflective monologues as they are dialogical interactions. Courses that meet in a face-to-face structure with an online component allow for in-class work on clarifying these expectations.

Social constructivist ideas about the most productive characteristics of learning environments can be supported through an online discussion opportunity where students reflect on others' ideas as well as their own. This is particularly true when students are required to share ideas in writing. According to the results of this study, the most effective instructional strategy of the three employed for a constructivist, collaborative approach is using a student volunteer as discussion facilitator. Future research might focus on other strategies not included in this study which might prove even more effective.

Appendixes.

Appendix A.

Guidelines and Rubric for Online Discussion Requirements
Educational Leadership Courses

In this class, online discussions will be graded assignments. The purpose of the online portion of the course is to frame and promote collaborative learning. Active and regular participation is not only an important part of your responsibilities to the class but also important for you in learning new course content and in developing your thoughts and positions on various topics.

There are three very important rules for using online discussion boards:

1. Please remember that the culture of mutual respect that is part of our face to face time extends into the virtual classroom environment.
2. Participation is required.
3. Participation alone is not enough. Your posts require a thoughtful and meaningful approach. Quality does count!

The total of your participation in a single discussion topic (noted as a weekly assignment) will be graded on a 10-point scale.

Please follow this protocol for posting and responding to online discussions:

a. You are expected to participate on multiple days. As this is an asynchronous discussion format, not everyone will be ready to post on the same day. Check your discussion board on at least three different days to get the full effect of your group's discussion.
b. You should follow the specific posting requirements noted for each week. Make sure you meet the minimum requirements for the week.
c. There is a rather fine line between a post that is too short and one that is too long. Whether you agree or disagree with someone else's post, explain why with supporting evidence and concepts from the readings or a related experience. Include a reference, link, or citation when appropriate.
d. Be organized in your thoughts and ideas.
e. Incorporate correlations with the assigned readings or topics.
f. Stay on topic.
g. Provide evidence of critical, graduate-level thinking and thoughtfulness in your responses or interactions. Avoid summarizing.
h. Contribute to the learning community by being creative in your approaches to topics,, being relevant in the presented viewpoints, and attempting to motivate the discussion.
i. Be aware of grammar and sentence mechanics.
j. Use proper etiquette. Being respectful is critical.

A Discussion (9-10 points)
A-level postings:
- Are made in a timely fashion, giving others an opportunity to respond.
- Are thoughtful and analyze the content or question asked.
- Make connections to the course content and/or other experiences.
- Extend discussions already taking place or pose new possibilities or opinions not previously voiced.
- Are from participants aware of the needs of the community, motivate group discussion, and present a creative approach to the topic.
- Follow the conventions of quality writing.
- Meet the minimum posting requirement.

B Discussion (8-9 points)
B-level postings:
- Are made in a timely fashion, giving others an opportunity to respond.
- Are thoughtful and analyze the content or question asked.

- Make connections to the course content and/or other experiences, but connections are unclear, not firmly established or are not obvious.
- Contain novel ideas, connections, and/or real-world application but lack depth, detail and/or explanation.
- Are from participants who interact freely and occasionally attempt to motivate discussion.
- Have few errors in writing conventions
- Meet the minimum posting requirement

C Discussion (7 points)

C-level postings:

- Are usually, but not always, made in a timely fashion.
- Are generally accurate, but the information delivered is limited.
- Make vague or incomplete connections between class content and posting by other students.
- Summarize what other students have posted and contain few novel ideas.
- Show marginal effort to become involved with group.
- Have numerous errors in writing conventions
- Do not meet the minimum posting requirement.

D Discussion (6 points)

D level postings:

- Are not made in timely fashion, if at all.
- Are superficial, lacking in analysis or critique.
- Contribute few novel ideas, connections, or applications.
- May veer off topic.
- Show little effort to participate in learning community as it develops.
- Does not understand the standard conventions of written English.

F Discussion (0 points).

- Participant was rude or abusive to other course participants. In this case, the number and quality of other posts is irrelevant.

OR

- Participant failed to meet the basic criteria for the "D Discussion."

Appendix B.

Coded Excerpts from Discussions

Initial Post – Structure Discussion

After doing a little reading I related really well to one part and wonder if you did as well. In the section about structural dilemmas the very last sub-category of "Irresponsible vs. Unresponsive" created a vision for me of the "go-to" parent or teacher. What I mean is, are you going to tell Mom or Dad first you failed a test, which one will be cooler with it and which one will blow up at you take away your phone and ground you? I feel this can happen in a school setting easily if one teacher is laid back on homework and allow students a few days to get stuff in verse a teacher who allows no days. Or a bigger one that I think we see more often is with discipline and behavior issues. What do some teachers allow and others do not. For example a teacher who writes a student up for every little thing is losing the "power" of the referral where as a teacher who uses the referral as a last chance still hangs onto that power and uses it when necessary? What are your thoughts and have you had similar situations? **[Question]**

Replies to Initial Post

This is a very good point that you brought up, and I think it to relates back to that lateral coordination. Not only do we need to have more cross-grade level meetings but I think we also need to have meetings on things such as these. I know that every teacher is going to have a different view on what students can get away with, as well as what administration is going to take as a serious offense, or taken more lightly. I think that the PBIS at the middle school is run very well, and I know that we are just really getting into the "good years" of it. I think that we can start opening up some discussions on issues such as these so that administration and teachers, are all on the same page as to what should be a referral and what should be let go. How many chances does each student get? These are good conversations to start having in teams. **[Reply]**

I could not agree more with the feeling of isolation. Throughout the course of the day, I sometimes do not see teachers from my grade level. Information has to pass through all people involved. M__ your point about structure and lack of opportunity here at the middle school is exactly how I feel. Cross-grade level meetings would be beneficial if used properly. If nothing more, you interact with peers and build personal relationships. Like you stated Stephanie, it's important to find the common ground between the two. **[Clarification]**

When I look at the structural assumptions, number four really jumps out at me. I think that it is important to be rational about things that go on in an organization, and I feel that many administrators are quick to forget about rationality, and want to get their agenda met and accomplished. Adding pressure and forgetting about rationality only stresses individuals out, and doesn't accomplish much. Going off of this, I will talk about how I feel my building is run. I feel that in the building that I am in there is a later coordination. There are many different groups that are working on different things, and then we come together as a staff to report on them. We have school-wide improvement committee, literacy committee, etc. These groups meet on their own and have their own agendas, and report back to the staff as a whole to keep everyone informed and up-to-date. My question on this is whether or not administration (not just in my school, but anywhere with a similar approach) actually looks at it as a lateral approach or if they have it in the back of their minds that ultimately they are making the last decision? And, how as an administrator do you come to certain conclusions without taking it to a vertical approach if groups aren't getting the outcomes that you would like them to? **[Clarification]**

When I think about the structural dilemmas, the first one that really got my attention was the *Excessive Autonomy Versus Excessive Interdependence.* When I look at the building I am in, I feel very much isolated from other teachers. I feel that having cross- grade level meetings would help this feeling a lot. The big question that I come too is when are you being too isolated? And when are you coming together too much? As an administrator I think it is important to find the common ground between the two and is something that should have thought put into it in an organization. **[Clarification]**

Glad you feel valued. That's a big key to keeping younger staff like you here. I think the administration is making a much better effort to give positive feedback and thanks to staff. However, I feel like it's usually when staff brings some kind of positive PR to the district that the administration seems to notice. I think so much of the day to day things some of us do that go above and beyond go unnoticed. Curious what others thoughts are on that... **[Reflection]**

Initial Post – Human Resource Discussion

In my short career thus far as a teacher/coach at MHS, I have little evidence to argue that people are not the greatest asset in my workplace. Opinions about this might be different amongst other staff members, but for me personally, I have been made to feel that I am an important asset in our building. **[Clarification]**

Replies to Initial Post

Our Physical Education Department at the middle school consists of me and two other professionals. In the last year and a half, the three of us have overhauled our entire curriculum hoping to create a quality program for our students. Many of the changes to our program would not have been possible without the support and trust of our administrators. Additionally, our Physical Education Department recently had an article published in *Teaching Today,* the statewide educational newsletter for Wisconsin. In the article we discussed methods we use to incorporate literacy into our Physical Education classes. Shortly after the article was published, we received an email from our administrators thanking us for our hard work and commitment to our student's education. By sending a simple email saying thanks, our administrators provided confirmation that what we do is meaningful and we truly are assets in our workplace. *"When individuals find satisfaction and meaning in work, the organization profits from effective use of their talent and energy. But when satisfaction and meaning are lacking, individuals withdraw, resist, or rebel"* (Bolman & Deal, 2008, p. 164). **[Clarification]**

I definitely agree with your opinion that promotion within education is less practical in comparison to being promoted in a business environment. In education we know that there are great teachers, some with wonderful leadership qualities, which never pursue administration. I believe many because of the time and money needed for an additional degree/certification. In result, promotion within education isn't always the result of quality performance, but instead, the result of who is able to afford it vs. who is not. **[Clarification]**

Initial Post - Organizations as Cultures

I feel as though M___ High School *tries* to produce a positive school culture. We have annual traditions such as Homecoming (spirit week), Winterfest, Spring Fling, and graduation. Students and staff also receive purple t-shirts at the beginning in the first week of school and wear them with pride throughout the year. However, I often feel as though it's the **SAME** teachers who make an effort to participate in all of these activities. I can't recall the number of times I've heard a veteran teacher say something along the lines of "*it's the new teacher's turn to do this...*" I try to attend various athletic and extra-curricular events or judge for Student Senate competitions. At the Winterfest assembly this year I judged with ONE other teacher because no one else could/would help. During this year's corporate challenge we forfeited an entire evening of events due to lack of participation. It's frustrating to feel as though the same people take on the majority of all the tasks. **[Clarification]**

Replies to Initial Post

The truth is, we ALL have obligations. I know that while I may be considered a "younger" teacher, I have two children, a husband who works long hours and often travels, work a second job, advise three clubs, plan a trip to France every other year, took several graduate courses this year and am pursuing an additional master's degree, all in addition to my four (next year five) preps while most teachers have two or three. Yet I still manage to find time to make it to a few athletic events, extra-curricular activities, or academic nights (awards, graduation, etc.). So I wouldn't say I have more time, but maybe more energy. Hopefully that lasts! **[Clarification]**

I respect that many teachers, new and veteran, have obligations, commitments, or other priorities. However, younger teachers look to veteran teachers to lead by example. That's typically why they are chosen as mentors. The bottom line is there's always a reason *not* to do something. As a group of individuals pursuing a degree in *administration* is it not our goal to lead by example? Would we not look to our future employees to do the same? Is an administrator given a choice not to attend extra-curriculars because of a variety of other obligations? Food for thought. **[Question]**

[Full transcript sets are available from author upon request]

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Human patient simulation to teach medical physiology concepts: A model evolved during eight years

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Abstract: Worldwide, the use of human patient simulators in medical education has expanded rapidly as a means of enhancing the clinical and emergency response skills of health care students in a risk-free environment. The use of patient simulation for teaching of medical basic science concepts, however, is still in its infancy. At our medical school, ten years ago we had relatively inexpensive access to a high fidelity patient simulator which we used for teaching in the following courses: anatomy, medical immunology, and medical physiology. When this situation changed five years ago with the building of an education simulation center, the cost-to-benefit ratio for the use of simulators during the physiology class had to be reevaluated (anatomy and medical immunology discontinued simulation teaching after three years). This Best Practice paper presents our use and learning outcomes of low and high fidelity simulation for the past four years as part of a flipped physiology learning model and discusses its potential for widespread adoption for medical science teaching.

Keywords: human patient simulation, medical school, physiology, cardiovascular, basic science teaching

I. Introduction.

Medical education is increasingly adopting integrative learning curricula, which aim at teaching traditionally separated subjects such as basic sciences and clinical competency in a comprehensive way. Information on which teaching tools effectively provide such integration is, however, still sparse. While the efficacy of human patient simulation as a teaching tool to train and assess *clinical* competency has been well accepted (Grenvik, Schaefer, DeVita, & Rogers, 2004; Naik & Brien, 2013), there are only a few institutions worldwide that use patient simulators for *medical science* teaching (Euliano, 2001; Gordon, Brown, & Armstrong, 2006). In our view, its widespread use in the latter context is hampered mainly by three factors: First, it is challenging to achieve clinically correlated science teaching objectives with medical students in their early stage of training since they do not yet have sufficient clinical knowledge. Second, basic science educators often do not feel comfortable providing ad hoc clinical realism in a medical scenario. And third, as is true in general for simulation training, it requires expensive technology, faculty competence and time-intensive repeats with multiple student groups.

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We use human patient simulation for teaching of medical physiology since 2006 and arrived in 2010 at a ‘Flipped Learning Classroom’ (Hamdan, McKnight, McKnight, & Arfstrom, 2013). In the flipped learning paradigm, students are asked to prepare for the content of the scenarios ahead of time, leaving class time for the simulation exercises which consist of role play and discussion. This serves to reinforce and conceptualize physiological principles and to illustrate the clinical relevance of the basic science information. This is different from the patient simulation teaching paradigm for advanced learners, which tests the students’ clinical competence in unknown situations and minimally disrupts the flow of action during the simulation by directing any discussion to the wrap-up session. This Best Practice paper describes our flipped learning simulation teaching model, presents its efficacy over the past four years for learning physiology, and discusses its relevance for widespread adoption of patient simulation for medical science teaching.

II. Patient Simulation for Teaching of Medical Physiology.

A. Motivation and Program Development.

Indiana University School of Medicine-Terre Haute (IUSM-TH) is one of eight regional campuses of the Indiana University School of Medicine, which has its main campus in Indianapolis. One advantage of the regional campuses is the small class size (24 students per entering class at IUSM-TH), which allows for experimentation with new teaching modalities and ease of interdisciplinary communication with instructors in other courses. The patient simulation activities described here were conducted as part of two spring semester courses in the first year of medical school: Medical Physiology and Clinical Problem Solving (CPS). Medical Physiology is a 7 credit hour, CPS a one credit hour course.

In 2004, IUSM-TH joined with Indiana State University and Union Hospital to build the Landsbaum Center for Health Education (LCHE), an educational facility designed to house the training of nurses, medical students and family practice resident physicians in close proximity. The LCHE purchased a high fidelity human patient simulator from METI (Medical Education Technologies Inc.), and several faculty and staff underwent the certification training offered by the manufacturer.

In 2006, IUSM-TH’s medical physiology instructor used the simulator for the first time during the medical physiology course, resulting in overwhelmingly positive student feedback. Students were fascinated by the clinical relevance that the new teaching tool provided during their first year of medical education, but also voiced concern that they were lost and overwhelmed by the new clinical information provided at the simulated bedside. The following years were used to modify the simulation activities in order to improve student learning and satisfaction. By 2010, we had developed an effective teaching method that is presented here.

By 2012, through a continuing collaboration (Rural Health Innovation Collaborative – RHIC) with other educational facilities and health organizations, the simulation teaching room with one simulator had evolved into an 8000 square foot Simulation Center with a wide variety of high and low fidelity simulators (RHIC Simulation Center, 2013). While the creation of the RHIC Simulation Center indicates enormous progress for patient simulation teaching at IUSM in general, the ease of access to the use of simulators by medical school faculty decreased due to scheduling conflicts and increased administrative barriers related to the growth of the RHIC Simulation Center. This triggered at IUSM-TH the development of a “longitudinal simulation curriculum." Most of the medical school physiology simulation exercises used in the first year are conducted inside the physiology classroom using a non-computerized manikin along with physiology software that projects 'patient information' on a screen at the front of the classroom. The culminating simulation exercises conducted at the end of the first year and those conducted during second, third and fourth year of medical school take place at the Simulation Center. These later activities aim at training and assessing clinical competency and follow established clinical teaching models (Orledge, Philipps, Murray, & Lerant, 2012). Figure 1 outlines the transition from guided patient simulations, which aim at applying physiology knowledge, to open simulations, which aim at formative assessment of medical competency in a risk-free environment.

Courses:	Bloom's Taxonomy Goals:	Educational Objectives:	Teaching Method:	Assessment:
Basic Science Courses (e.g. Physiology) Clinical Problem Solving (CPS)	Cognitive: knowledge, understanding, application, thinking skills	Apply physiology knowledge in clinical context	Pre-session lecture Self preparation Didactic session Wrap-up Post-session lecture	Focus on formative feedback & comprehension evaluation
End of semester Clinical Courses & Electives Years 2, 3 and 4	Psychomotor: motor skills, organization skills Affective: emotions, attitudes, values	Acquire problem-solving, clinical, organizational and communication skills, Demonstrate self-perception, values and professionalism	Skill training Team Training Patient Care Leadership training Professionalism	Focus on summative feedback & performance evaluation

Figure 1. Longitudinal patient simulation curriculum.

B. Resources.

An adult sized manikin, the Human Patient Simulator® (HPS, Medical Education Technologies Inc.), which was part of the Landsbaum Center for Health Education, was used through 2011. This HPS system was maintained by the building's Information Technology personnel who underwent special training. Simulation programs were created by faculty and staff by adapting scenarios provided by the manufacturer. The manikin was operated by staff from a side room, separated from the simulation room that housed the learners and facilitators by a one-way mirror. Figure 2A shows the HPS manikin, six medical students, the physiology instructor at the end of the bedside, and educational staff on the left side facing a table with demonstration material.

The SimMan®3G system (Laerdal Medical Inc.) was used for the simulation exercise in the RHIC Simulation Center. The Center is managed by a Simulation Specialist and a Technical Support Specialist who help with the design, programming and execution of the simulation exercises. The Center is operated by a Memorandum of Understanding between various educational health organizations, which facilitates interprofessional activities. Figure 2B shows two respiratory therapists, one nursing student and two medical students working together for the first time as a Rapid Response Team. In 2013, the costs for use of the Center for 0-4 hours were ~$ 350 per student.

Figure 2. Medical physiology learning using human patient simulation. A: Six medical students plus two facilitators using a high fidelity simulator. B: Respiratory therapist, nursing students and medical students acting as a Rapid Response Team. C: Two medical students using a manikin and physiology software in the classroom. D: Material from handouts and textbooks displayed in the classroom for content discussions.

For the simulation exercise in the physiology classroom we used a life-sized inexpensive manikin (Amazon.com, Inc.) that was outfitted with wigs, makeup and wardrobe. It was placed on the floor, on an examination table, or in a wheelchair to suit the clinical case. The computer simulation program Müse™ was used and displayed on the projector screen. It is designed as an interface for METI products but was operated in the classroom on its own. Other physiology or clinical software could have been used instead. Figure 2C shows two medical students reviewing physiological principles by plotting simulated patient data from the projector screen on the white board. Handouts from lecture and clinical information new to first-year medical students were posted on the chalk board of the classroom (Figure 2D).

At the beginning of the course, we use patient simulation exercises in which the facilitator guides the students through history, physical, diagnosis and treatment while relating the case to physiology core principles. An example of such a facilitator-guided case is presented in the following section. Then, throughout the course, as the students gain familiarity with the teaching tool and the learning objective of applying physiology to a patient encounter, we gradually transition to more traditional simulation exercises. For the traditional exercises, the students work through the patient scenario with minimal interruption and the discussion is postponed until the debriefing session.

C. Example of A Facilitator-Guided Exercise.

I. TITLE: Early stage hypovolemic shock
II. AUDIENCE: First year medical students at the end of the cardiovascular physiology section, in groups of 4-23.
III. STUDENT PREPARATION: Review of cardiovascular physiology and handout with three short cases of cardiogenic, septic and severe hypovolemic shock containing questions on the cardiovascular and hemodynamic parameters of the patients before and after treatment.
III: MAJOR LEARNING OBJECTIVES:

- Each student should achieve an introductory understanding of hypovolemic shock and how it compares to cardiogenic and septic shock.
- Each student should understand the relationship between the simulation case and the following physiological principles: Preload/afterload; Stroke volume and cardiac work; Frank Starling relationship and Starling forces; Cardiac autonomic regulation.
- Each student should develop an insight into emergency care.

IV. ENVIRONMENT:

Classroom: The manikin will be in front of the computer projector screen, in close proximity to a writing board. Students gather around the manikin or sit in close proximity to it. Each student should easily reach the board.

Manikin: A life-sized manikin is used. Hair and clothes are of a young 17-year old man. A bruise is painted on the skin above the spleen. At the beginning, there are no leads, lines or tubes. The computer is blank.

Audiovisual: A two-monitor set-up will be used. One screen is used to display cardiovascular/ respiratory/ hemodynamic monitoring from programmable software. The second screen is used to show educational slides and laboratory studies. The latter information can also be printed and displayed, and/or made available on students' portable devices.

Preparation: The following will be available: Blood pressure cuff, pulse oximeter, supplemental oxygen by facemask, ambulance blanket, hospital bed sheet, various gauge needles, catheter tubing, IV pole, empty IV bags, adhesive tape, scissors, calculator, colored markers. Optional: Swan-Ganz catheter, rapid-infuser device, Foley catheter.

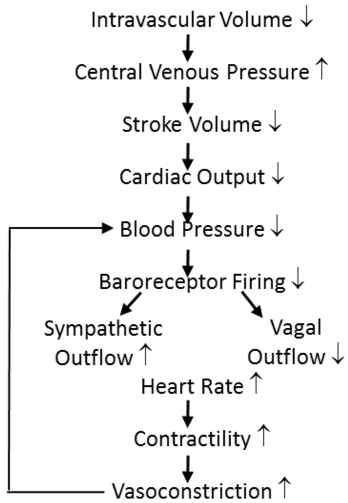
Learners: Students will act as emergency medical technicians and as emergency medicine or critical care physicians. All students will participate in discussion, interpret data, answer questions, and assume miscellaneous roles such as nurses and support staff.

Facilitators: The physiology faculty manages the overall flow of the case by prompting necessary actions, referring to provided background information, asking questions, and providing feedback. A second person controls the software and adjusts the patient's clinical values upon signal to pre-defined, clinically realistic numbers. The person may also help with adjusting the scenario environment, explaining the use of the clinical equipment, and being the voice of the manikin.

V CASE NARRATIVE:

In the Rural Ambulance

The case starts with a 911 dispatch: All-terrain vehicle accident in Vermillion County near St. Bernice on County Road 9505, ½ mile east of Route 71. One adult male possibly injured. Another adult male is with him.



Initial assessment by the Emergency medical technician of the responding ambulance reveals: Alert and oriented times 3, Respiratory rate 18, Heart rate 100, Weak peripheral pulses, Slightly cool and clammy skin, Capillary refill delayed, Blood pressure 118/78, Oxygen saturation 96 percent, No obvious external bleeding, Bruise on abdomen, no clear tenderness or distention.
Students discuss how the information is obtained and what it means. They discuss potential hemorrhage by comparing the patient's information with provided information on the four stages of hemorrhage. The values and signs best fit to Class II hemorrhage with mild blood loss.
Students are to discuss the physiological responses to mild blood loss including the patient's stable blood pressure. A flow diagram as shown on the left can be developed or provided without arrows. Students are asked to indicate on the diagram the principles of Preload and Afterload, the presence of beta-1 and alpha-1 autonomic receptors, and their cell signaling when activated.
The roles and response times of the following may be discussed: chemoreceptor reflex, the activation of the thirst mechanism, the renin-angiotensin-aldosterone system, and hemopoiesis.
Three treatments are initiated: 1) An ambulance blanket is used to keep the patient warm, 2) Supplemental oxygen is intermittently provided by face mask, 3) A peripheral intravenous line is laid into the antecubital vein.
For the IV line, the students are to select a large bore needle from a variety of choices. A student will write on the board Poiseuille's flow equation that explains the use of a large diameter, short length catheter.
The students are to select saline as the fluid replacement from the choices of crystalloid, colloid and type O blood and discuss their relevance for maintaining oncotic pressure and oxygen saturation.

Dispatch information:
- Age and sex of patient
- Cause of injury
- Vital signs
- Injuries noted
- Any care you have provided
- Estimated time of arrival

A student role-plays the dispatch from the rural ambulance to the emergency room staff guided by the information provided in the box on the right.

In the Rural Clinic

As shown in the following, a wide range of cardiovascular physiology principles can be tied to the case. The sequence in which they are discussed and the time required for discussing the principles is flexible and should be adjusted to the individual class circumstances:
A quick History and Physical exam reveals no information relevant to the case, except for an increasingly tender abdomen. Following blood tests are ordered for Mr. Frank R. Starling, the name of the patient: CBC, PT, aPTT, BUN, Cr, Ca, Mg, serum lactate, ECG, blood typing and cross matching. A clinically used form to request laboratory tests may be available for students to fill out.
The students simulate laying an arterial line, a urinary catheter and a central venous line and discuss their purpose. It is important for the facilitator to point out that the central venous line allows continuous monitoring of fluid balance, but is not routinely used due to the risks involved.

In the simulated case, use of the central venous line allows discussion of additional cardiovascular physiological concepts.
The physiology software is started and the computer monitor shows blood pressure (BP), heart rate (HR), central venous pressure (CVP) and cardiac output (CO). Students fill out the first row of the table below and calculate stroke volume (SV) and mean arterial pressure (MAP).

	BP (mmHg)	HR (BPM)	CVP (mmHg)	CO (L/min)	SV (ml)	MAP (mmHg)
Admission	*100/85*	*102*	*-1*	*4.6*	*45*	*90*
+ 1 liter	*106/82*	*81*	*2*	*5.7*	*70*	*90*
+2 liter	*112/80*	*74*	*6*	*5.8*	*78*	*90*

”How can cardiac output be obtained?” becomes the next topic of discussion. Discussion should include the thermodilution method with the help of a Swan-Ganz catheter and the Fick principle with the help of a spirometer and blood oxygen sensors. Detailed discussion of commonly used non-invasive methods is postponed to the wrap-up.
Two liters of saline are sequentially administered by a rapid-infuser device and students record the resulting new patient values in rows two and three of the table above. Students discuss the rate of fluid replacement and its physiological limitations. They review the body’s fluid compartments (60-40-20 rule) and estimate the amount of fluid that remains inside the patient’s blood vessels.
Students are asked to plot a Frank-Starling curve based on the tabulated patient’s values over time. SV versus CVP should be plotted.
Students are asked to expand the plot of this cardiac function curve with a vascular function curve and indicate its change with increased blood volume.
Reviewing the principle of how blood volume relates to end-diastolic cardiac muscle fiber length and ventricular pressure, the students are asked to sketch a left ventricular pressure volume curve of a cardiac cycle and its changes with increased vascular fluid volume.
An arterial pulse curve may be shown and students demonstrate the expected changes in systolic and diastolic pressure with stage II-IV hemorrhage.
Last, it is discussed how vascular fluid changes affect capillary Starling forces and how the accumulation of metabolites and hypoxia may affect compensatory mechanisms.
At this point, the results of the blood tests become available and can be discussed. Normal results of the 12-lead ECG are shown and may be discussed.
After stabilization, the patient undergoes Focused Abdominal Sonography for Trauma (FAST), which is explained using slides or a short video. The patient’s results are shown and reveal a damaged spleen. Treatments are discussed.

VI WRAP-UP: Physiologist and clinician

- The physiological principles of the case are recalled in the order that they were studied throughout the cardiovascular section and the order they appear in the textbook.
- The students’ answers to the questions presented in the paper cases are discussed, and a summary is created showing the similarities and differences between hypovolemic, cardiogenic, and septic shock.
- The simulated case is reviewed from the clinical perspective. The following are examples of clinical questions that can be discussed: Who staffs a rural ambulance? What are the major sources of trauma morbidity in a rural setting? How would the case be different with a 70-year old patient? How do clinicians work with nurses to monitor the status of a recovering

patient? What role does a Frank Starling curve play in the clinic? What role does cardiac output play in the clinic, and how is it obtained?

III. Evaluation.

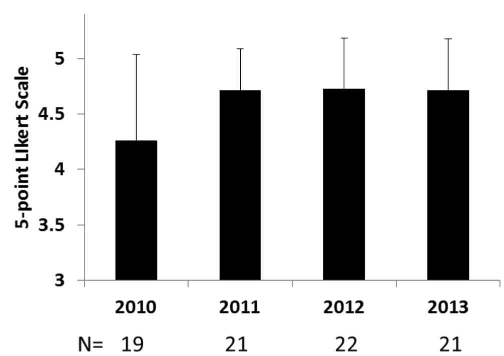


Figure 3. Four-year Likert scale student evaluation scores of the hypovolemic shock simulation exercise.

The hypovolemic shock simulation was conducted in 2010 and 2011 with a high-fidelity simulator in groups of 6 students. In the following two years it was conducted with a non-computerized manikin and physiology software, in 2012 in groups of 6 students and in 2013 with the whole class of 23 students.

Voluntary student feedback was collected immediately after each exercise using a mixed-type questionnaire with Likert scale and open-ended questions. Question one asked to "provide a rating for this exercise," followed by a 5-point Likert scale, with 5 indicating the highest rating. Figure 3 shows the results of the past four years from the hypovolemic shock exercise. Average ratings are 4.3 in 2010 and 4.7 in the following three years, indicating high student satisfaction. Average questionnaire response rate was 93 percent, with a standard deviation of 6.2. This response rate was significantly higher than the average response rate of laboratory activities without patient simulation, such as a nutrition-related activity, indicating a higher student interest in the simulation exercise.

In addition, question one encouraged students to explain "what made you choose this rating" by writing in the space provided below the question. This open question format was chosen to obtain formative feedback which otherwise is difficult to obtain when collecting identifiable information throughout the course. The answers were analyzed using NVivo10 (QRS International Inc.). The analysis revealed six categories that are shown in Figure 4. Out of a total of 110 comments, 29 percent commented on the clinical context of the learning experience, followed by 25 percent expressing that they liked the teaching method. Some form of learning enjoyment was expressed in the vast majority of all answers, often using a single word or a short phrase such as 'awesome,' 'was fun,' or 'good experience' as an introduction. Twenty-one percent expressed that the simulation exercise helped them understand physiological principles. Sixteen percent of the answers mentioned benefitting from the debriefing session. A few students commented on educational objectives such as 'problem-solving' and 'team work,' which become the focus of more advanced simulation exercises. Three comments were disapproving and expressed thoughts of disinterest (1), feeling rushed (1), and using up too much time (1).

Categories of Student Answers	Answer Percentages	Representative Student Comment
Appreciated clinical application of knowledge	29	"Made me think of what I would really do in a real situation & how the principles we learned in class apply to the situation."
Liked teaching method	25	"It was awesome…I enjoyed talking through the case with a working example on the table."
Learned physiology concepts	21	"The case was interesting and helped to better understand a lot of principles."
Wrap-up tied things together	16	"… answered remaining questions effectively and strengthened understanding."
Practiced problem-solving	3	The cases were challenging and required a great deal of thought to explain.
Recognized relevance of team approach	3	"It is important to work as a team to make decisions."

Figure 4. Evaluation comments of the hypovolemic shock simulation exercise.

Figure 5 shows the average score for each year of the Physiology Only Examination from the National Board of Medical Examiners (NBME) Subject Examination Program. This examination is administered as an end-of-course assessment. A high score on the NBME test indicates that the student has acquired the core principles of Medical Physiology. By 2010, the NBME grading scale had changed. Therefore, to allow comparison, the data of Figure 3 are shown as percent above national average. The IUSM-TH scores (solid line) were consistently above national average, and after 2011 they increased to a level higher than the average scores of students of the other eight educational IUSM sites (broken line). The scores transferred into percentiles between 59 and 83, dependent on the difficulty of the test (not shown). Since the NBME Physiology Subject Examination is designed to test the students' application of physiological principles, it is reasonable to assume that practice of this skill via patient simulation contributed to the high scores.

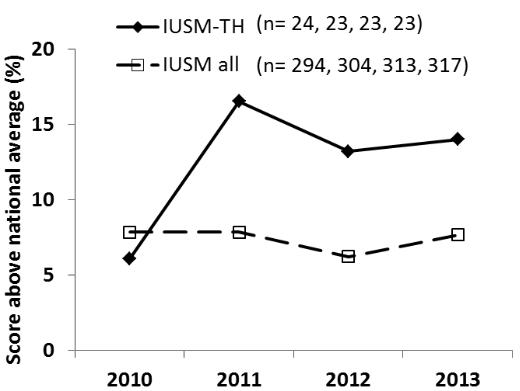


Figure 5. Four-year grades of the Physiology Only Examination from the National Board of Medical Examiners Subject Examination Program. For details, see text.

To evaluate whether the use of patient simulations for the teaching of medical physiology facilitates the students' ability to achieve the learning objectives of more advanced simulation exercises, further data have to be collected. For instance, data are currently being collected for the mid-term exam of the fourth year emergency medicine clerkship, which is a simulation exercise during which students are individually evaluated for clinical competency in the emergency room. For now, we only have sporadic evidence from unsolicited contacts of advanced students with the physiology instructor, in which these students refer to "Mr. Frank Starling, the young man with hypovolemic shock," or "Ms. Carrot, the elderly lady with a hypoglycemic episode," indicating that the simulation exercises remain memorable as early 'patients' of their education.

IV. Discussion and Conclusion.

It is well accepted that human patient simulation training helps ensure competence of physicians by allowing medical students and experienced clinicians to practice procedures in a realistic setting (Orledge, et al., 2012). It is less clear if simulated patient encounters in the first year of medical school can also facilitate basic science learning and if the investment of time and expenses related with such simulation exercises is justifiable.

At our institution, several years ago, we had easy and relatively inexpensive access to the use of a high-fidelity human patient simulator for re-emphasizing medical physiology concepts. First-year medical students enthusiastically embraced the active learning mode. When the simulator was moved to a Simulation Center, which meant increased costs and more limited access, it became time to re-evaluate the usefulness of patient simulation for physiology learning.

This paper on best practices of patient simulation for medical science teaching presents the four-year results of student evaluations of a cardiovascular simulation exercise, indicating high student satisfaction and perceived learning benefits in alignment with the learning objectives. Objective summative physiology course evaluations of the students' physiology knowledge are above the national and the school average. Whether simulation itself is responsible for the high scores is unclear and can only be answered with an evaluation tool specifically tailored to answer this question. It is interesting to note that, by comparison, the scores of the IUSM-TH students at the statewide microbiology end-of-course exam are at the school average and did not change over the past five years. Throughout this time, microbiology was taught by the same instructor, using the same teaching methodology.

Interestingly, there was no difference in student outcomes and student satisfaction whether the exercise was performed with a high-fidelity or low-fidelity manikin and whether the learning experience was conducted in small or large groups. A similar lack of a relationship between simulation fidelity and learning has recently been found even for clinical training (Norman, Dore, & Grierson, 2012). These findings point to the possibility for the more frequent use of inexpensive patient simulators in the classroom. Our experience shows that using non-computerized manikins and inexpensive physiology software can also illustrate theoretical concepts in a way that goes beyond classroom demonstrations.

We found it especially helpful to use facilitator-guided exercises at the beginning of the physiology course, such as the presented hypovolemic shock case and to gradually transition throughout the course to more traditional simulation exercises. Our plan is to also integrate the traditional exercises into our flipped learning model, so that students will work by themselves through the scenarios while class time is used for debriefing and answering questions by various content experts. That way, the three major concerns that limit widespread use of patient simulation for medical science learning can be addressed. First, students might feel less overwhelmed since they can work through the case at their own pace in order to reach the physiology teaching objectives without being overwhelmed by the clinical aspects of the case. Second, the debriefing session can be conducted by basic science and clinical experts to realistically cover all aspects of a patient encounter. And third, self-directed learning minimizes instructor time and adds flexibility for each individual teaching environment.

Overall, we find the use of patient simulation with preclinical medical students rewarding and beneficial for integrated learning. However, additional analysis of this teaching tool, using a larger student cohort, control groups and robust assessment tools will be necessary to further support widespread global implementation of patient simulation for teaching the basic sciences during medical training.

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Mobilizing the past for the present and the future: Design-based research of a model for interactive, informal history lessons

Brett Oppegaard[1] and Olusola Adesope[2]

Abstract: Informal history education, including many popular museum learning studies, have shown that mobile media objects, such as apps, quickly could become critical parts of the predominate learning technologies of the future. In the process, this could lessen the overall pedagogical focus for history education on aural transmission, such as lecturing, as well as traditional media delivery systems, such as printed books. Having "an app for that," though, is just the start of the process of developing effective, efficient, and evocative learning systems. This case study describes a National Endowment for the Humanities-funded mobile app designed in situ and deployed at a National Historic Site with the goal of creating a mobile learning model for the National Park Service. An evaluation of the app module was conducted using a LORI-scale to assess the efforts as they related to informal history learning objectives. This evaluation identified potential best practices for the design of these types of mobile apps, such as interactive activities enabled by the mobile technology, as well as opportunities for improvement in the design of such learning systems.

Keywords: mobile, app, design, design-based research, national historic site.

I. Introduction.

While most of adult learning already happens informally, students of all ages increasingly are becoming disassociated from the teaching and learning of institutional educational contexts (Jones, Scanlon, & Clough, 2013; Lim, Zhao, Tondeur, Chai, & Tsai, 2013). Educators, in turn, have begun reaching out and exploring the potential of mobile technologies as ways to reconnect with learners, through emerging mobile systems that offer powerful pedagogical tools, flexible student scaffolding support, and engaging delivery platforms. Anytime and anyplace, educators suddenly can commune with a learner, without traditional boundaries of time and place, or with the added richness of specific times and places. Mobile technologies have affordances that can expand access to learners in authentic contexts, in which learners continually connect with accessed information, or theoretical knowledge, with the situated knowledge of the environment (Martin & Ertzberger, 2013). Such integration of mobile technologies into varied learning contexts – both traditional and nontraditional -- requires organizational shifts while also demanding innovations that expand openness and responsiveness to new learning environments; these are major changes that many organizational frameworks can be slow to embrace (Cavanaugh, Hargis, Munns, & Kamali, 2012). Despite such potential, though, the combination of mobile technologies and informal learning structures has received relatively miniscule academic attention, especially from researchers approaching the topic with a design-based perspective (Jones, Scanlon, & Clough, 2013). Scholars also have spent a lot of time and effort understanding early formative stages of app design as well as final stages of deployment (Kim, 2005). But an additional gap exists in the literature for refinement of prototypes that are a few iterations into their developments, as a way to establish best practices for sustained improvement of ideas throughout the design process. Of primary concern in this article, then, is the ways in which mobile technologies, and tailored, place-based media, could offer unrealized potential for improving history teaching and learning as well as provide engaging and interactive options that could help to redefine the field. Therefore, in an effort to explore such possibilities through design-based research, a mobile app prototype was designed, built, and launched at a National Historic Site in the Pacific Northwest (Fort Vancouver), and then evaluated using a Learning Object Review Instrument (LORI) scale analysis.

Within the related educational technology literature, a serious and pervasive issue is raised, identified generally as the widening gap between the researcher and the practitioner communities, creating a significant communication chasm between the educational system developers and the educators who eventually adopt (or reject) such systems. This phenomenon is illustrated by the shrinking frequency of system and/or model design research papers being cited in the field (Kinshuk, Huang, Sampson, & Chen, 2013). From a practical viewpoint, researchers who do not develop mobile apps tend to only have access to -- and interest in -- the design process at the beginning and end of projects, when clear stages of development are established and apparent. Yet many of the most significant design decisions actually arise during the in-between moments, and only the most attentive, engaged, and committed members of the project, such as the design team members, are present for those moments.

In response, as a Call to Action to face the "grand challenges" of e-Learning in the 21st century, Psotka (2013) suggested that new leaders and a more modular educational system are needed to expand the classroom into more informal settings and to broaden the attention educators pay to modular design. Psotka added that exploring embedded or augmented realities could be extremely valuable paths of inquiry. Motivated by such sentiments, this article attempts to address the gap between researchers and practitioners by reflectively describing the design, creation, and implementation of a mobile learning object in an informal educational setting (at a national historic site) and then demonstrating how a scholarly instrument can be used as an intermediate step – between the early user-centered development of a learning object and the wide public release of it -- for evaluating such a mobile learning object and guiding its future developments.

Although the label "learning objects" has been defined differently by many researchers and organizations, the most frequently cited definition of a learning object is: "any entity, digital or non-digital, which can be used, re-used, or referenced during technology supported learning" (IEEE, 2005). Traditionally, learning objects included images, simulations, texts, etc. More contemporary digital technologies, including mobile apps, also can be regarded as learning objects. One tool that extensively has been researched and used for evaluation of learning objects is called the *Learning Object Review Instrument* (LORI; see Leacock & Nesbit, 2007; Nesbit & Belfer, 2004; Vargo, Nesbit, Belfer, & Archambault, 2003). A LORI analysis, then, is specifically used to evaluate e-learning resources. The instrument was developed by John Nesbit and colleagues at Simon Fraser University and consists of rubrics and rating scales as well as comment fields to provide qualitative support for the ratings.

LORI has nine items that can be rated and used as metrics for evaluating a learning object. These items include content quality, learning goal alignment, feedback and adaptation, motivation, presentation design, interaction usability, accessibility, reusability and standards compliance. Each item is evaluated on a rating scale of 5 levels ranging from 1 (Low) to 5

(High). Evaluators may opt out of scoring a learning object on a particular item if the item is not relevant to the learning object, or alternatively, if the evaluator does not have sufficient knowledge on that item. In such circumstances, a "non-applicable" (NA) rating could be assigned. For more information on LORI analysis and its use, please refer to Leacock and Nesbit (2007).

As design-based research demands, cyclical stages of analysis of user feedback and redesign are key components of the iterative process integrated into learning object improvement. But scholarly interventions into this process, and as another source of design feedback, are not common, perpetuating the gap between researchers and practitioners.

Hence, the present study investigates these core research questions:

- How does design-based research, through an action-research methodology, affect the creation of a learning object in the form of a mobile application?
- And, as part of that design process, how does applying a scholarly intervention, in the form of a Learning Object Review Instrument (LORI) analysis, affect the development process?

This study, in turn, will describe design-based research as the perspective within which different methodologies, such as action research, can function to shrink gaps between the academy and the industry. User-centered design principles, as part of action research methodologies, are critical to the development of learning objects in many ways, which have been studied in depth (Wallach & Scholz, 2012). This article, instead, focuses on an intermediate step within the design process, in which user-centered design principles have been applied, through a design-based action-research paradigm, and a checkpoint is chosen for an academic evaluation tool – the Learning Object Review Instrument (LORI) -- to intervene. Such formative evaluation tools are intended to provide evidence about the design and value of learning objects, providing expectations of the effects, against which further design iterations could be made and studies could be conducted with actual users to compare results against those expectations (Akpinar, 2008).

II. Developing design-based research through action research.

The design-based research perspective – proposed and developed at first by Brown (1992) and Collins (1992) -- is known by many names, such as design science, design research, design experiments, design studies, development research, developmental research, formative research, and action research. As a broad research label, design-based research typically describes methods that integrate the design of learning environments with the development of theories of learning, in authentic settings, through continuous cycles of design, enactment, analysis, and redesign (Design-Based Research Collective, 2003). Design-based research, in turn, has been proposed as a solution for bridging the gap between research and practice, and it also has been framed as having the flexibility to include a variety of research methods, including action research, in the pursuit of solving a particular kind of research problem: the design problem. In such cases, the researcher acts like a "designer," to create a blueprint of a solution, based on existing knowledge about the way organizations work. These solution concepts are like designs that consciously and explicitly have been designed before they are used and then are redesigned several times to improve them; these designs also are tested to check their validity, including with action-research type interventions (Wang & Hannafin, 2005; Andrieseen, 2007). While not framed by a single method, design-based research instead uses various methods, such as action-research methods, to triangulate multiple sources and kinds of data to connect intended and unintended outcomes and to link processes of enactment to outcomes, generating knowledge with direct application to educational practice. In short, the design of innovations enable researchers to create learning conditions that learning theory suggests are productive but that are not commonly practiced, or, are not well understood; methods that document those processes of enactment provide critical evidence to establish warrants as to why particular outcomes occurred (Design-Based Research Collective, 2003).

If the essence of research, in general, is creating new knowledge, action research does that through inquiries conducted within specific and often practical contexts (Koshy, 2005). Traditional predictive research of educational technologies has had limited impact in informing actual use, but recognizing technology as a constructivist process has many potential implications for bringing the technology to the foreground, for deeper understandings of the process and more-focused insider investigations (Amiel & Reeves, 2008). The action-research mantra, established by Fals Borda (1979), is to: "investigate reality in order to transform it" and transform reality in order to investigate it (Kemmis, 2006, p. 470). To follow that mantra, a fundamental binary choice had to be made at the onset of this research process. That was to decide whether the work would be done from an outsider's or an insider's perspective, to establish the positionality of the researcher to the research. The interpretive perspective, from which design-based research and action research generates, acknowledges the researcher as an insider, as a part of the fabric of the inquiry, and an indivisible element of the environment, within which people, including the researcher, are interacting (McNiff & Whitehead, 2006).

A model manifestation of this type of situated knowledge is the study of history, which is being continually shaped and contextualized by social and cultural factors. From traditional educational perspectives, history education has been foundering in the United States, with national test scores as well as funding in the field generally remaining stagnant, or declining, for decades (Symcox, 2012; United States Department of Education, 2010; Yarema, 2002). The effectiveness of traditional lecture-based pedagogy, presented in formal contexts, meanwhile has been questioned, and a variety of new methods for learning history have been proposed, including those enabled by technological advances, such as learning with mobile devices (Hung, Hwang, Lin, Wu, & Su, 2013; Kearney, Schuck, Burden, & Aubusson, 2012; Rogers, Connelly, Hazelwood, & Tedesco, 2010; Vavoula & Sharples, 2009; Lee, Doolittle, & Hicks, 2006). While no known studies suggest that history educators simply need to lecture more, or write more books, for the field to thrive once again, a flurry of recent field studies – focused on informal learning environments, such as museums – suggest ideas that new digital media forms could help to change the trajectory of history education in positive directions (Huang, Liu, Lee, & Huang, 2012; Sedano, Sutinen, Vinni, & Laine, 2012; Cho, Yeh, Cheng, & Chang, 2012). Fueled by pedagogical successes established and documented in informal settings, formal classroom environments might expand their boundaries and benefit from such experiences, too, through more educators experimenting with mobile technologies. Mobile apps can embody that potential cross-over platform by bridging informal and formal learning, and they appear particularly poised to benefit history educators, from a variety of different perspectives and in a variety of different ways, as numerous studies have shown (Farman, 2012; Gordon & de Souza e Silva, 2011; Sharples, Taylor, & Vavoula, 2010; de Souza e Silva & Hjorth, 2009; Crow, Longford, Sawchuck, & Zeffiro, 2009; Akkerman, Admiraal, & Huizenga, 2009; Azaryahu & Foote, 2008; Raessens, 2007).

The American Historical Association (2008), when presented with the fundamental question of "Why Study History," offered two core defenses: 1. History helps us understand people and societies, and 2. History helps us understand change and how the society we live in came to be, by showing what elements of an institution persist despite change. Within that reasoning, then, history also provides people ways in which to understand their own lives as well as offers a moral compass, a source of identity, and paths to better citizenship.

From the mobile-app development perspective, a thorough examination of the myriad of issues facing the U.S. history education system or a fundamental argument for history education as a core component of a liberal arts agenda, is beyond the scope of this article. This piece instead makes the assumptions that history should be vigorously taught throughout formal and informal educational systems and that simply providing more of the same traditional pedagogy will not lead to a resurgence of this field, any more than requiring broccoli to be served in schools will lead to better overall student health and wellness. The intent here, then, is to explore the space between -- and to find common ground among -- the research and practitioner communities through close examination of possibilities afforded by dynamic mobile technologies and interactive, place-based media. The design-based-research approach allows new forms to emerge and to be tested in real-life environments and scenarios, vetted by established criteria. In this case, the new form is a mobile app, created at a national historic site, and analyzed through the perspective of a LORI-scale analysis.

The research site, Fort Vancouver, was the regional trading hub of the Hudson's Bay Company in the mid-1800s; a massive operation for its time, on the north bank of the Columbia River, a place near present-day Portland, OR. The British contracted Hawaiian laborers and brought them to the Pacific Northwest by the hundreds to work in the booming fur trade. When the furs were gone, and the United States wanted the property, the company moved north to what is now Canada. But many of the Hawaiians remained in the area, helping to form the culture of the region. The mobile app module "Kanaka," which translates to "Hawaiian," was created during this research process to tell the Hawaiian story while experimenting with mobile technologies. Congress designated Fort Vancouver as a national historic site in 1961, and substantial reconstruction of the fort and its surroundings, plus active educational programming, have brought hundreds of thousands of schoolchildren, as well as lifelong-learning adults, back to Fort Vancouver in the decades since.

From a design-based and action-research perspective, envisioning this site as an informal classroom of sorts, this case study is intended to demonstrate ways in which a mobile app could improve history pedagogy not only in this particular place, under these specific circumstances, but as a model for use in other contexts, with different content. As such, this research project originated not from a specific interest in regional history, or historical interpretation, or even mobile devices in general. Its inspiration came from a recognition of – as well as a curiosity about -- the emergence of the ability of mobile devices to "see" places in different ways -- as far back in time and with as much detail as one wanted -- characterized as the "dynamic peephole interface" (Rohs, Schoning, Raubal, Essl, & Kruger, 2009, p. 1; Hurst & Bilyalov, 2010, p. 1). Indeed, Hight (2003, p. 6) envisioned such place-based media composition through mobile devices as "narrative archaeology," in which the author, by composing and embedding narratives and sound in physical locations, is "establishing artifacts culled from layers in time." Examining that phenomenon within a history education format simply became a logical extension of the idea.

With such a perspective, this study focused on the material, concrete, and particular practices of particular people in particular places, in the "here and now." Rather than taking a more abstract view that construes -- but does not constitute – practice, this research approach aimed to demonstrate that understanding comes from clear awareness of social and educational practices in situ. That focus meant the emphasis for interpretations are drawn from the product of the specific material, social, and historical circumstances that produced the practices, and by which, they are reproduced regularly through social interaction in the particular setting (Kemmis & McTaggart, 2005).

While supporting creative freedom and innovation in research, such an action-based cultural heritage project with a multimodal emphasis, like this Fort Vancouver Mobile project, also builds skills and experience. Those developments, at least in this particular case, come in various styles of writing, editing, graphic design, photography, videography, collaboration, team coordination, public relations, marketing, and computer and Internet technologies. In addition, the public benefits as well from such an app being created (Henson, 2005). Hundreds of people get involved in the app development, testing, and use, gaining access to historical material in innovative digital forms as well as building a new community of people interested in such mobile historical interpretation, around the process of creating the project.

Core action-research goals are to improve practice and develop individuals as well as to transform practice and participants (Herr & Anderson, 2005). "When we build, we do more than create content," wrote Thomas and Brown (2011, p. 94). "Thanks to new technologies, we also create context by building within a particular environment, often providing links or creating connections and juxtapositions to give meaning to content." They added (p. 96), "By participating in the making of meaning, we also learn how to judge and evaluate it, giving special sensitivity to the ways information can be shaped, positively as well as negatively." During such a process, the creator transcends "from experience to embodiment, where the personal investment in technology and digital media changes the focus from social agency to personal agency. When that happens, technology and digital media begin to be viewed as an extension of oneself" (p. 103). To then assess the app product and its effectiveness as a learning tool, an independent evaluation was conducted using the Learning Object Review Instrument (LORI, Leacock & Nesbit, 2007). Descriptions of the LORI evaluation of the app are presented in the results section.

III. Methods.

Design-based research has been heralded as a practical methodological approach, developed to bridge the research and practice communities in education. This puts an analytical focus on learning environments that are designed and systematically manipulated by a researcher to address a localized issue. By closely examining a single, dynamic, built environment, like the one created with the "Kanaka" module, new theories, artifacts, and practices can be established and transferred to other learning situations (Barab, 2006; Anderson & Shattuck, 2012). Yet design-based research also has been critiqued, primarily because of the positionality of the researcher, and how bias might affect the assertions being made (Barab & Squire, 2004). With awareness of this criticism, and mindfulness about how the positionality creates skew, design-based researchers recognize bias not as a flaw within the system but as a fundamental aspect of the personal way of knowing, as outlined by Polanyi (1962). From this perspective, an important part of the research methodology is determining what gets reported and what is left out. As a brief elaboration, to begin to describe what the Fort Vancouver Mobile app became during this design-based research process involves also acknowledging what parts of the endeavor will remain otherwise unmentioned, due to space constraints. To call this project an app is to flatten the hundreds of iterations of this app into a single piece of mobile software, frozen in time, despite the fact that with mobile development, the creation and refinement process is fluid and never really ends. Since this app was launched to the public in June 2012, many more versions of it have been uploaded, and the app today maintains mostly familial resemblances to the app described here. In addition, this accounting of the app development process will not describe in depth the dozens of meetings and site visits; the thousands of pages of historic source material examined, including maps, images, and journals, which then laboriously were remediated into digital forms; the countless number of informal conversations, ranging from information gathering exchanges to formal partnership building; or the innumerable dead ends as well as pilot tests and experiments that ensued. Instead of aiming for such a book-length breadth and depth of coverage, this article focuses upon the intermediate step of the LORI analysis, providing relevant context about the decision points during the previous and latter stages of development, as a way to situate the study as part of iterative design cycles, with the first primary decision point being to determine the research place.

A. Choosing a place and a story to remediate.

The Fort Vancouver National Historic Site was chosen as the test site, primarily because of its affiliation with the National Park Service, its 1 million annual visitors, its many supporting amenities, its location near the main north-south highway on the West Coast (Interstate 5), and the eagerness of the staff to participate in the project. The main attraction of this site was the reconstructed Hudson's Bay Company stockade, which presented an atmosphere like a scaled-down version of Colonial Williamsburg, with costumed interpreters, regular demonstrations of period arts and crafts, and other interpretive activities. Within the fort grounds, The Village area (see Figure 1) was designated as the area in which the app would attempt to interpret, and within that area, historically, the tales of the native Hawaiians were considered the richest and with the most potential. In The Village, a wayside sign marked the entrance, and another one had been placed in front of the westernmost of the two small houses (see Figure 1). Otherwise, no traditional media was being offered in the immediate vicinity, and the houses were kept empty and locked, meaning the media richness value was quite low, except during rare special events that included live demonstrations and costumed interpreters. This dynamic offered a relatively controlled – and controllable – setting, akin to other unstaffed National Park Service sites. The Village therefore could be considered a model mobile learning environment, in that it is fully mediated, through curatorial

Figure 1. The Village area of the Fort Vancouver National Historic Site, as seen from the Maya Lin-designed Land Bridge.

reconstructions, grounds maintenance, and the educational content available, and the juxtaposition of the digital and the physical could be kept in rough balance. Without the mobile app, visitors to this site encountered little in terms of historical context and guided pedagogical scaffolding. During the development process, the staff members expressed assumptions that visitors to this part of the 350-acre campus would enjoy and appreciate technological assistance in learning about the place, through electronic media, but rather than start by testing those base assumptions, we made the decision, per Herr and Anderson (1999), to begin by doing something with mobile technology in The Village to allow observation of how users responded to the progressively higher fidelity versions of the app. Design-based research, at its core, involves numerous decisions like that, large and small, and is aligned with other traditional research principles in terms of being inherently systematic and done in an effort to produce knowledge. The purpose of such an approach, according to Giacomini and Cook (2000, p. 480), is to offer a "window-like" or "mirror-like" view on the specific situation or phenomenon being studied (Koerber & McMichael, 2008). As part of the action-research framework, the techniques for inquiry were practical, cyclical, and problem-solving by nature, meant to generate change and improvement at the local level (Taylor et al., 2006). Also embedded within this type of research is the idea that the builders of a system gain knowledge in ways that an observer cannot.

Through this process, the interactive design for the app module began to develop generally around the idea that Hawaiian coral had been found at the site, and the Fort Vancouver staff would like the visitor to help unravel the mystery of why it was there, and what that information could reveal about the people who lived in this place during the apex of Fort Vancouver. Hight's work in Los Angeles (2003) and the Dublin Liberties Neighborhood project by Nisi, Oakley, and Haahr (2006) were models for this project, in an effort to keep the characters as real as possible. Of the innumerable decisions made in relation to the design of this project, from text syntax to interface affordances, some of these decisions were more global, and philosophical, in nature, decided in the early stages of this process, and with far-reaching implications. The focus here will be upon those key moments, in an attempt to investigate best practices of mobile design, framed as design philosophies. Such crucial decision points from the design-perspective were:

- The app should establish an immersive point of view: The learner would be positioned as being an integral part of the app-using experience, including being asked to help solve the mystery and to produce and provide media at various steps in the storyline. As an example, in pragmatic terms, the first video that was pushed to learners at the entrance to The Village showed archaeology students finding something interesting on site, although not showing exactly what that was, near where the learners were standing. The learners then were asked, "What do you think they found?" Such an immersive approach was hypothesized to improve learning and engender motivation in learners.
- The app would embrace interaction: The learners were asked, through various forms of prompts, to provide responses in text, still imagery, audio, and video, as part of creating and continuing the experience. The interaction affordances of the app were expected to improve learning and motivation.
- The app would experiment with media forms: Some of those digital creations included puzzles, games, Twitter-like dialogues among historical characters, reenactments, and prompts for the user to do tasks both physical and digital, including walking to particular places and engaging in particular mobile-oriented activities.

Procedurally, the app prototype was built in Java and Objective C at first, but HTML5, CSS 3, JavaScript, jQueryMobile, PhoneGap, and other mobile libraries developed dramatically during the various production cycles and later versions of the app were built through non-native code. Four distinct cycles of action research were conducted with users of prototypes before the app was launched to the public from June 2010 to June 2012, and before the Learning Object Review Instrument (LORI) analysis was conducted. As of this publication, the free Apple and Android apps have been downloaded more than 1,500 times, and the behind-the-scenes blog on this project, www.fortvancouvermobile.net, has recorded more than 35,000 page views. The app meanwhile has expanded significantly, as illustrated in the comparison of the June 2010 schematic to its June 2013 counterpart (Appendix A). From a constructivist perspective, as m-Learning inherently tends to be, learners build their own meanings in such situations, and tests of explicit knowledge transfer generally are insufficient and sometimes inadequate for assessing the overall effectiveness of the learning environment, so various evaluation tools were considered, before a LORI analysis was chosen and applied to the prototype app by an independent, external evaluator. While this evaluator worked within the same university system as the project coordinator of the app design team, he also worked on a campus several hundred miles away from Fort Vancouver and had not been involved in the project in any way until this point of evaluation.

After all of the decision points had been made independently by the design team, and the prototype had been built, including a working "Kanaka" module, about the Hawaiian story at Fort Vancouver, the external evaluator was contacted and brought into the project to help provide formative feedback by applying the LORI-scale analysis. Through this approach, we thought he would not be invested in the project in the same ways as the designers and other collaborators, investigating how such independence might affect potential concerns about positionality. In short, besides brief pragmatic discussions about the project, such as what form it was taking, to help decide on the most appropriate evaluation tool, and when it would be done, the evaluator had little knowledge about what the prototype would be like, and he had no input on the design until his feedback on the LORI analysis was completed. The methodological goal in that case was to keep the evaluation as separate as possible from the design, allowing both processes to happen independently until this research project eventually brought them together.

IV. Results.

A. Evaluation of the App.

As his first exposure to the project, the external evaluator visited the test site in August 2012, shortly after the public launch of the app prototype, and he used a LORI analysis to evaluate the "Kanaka" module and to assess the pedagogical design in a detached manner. In the section below, the results of that evaluation are reported, including suggestions for further development of the "Kanaka" module and the Fort Vancouver Mobile app. The evaluation results do not include an extensive description of the nine dimensions of LORI, as previously published papers adequately describe those and how they are rated (Leacock & Nesbit, 2007; Nesbit & Belfer, 2004; Vargo, Nesbit, Belfer, & Archambault, 2003; Nesbit, Belfer, & Vargo, 2002).

Although there is no general consensus on the definition of learning objects, most researchers agree that they are reusable digital learning resources that are designed based on sound pedagogical practices and aimed at promoting learning (Sampson & Zervas, 2011;

Churchill, 2007; Wiley, 2002). From that perspective, the app, especially the "Kanaka" module, can be considered a learning object. Although there are many instruments for evaluating a learning object, a LORI analysis is commonly used, per the literature already cited. In the following section, the results of the evaluation are reported:

B. Overall Analysis of the App.

The Fort Vancouver Mobile app with the "Kanaka" module has been designed with pedagogical and theoretical considerations in mind. Listed below are some of the pedagogical implications evident in the "Kanaka" module:

- The text describing the pictures or what to do with the pictures are close enough to the picture. This aligns with Mayer's (2009) spatial contiguity principle of multimedia learning resources.
- Learning objectives are clearly set in the introductory page and are followed through with headings showing clearly defined goals.
- There is a great deal of interactivity with the app. Users especially like the recording feature, and its integration throughout the app design provides beneficial learning opportunities.
- There is consistency in the layout (with font, size, and video). This is a good practice, as users will increasingly become familiar with the interface with repeated exposure.
- Sufficient metadata were included and complied with international standards. Metadata, such as credits for the creative team, and descriptions of the various modules, were included.
- The app, and its modules, conform to WCAG 2.0 accessibility guidelines. The "Kanaka" module is mostly accessible to disabled people. Tests with different mobile devices also show that the module is accessible on most devices. Evaluator noticed, though, that the "sponsored by" logos do not have alternative texts, which would improve accessibility. Given that there is complexity in designing modules that are fully accessible, a more pragmatic approach might be to address simple accessibility issues through the use of "alt" tags.
- Ubiquity: The media player required for the user to see the application on the mobile display is widely available.
- Richness: The module loads quickly on mobile phones and videos play well with rich pixel quality.
- Flexibility: The module is viewable and of comparable quality on a variety of mobile devices.
- Display Reliability: The module displays consistently regardless of the browser, mobile device, and screen size.

C. LORI Analysis of the App.

The Learning Object Review Instrument (LORI) analysis was used to more specifically evaluate the potential effectiveness of the app. The nine items of LORI have typically been used to evaluate learning objects. As described earlier, each of the items of LORI has a scale ranging from 1 (Low) to 5 (High). In the section below, the results of the independent evaluation are presented.

1. Content Quality: Veracity, accuracy, balanced presentation of ideas, and appropriate level of detail

*The contents of this module are accurate and ideas are well presented. More importantly, the choice and design of this content were deemed appropriate for learners of varying abilities in history. Out of a scale of 5, the module was rated a **5** in content quality.*

2. Learning Goal Alignment: Alignment among learning goals, activities, assessments, and learner characteristics

*Learning goals are declared in the introductory page of the "Kanaka" module and are appropriate for the intended learners – visitors to the historic site. There are some recording features that could be used to assess users' learning. It is recommended that the module should have more assessments that test whether the learning goal has been achieved or not. Out of a scale of 5, the module was rated a **3** in learning goal alignment.*

3. Feedback and Adaptation: Adaptive or interactive content

*The module is adaptive and can be used in different learning situations. The recording feature could help relay feedback to designers. It was suggested that feedback for users should be incorporated into more of the design. Out of a scale of 5, the module was rated a **3** in feedback and adaptation.*

4. Motivation: Ability to motivate and interest an identified population of learners

*The module is very motivating. The contents are really useful for the intended users. However, motivation with the module can be improved by embedding more feedback that compares the performance of learners with the goals of the module and how performance could be improved. Again, incorporating assessments or tests would be a good approach here. Out of a scale of 5, the module was rated a **3** in motivation.*

5. Presentation Design: Design of visual and auditory information for enhanced learning and efficient mental processing

*Text is legible enough with good font size. The content is well segmented. All features are aesthetically appealing. Also, there is nothing in the app that could potentially constitute cognitive overload to effective learning. Out of a scale of 5, the module was rated a **5** in presentation design.*

6. Interaction Usability: Ease of navigation, predictability of the user interface, and quality of the interface help features

The module was evaluated as having a good interface design, easy to navigate and *predictable. The module has clear instructions on how to navigate thereby offering just-in-time help to learners. Out of a scale of 5, the module was rated a **5** in interaction usability.*

7. Accessibility: Design of controls and presentation formats to accommodate disabled and mobile learners

*The module conforms to W3C guideline at level AA. It was suggested that alternative texts be provided for all images so as to improve the accessibility of the module. Out of a scale of 5, the module was rated a **4** in accessibility.*

8. Reusability: Ability to use in varying learning contexts and with learners from differing backgrounds

*This module can be readily used in other contexts and by other learners without modifications. Its use is not tied to the course or to any external resource. Out of a scale of 5, the module was rated a **5** in reusability.*

9. Standards Compliance: Adherence to international standards and specifications

*Sufficient metadata were provided. Out of a scale of 5, the module was rated a **5** in standards compliance.*

The evaluator recommended that future iterations of the module should provide more simple quizzes, surveys or teaser information to (a) improve interactivity; and to (b) examine the user's understanding at the end of each video presentation. Such low-stakes formative tests have been found to be extremely effective in contributing to learning rather than only being used to measure learning (Roediger & Karpicke 2006; Rohrer & Pashler, 2010).

V. Conclusion and Future Research Directions.

From the beginning, this research had two primary concerns: 1. Reflecting upon how a design-based research methodology could affect the creation of a learning object, and, 2. As part of that process, determining how applying an independent scholarly intervention, a LORI analysis, would affect the development of a learning object, if applied during an intermediate step, which is seldom done.

Design-based research, in this case, allowed an expansive teaching and learning project to grow, in scale, from an idea into a full-fledged prototype by embracing the messiness of learning-object design but also by approaching such design systematically and with particular checkpoints in mind, including the intermediate evaluation step offered by the LORI analysis. The initial teaching and learning goals of creating an immersive experience, embracing interaction, and experimenting with new mobile media forms led to an innovative mobile app prototype, celebrated nationally by such vetting organizations as the National Park Service, the Society for History in the Federal Government, and the National Endowment for the Humanities. In terms of affecting the creation of the mobile app, a design-based research approach affected the project in some of these significant ways:

- By focusing on giving the learner an immersive point of view, and allowing the learner to participate directly in the recreation and interpretation of history, the mobile app changed the ways in which this National Park Service site, and others who have used the app as a model, view the potential of immersion with new teaching and learning technologies. By giving the learner agency in this process, a sovereign view of history emerged, in which each new perspective enriches understandings but also raises questions about what is not being covered through this viewpoint. In short, when history is experienced in this participatory way, as a personal journey, the paths to knowledge no longer seem as straightforward or as narrow, opening more opportunities for teachers and learners.
- By embracing interaction, this mobile app showed that history pedagogy easily could be expanded beyond the megaphones of one-way transmissions, such as lectures, brochures, and wall texts. Teachers can ask for more complex responses, and learners can express more complicated reactions than many of the traditional means of assessment allow. These responses can be shaped within the most appropriate media form -- including audio, video, and still imagery -- rather than primarily being expressed through text, and these responses can happen instantaneously, in the moment, when the student's mind is the most open and active and engaged in the activity of learning.
- By experimenting with media forms in this project, the many untapped possibilities quickly became apparent, in both mobile apps, and in other emerging forms. For example, as soon as the design team started building geolocated material that provided digital overlays of physical locations, augmented reality extensions of this idea seemed as obvious next steps, followed by explorations of such overlays in glasses-like wearable computing. In short, each new step into a new form seemed to raise ideas about where that step could lead. A relatively well-established technique of learning about history, such as watching a historical reenactment video, for example, begins to seem like only the beginning of the possibilities when that video is geolocated through a mobile app into a particular spot, where the historical activity took place, and anyone who comes along can see it there. With that idea already easily accessible, and new technologies emerging, one quickly wonders what historical teaching and learning would be like if the student could see that same scene from the perspectives of the different characters within it; and if the student could play one of the parts; and, if the student eventually could alter the historical choices of any of those characters to affect the outcomes and then role-play the scene over and over again, like modern video games allow, with the student manipulating the parts, as a way to get a deeper appreciation and understandings of how and why things happened, and, in turn, when returning to a present state of mind, gaining a greater appreciation for how they happen in contemporary society.

With the additional step of the LORI analysis, this research project also offered insights into intermediate evaluation opportunities and how those might guide and refine a learning object after the initial user-centered design principles are applied but before the object reaches the end market. The LORI evaluation of the app indeed enabled us to examine the extent to which the design of the app was guided by relevant theories of learning and assessment. Leacock and Nesbit (2007) claimed that one of the major contributions of LORI is to provide a quality tool "to support evaluation of multimedia learning objects" (p. 44). The use of LORI afforded the ratings and commentaries on nine dimensions of quality of the Fort Vancouver Mobile app: content quality, learning goal alignment, feedback and adaptation, motivation, presentation design, interaction usability, accessibility, reusability, and standards compliance. Overall, the LORI analysis found the Fort Vancouver Mobile app an effective learning resource. Specifically, LORI evaluation found the app to be easy to use and that it presents accurate historical knowledge that aligns with the intended learning goal. Moreover, the interactive features of the app (e.g., recording elements) enhanced learning. By using the LORI-analysis method, the evaluator was able to acknowledge and appreciate the high-quality content and design aesthetic but also to separate and identify areas in which the app module could be improved, such as with user feedback, accessibility, and learning goal alignment.

Since the design team and the evaluator worked independently in this case, before reuniting for the LORI analysis, the design team did not know what evaluation metrics would be used in the process, which could be considered both positive and negative. In one sense, the design team worked more organically that way, behind the guiding philosophical ideals established at the onset, and generally received high marks on the prototype because those ideals often aligned with the LORI scale. In a different case, with different ideals, or a different scale, the results would change. For example, if the value of the learning object was based more heavily on establishing and achieving specific learning goals, then the experimental design approach of the Fort Vancouver Mobile app might be considered less successful. The app also did not score highly on motivating the student through regular and explicit feedback. These ratings show potential weaknesses in the app design, in relation to learning-object evaluation, but they also raise the importance of the alignment and awareness of evaluation metrics. In addition, these ratings were provided by only one trained evaluator. How would the results and the feedback and the effects on design change if the design team started the project with the specific evaluation metrics in mind, and if more evaluators participated? Those are two potential paths for future inquiries.

Mobile technology alone cannot provide the panacea for improving history education in the United States, either. To present findings that demonstrate learners are attracted to the novelty of a mobile app at the Fort Vancouver National Historic Site -- and might even be willing to give it a try -- would not be surprising. More revealing results in this study, then, come from the deeper observations and analyses formed during the construction and use of the app, or the lack of use of it, based on individual needs. In a free-choice learning environment, without coercive controls in place, the learners always have the opportunity to, as the saying goes, vote with their feet, or to close the app at any point, and to never return to it. They are under no obligation to pay attention, to learn, or even to keep the app, no matter how much work has been invested into its production. There is not even the slight guilt of having paid for it, in the Fort Vancouver Mobile case, since this app can be downloaded for free.

Researchers in environments like Fort Vancouver must also wrangle with diverse varieties of competing stimuli and understand that free-choice learners expect communication to get to the point quickly and to be fun. Several studies have demonstrated that people are unwilling to devote sustained attention to media and messages that are not entertaining, and that traditional interpretive and educational materials typically get less viewing time and attention than designers envision (Novey & Hall, 2006). Researchers, though, also have established the potential of interactive exhibits to attract and hold visitor attention for longer periods of time than non-interactive exhibits, to produce more learner engagement with interpretive media, and to improve learning conditions in ways that reach an immersive experiential state of intellectual and emotional awakening.

While LORI has been extensively used in evaluating learning objects (Leacock & Nesbit, 2007; Nesbit & Belfer, 2004; Vargo, Nesbit, Belfer, & Archambault, 2003), the sole use of LORI for individual evaluation of the Fort Vancouver Mobile app, or other apps, is potentially limited in some ways. For example, LORI authors have explicitly delineated that "while LORI can serve as a component of a program evaluation process, it is not a sufficient tool for evaluating whole educational programs in which the learning objects may be embedded" (Leacock & Nesbit, 2007, p. 44). It appears that LORI may not provide a full picture of the effectiveness of the entire Fort Vancouver Mobile project but rather might provide a good intermediate evaluation of the app, after initial user-centered experiments and early prototypes have worked out the major kinks.

One prospective way of addressing future research, and building from this effort, then, would be to use LORI analysis as part of a convergent participation model of evaluation, so that different evaluators would examine an app project independently and then come together for a discussion of their ratings, and the divergences, which would allow for a collaborative evaluation of the app/project. This evaluation could happen at different stages of the project, too, to provide comparable moments and examine progress toward LORI-based goals. Additionally, as suggested by many within the Multimedia Educational Resources for Learning and Online Teaching (MERLOT) community, the process of evaluating the effectiveness of a learning object for teaching and learning would be further enhanced through the actual use of the object by students and faculty. Hence, we recommend that the LORI evaluation process followed in this paper could be used for formative purposes and that full-scale summative evaluation of the Fort Vancouver Mobile app should be conducted with historic site users. Although the Fort Vancouver Mobile app was evaluated as effectively designed, future research should investigate users' learning and affective outcomes with the app. Specifically, future research may conduct and report interviews with historic site users or collect survey data from them. This data then could be triangulated with design and evaluation data to more comprehensively examine the effectiveness of the app and provide design guidance for similar projects in the future. As valuable as these future research recommendations might be, we also believe that the LORI analysis has provided us with an important evaluation perspective at this stage of the app development as well, and those insights will continue to shape future refinement and deployment of modules for the project.

Appendices

Appendix A.

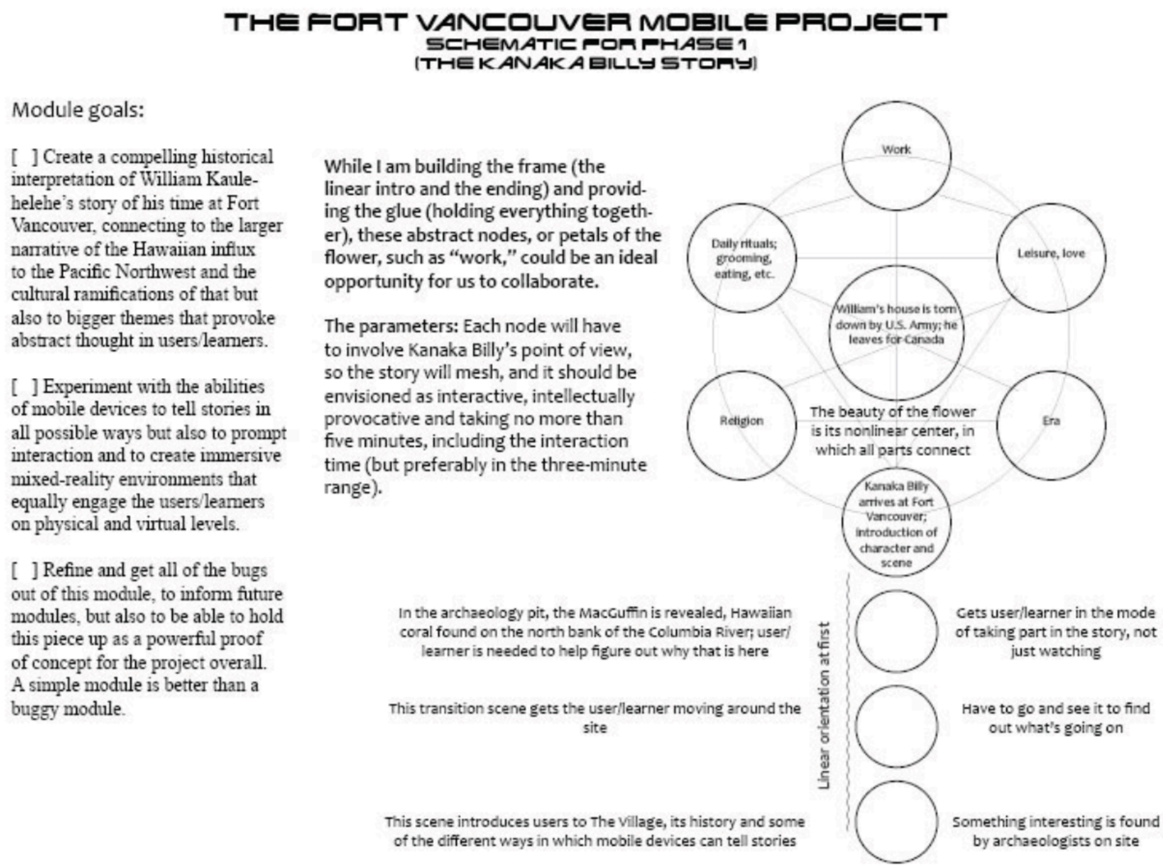
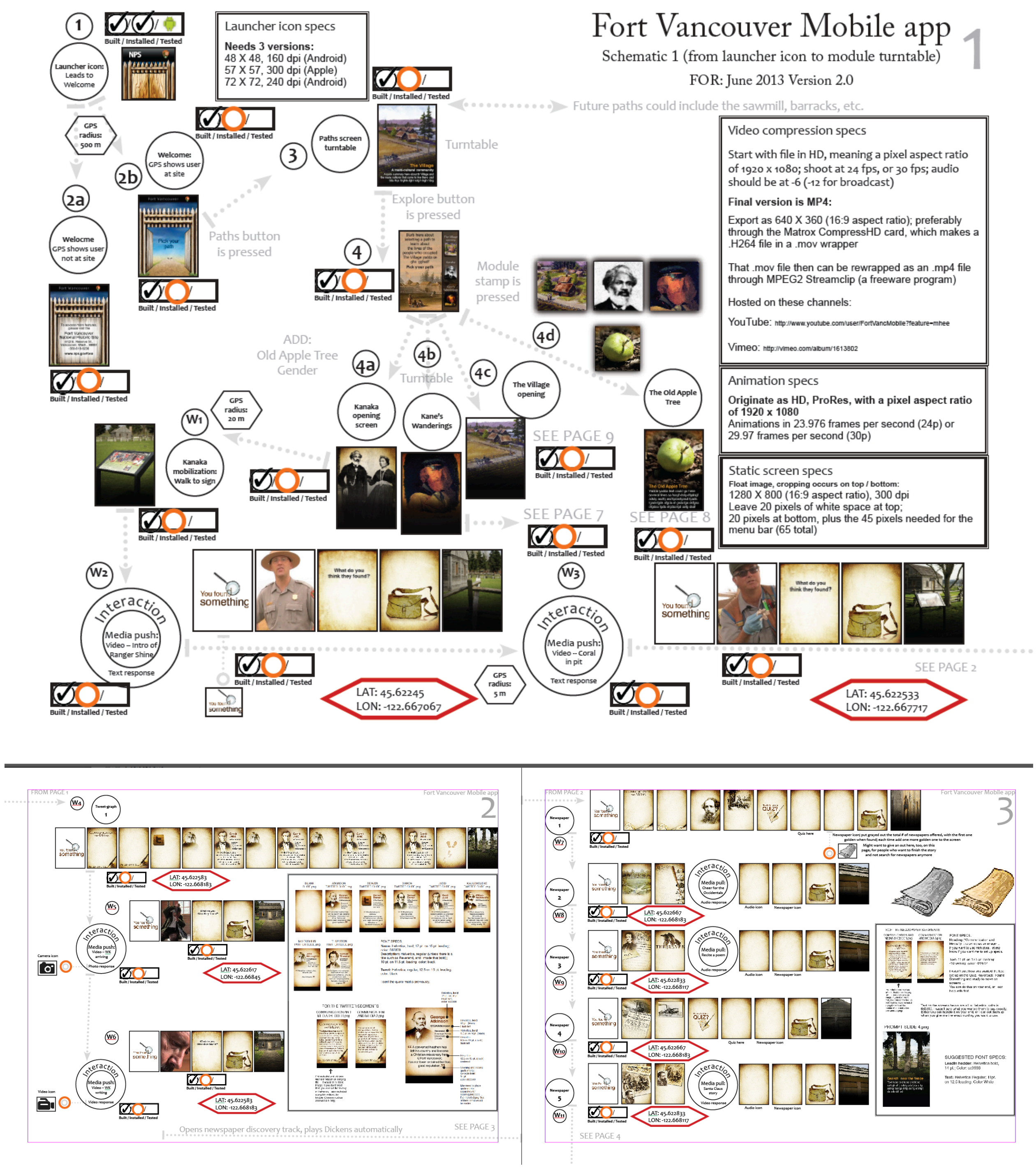


Figure 2. Screen shot of the Kanaka module's June 2010 schematic.



Fort Vancouver Mobile app
Schematic 1 (from launcher icon to module turntable)
FOR: June 2013 Version 2.0
1
Launcher icon specs
Needs 3 versions:
48 X 48, 160 dpi (Android)
57 X 57, 300 dpi (Apple)
72 X 72, 240 dpi (Android)
Launcher icon: Leads to Welcome
GPS radius: 500 m
Welcome: GPS shows user at site
Welcome GPS shows user not at site
Paths screen turntable
Turntable
Paths button is pressed
Explore button is pressed
Module stamp is pressed
Future paths could include the sawmill, barracks, etc.
ADD: Old Apple Tree Gender
Kanaka opening screen
Kane's Wanderings
The Village opening
The Old Apple Tree
GPS radius: 20 m
Kanaka mobilization: Walk to sign
SEE PAGE 9
SEE PAGE 7
SEE PAGE 8
SEE PAGE 2
Built / Installed / Tested
Video compression specs
Start with file in HD, meaning a pixel aspect ratio of 1920 x 1080; shoot at 24 fps, or 30 fps; audio should be at -6 (-12 for broadcast)
Final version is MP4:
Export as 640 X 360 (16:9 aspect ratio); preferably through the Matrox CompressHD card, which makes a .H264 file in a .mov wrapper
That .mov file then can be rewrapped as an .mp4 file through MPEG2 Streamclip (a freeware program)
Hosted on these channels:
YouTube: http://www.youtube.com/user/FortVancMobile?feature=mhee
Vimeo: http://vimeo.com/album/1613802
Animation specs
Originate as HD, ProRes, with a pixel aspect ratio of 1920 x 1080
Animations in 23.976 frames per second (24p) or 29.97 frames per second (30p)
Static screen specs
Float image, cropping occurs on top / bottom:
1280 X 800 (16:9 aspect ratio), 300 dpi
Leave 20 pixels of white space at top;
20 pixels at bottom, plus the 45 pixels needed for the menu bar (65 total)
Interaction
Media push: Video – intro of Ranger Shine
Text response
Media push: Video – Coral in pit
You found something
What do you think they found?
GPS radius: 5 m
LAT: 45.62245
LON: -122.667067
LAT: 45.622533
LON: -122.667717
Opens newspaper discovery track, plays Dickens automatically
SEE PAGE 3
SEE PAGE 4

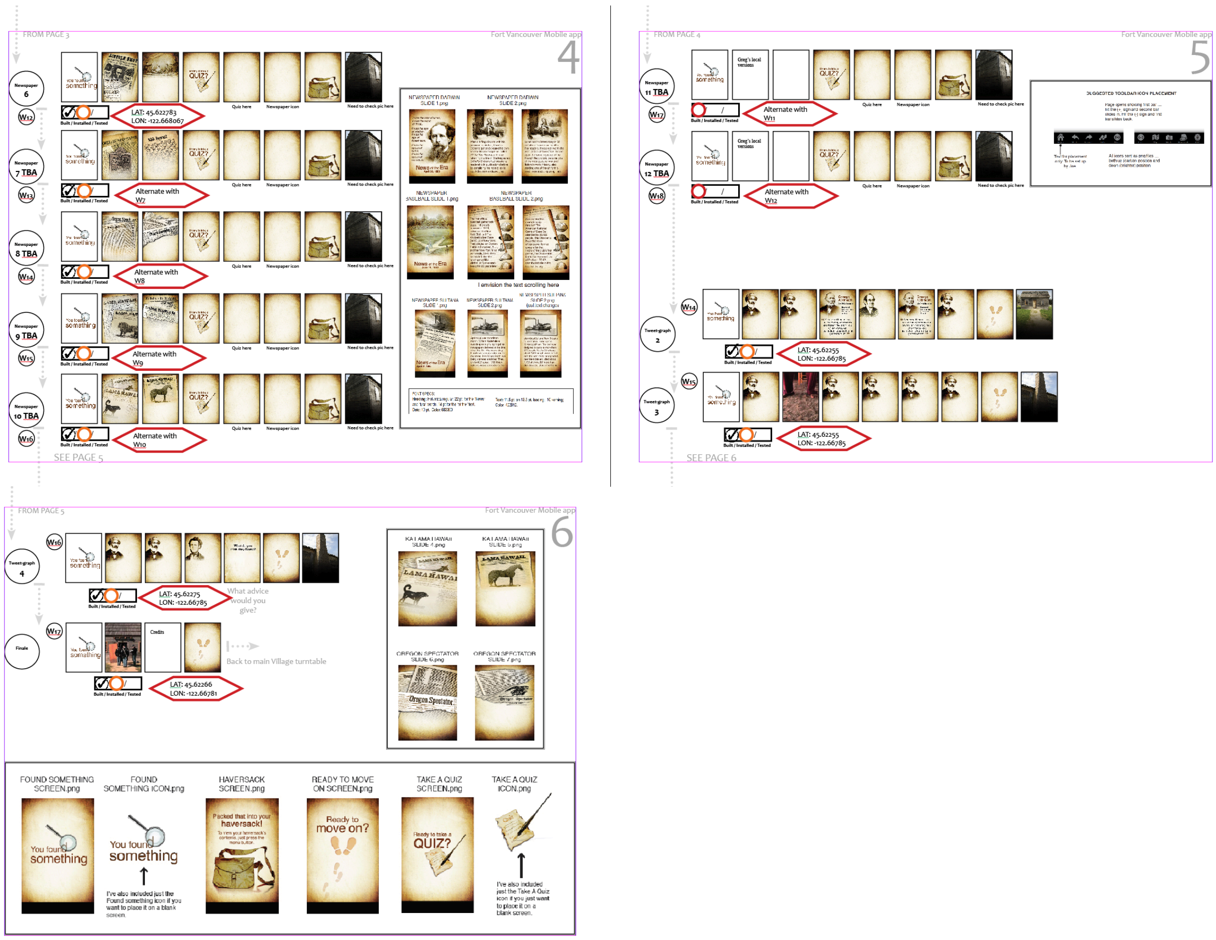


Figure 2. Screen shots of the Kanaka module's June 2013 schematic.

Appendix B.

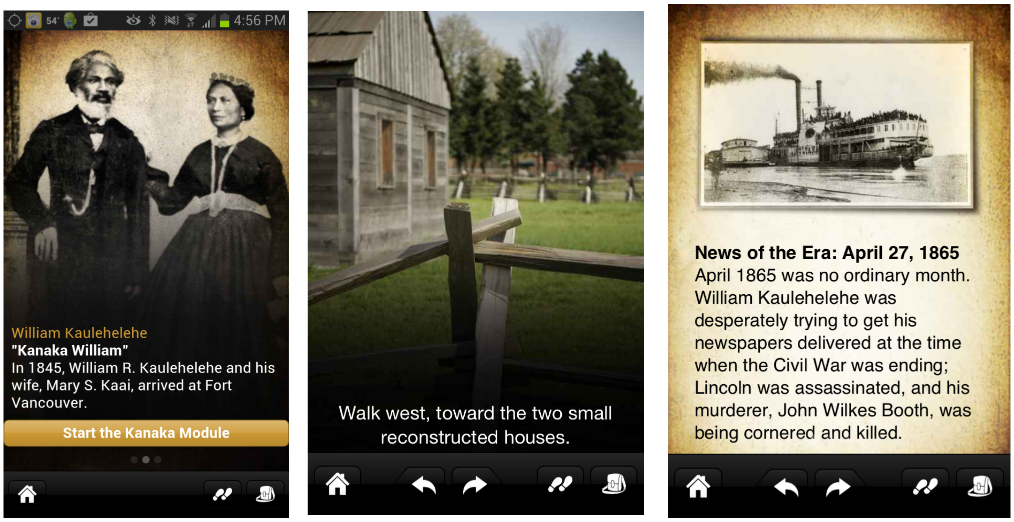


Figure 3. Screen shots of the Kanaka module at its June 2012 debut.

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How does a contextually-relevant peer pedagogical agent in a learner-attenuated system-paced learning environment affect cognitive and affective outcomes?

Noah L. Schroeder[1] and Olusola O. Adesope[2]

Abstract: Educational technology is becoming ubiquitous in schools, thus presenting new challenges in the classroom. For instance, teachers may struggle to find ways to motivate students to learn in multimedia learning environments. One plausible solution is the use of pedagogical agents, which are characters meant to facilitate learning in multimedia learning environments. This study examines the impact of a contextually-relevant, peer agent compared to a condition which provided narration and concurrent keywords displayed on the screen. The findings revealed no statistically significant differences between the two groups. The results, in part, support the presence principle of multimedia learning. However, the results do not suggest that a pedagogical agent is deemed a seductive detail, or distraction during the learning task. Rather, the agent's presence does not have any significant effect on learning or affective outcomes.

Keywords: learning environment, cognitive outcomes, affective outcomes, motivation, learner-attenuated

I. Introduction.

Shapley, Sheehan, Maloney, and Caranikas-Walker (2011) noted that "the present vision…imagines technology's infusion into all aspects of the educational system" (p. 299). Accordingly, it is not surprising that many researchers investigate the question of how we can most effectively use technology to enhance teaching and learning (Barreto & Orey, 2013). Perhaps the most iconic example of technology use in schools is the notion of online learning, which is now a commonplace in K-12 schools (Watson, 2005). For example, in the 2007-2008 school year, more than one million K-12 students were enrolled in online courses (Picciano & Seaman, 2009), and in 2009 there were 29 different states that had at least one virtual school (Hightower, 2009).

A challenge now faced by both educators and academics is how we will engage and motivate students to learn with multimedia and the Internet as technology changes how we communicate and learn (Archembault & Crippen, 2009). This gives rise to a new challenge: how to present the learning material to students. Researchers have dozens of technology tools at their disposal, such as learning management systems, message boards, videos, slide-shows, and interactive websites. One innovative tool now becoming accessible to teachers are pedagogical agents. A pedagogical agent is a visible character which appears in a multimedia learning environment for the purpose of facilitating learning (Moreno, 2005; Schroeder, Adesope, & Barouch Gilbert, 2013). Recently, a meta-analysis has shown that pedagogical agents provide small, positive effects on learning compared to non-agent environments (Schroeder, Adesope, &

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Barouch Gilbert, 2013). While pedagogical agent research is limited at this time, teachers may find them useful in the classroom as the agents can be customized to fit the instructors' teaching needs.

The purpose of this study was to explore the use of a contextually-relevant, peer pedagogical agent compared to a low verbal redundancy control group. The low verbal redundancy condition provided keywords on the screen concurrently with the provided narration (Adesope & Nesbit, 2012). A recent meta-analysis examining the effects of verbal redundancy showed that when compared to narration alone, the low verbal redundancy environment can improve learning by an effect of $g = .99$ (Adesope & Nesbit, 2012).

There is an important distinction between pedagogical agents and intelligent tutoring systems. For example, pedagogical agents may only provide the instruction they are programmed to present while intelligent tutoring systems are capable of providing adaptive and intelligent responses to student questions, as well as using students' current state of knowledge to offer developmentally appropriate instructions (Ma, Adesope, & Nesbit, 2013; Steenbergen-Hu and Cooper, 2013; vanLenhn, 2011; Veletsianos, Miller, & Doering, 2009). One form of an intelligent tutoring system is known as a conversational agent. Conversational agents differ from pedagogical agents because they can answer student questions (Veletsianos, Miller, & Doering, 2009). Incorporating adaptive features may likely increase not only the cost of implementation, but the time and skills required on behalf of the instructor. To summarize the differences between pedagogical and conversational agents, pedagogical agents provide an instructional monologue, while conversational agents may be more interactive and able to individualize instruction (Veletsianos, Miller, & Doering, 2009).

It is reasonable to question the use of pedagogical agents when conversational agents are available. Yet, researchers have continued to find novel ways to incorporate pedagogical agents into learning environments. One important delineation is that "pedagogical agent integration in educational settings should be guided by the added-value opportunities that agents present for enhancing the social, pedagogical, and technological opportunities provided to learners" (Veletsianos, Miller, & Doering, 2009, p. 179). Reconceived, a pedagogical agent may not be appropriate for all learning environments or all learners. Rather, their design and implementation must be thoughtfully guided to enhance learning.

Pedagogical agents can be extremely versatile since they are programmed and designed for specific applications. For instance, researchers have suggested that pedagogical agents can have six different roles in multimedia learning environments, including demonstrating or modeling (Clarebout, Elen, Johnson, & Shaw, 2002). Accordingly, it is not difficult to imagine how pedagogical agents may find their way into instructional materials through a variety of educational domains.

When educators decide to use a multimedia learning environment, they also have to decide what type of pacing it will use. The pacing of the system refers to how the learner experiences the learning environment. Specifically, pacing refers to the speed of the presentation and the control of the presentation. For example, do the learners control when they move on to new material, or does the learning environment provide them with a steady stream of information? Researchers of pedagogical agents have primarily utilized two types of pacing, system-pacing and learner-pacing.

In system-paced learning environments, the learner is generally shown a streaming video clip. Due to the nature of the video clip, the learner cannot pause, fast-forward, rewind, or restart the clip. Instead, the learner watches the clip from start to finish, and some researchers allow the learner to watch the clip more than once. Yet, there are some inherent faults with this type of learning environment. For example, individuals may encounter difficulties if the agent speaks too quickly, speaks unclearly, presents too many ideas, or uses too much complex terminology. If any of these incidents occur, the learner may get frustrated, confused, or stop paying attention entirely. It is also important to note that if the learner's attention wanes for any period of time, they have then missed that portion of instruction. Finally, researchers have suggested that system-paced instruction does not allow the learner enough time to assimilate the new information they are learning with their prior knowledge (Van Merriënboer & Kester, 2005) because they are continuously being exposed to new information, rather than having a short break to reflect on what they heard.

The other type of pacing commonly utilized in pedagogical agent research is learner-paced environments. Learner-paced systems are delineated from system-paced environments because they have buttons the learner can use to rewind, pause or fast forward through different segments of instruction (e.g., Dunsworth & Atkinson, 2007; Kizilkaya & Askar, 2008) as suggested by Mayer (2005b). Due to the segmented nature of learner-paced systems, there are built in 'breaks' where the learner can reflect upon what they learned in the previous segment before moving forward.

While learner- and system-paced environments have been common throughout the literature, not all technology tools create learning environments which fall explicitly into this dichotomy. For example, some internet-based programs can create pedagogical agent learning environments in the form of a streaming, non-segmented video. Yet, these videos also have a pause button and allow the learners' to fast-forward and rewind as necessary to optimize their learning experience. While the buttons to pause, fast-forward, and rewind are iconic of learner-paced environments, the learner does not control the pace of some aspects of the instructional material. For instance, the agent speaks at a pre-determined speed and proceeds to narrate the non-segmented instructional materials from start to finish. Accordingly, one can see how this type of learning environment contains features of both learner- and system-paced instruction. Hence, we feel is it is more appropriate to refer to these types of videos as learner-attenuated system-paced (LASP) instruction.

While researchers have examined the use of pedagogical agents compared to non-agent systems before in learner-paced environments (e.g. Baylor & Ryu, 2003) and system-paced environments (e.g. Mayer & DaPra, 2012), none have utilized a LASP learning environment. For example, Baylor and Ryu's (2003) work examined the affective and cognitive effects of incorporating pedagogical agents compared to a high verbal redundancy, non-agent learning environment. While Baylor and Ryu did not find significant differences in any of the learning outcome measures, they did find that the animated pedagogical agent was found to be significantly more engaging (d=.46, p<.05) and instructor-like (d=.86, p<.05) than the high verbal redundancy condition. Their results also showed that the conditions which included an agent were found to be more credible than the non-agent condition (d=.47, p<.05).

Although Baylor and Ryu's (2003) study was notable for the differences found in affective measures, it did not find significant differences in learning outcome scores between the conditions. More recently, Veletsianos (2007) has argued for the use of contextually-relevant agents. In fact, a recent study found that the visual appearance of agents may impact how they are perceived and how they affect learning (Veletsianos, 2010). In the literature, contextually-relevant agents have been defined as those which appear to fit the instructional domain (Velesianos, 2007; 2010). However, for the purposes of this study we will expand this definition by having the agent appear in a contextually-relevant environment. In this study, the contextually-relevant environment is represented by a virtual classroom. With the aforementioned findings in mind, we examined if the use of contextually-relevant, peer agents would not only facilitate learners' affect as seen in Baylor and Ryu's work, but also facilitate increased learning outcome scores.

Yet another factor in our decision to expand Baylor and Ryu's (2003) work was the control condition, which provided narration as well as verbatim on-screen text. For this study, a low verbal redundancy control condition (narration with keywords displayed on the screen as text) was used, which a recent meta-analysis found to be more beneficial than a fully redundant text and narration condition (Adesope & Nesbit, 2012).

Since the publication of Baylor and Ryu's (2003) work, they have developed the Agent Persona Instrument (Ryu & Baylor, 2005). The instrument has been found to be reliable in the past, and validity evidence for the instrument has been provided through confirmatory factor analysis (Ryu & Baylor, 2005). It is hoped that by utilizing this instrument, we may be able to capture a more accurate picture of how the agents are perceived by learners.

We also expanded previous work through the measurement of learning outcomes. While Baylor and Ryu (2003) administered a performance assessment as the sole means of measuring learning, we have utilized three different learning assessments, a free recall test, a multiple choice test, and a transfer test in the hopes of isolating the skills of retention and transferring the knowledge to a practical application. We believe that multiple outcome measures will enable us to examine the robustness of the effects. One additional component we investigated compared to previous work was the measurement of learners' computer-efficacy (discussed below) in order to minimize any measurement error due to the individual's confidence in their ability to use computers.

With a need to extend previous research, this study investigated the following research questions:

1) How does incorporating a pedagogical agent affect learners' free recall, multiple choice, and transfer scores in a LASP learning environment compared to a low-redundancy condition?
2) How does incorporating a pedagogical agent affect learners' perceptions of a LASP learning environment compared to a low-redundancy condition?
3) How does learners' computer-efficacy influence cognitive and affective outcomes when learning with a pedagogical agent compared to a low verbal redundancy condition?

II. Literature Review.

Numerous theories have acted as guides for pedagogical agent research. In this section, we will briefly describe the salient theories and their impact on this particular study.

A. Presence Principle.

Mayer, Dow, and Mayer (2003) claimed that while a pedagogical agent's voice is critical for facilitating learning, its physical image is not. This phenomenon was named the presence principle, and denotes a pedagogical agent's image as a "seductive detail" (p. 811), or a non-essential piece of information for the learning process (Mayer et al., 2003). Accordingly, if the agent's physical appearance is a seductive detail, then it is either ignored (Moreno, 2005) or presents a source of distraction (Mayer et al., 2003; van Mulken, André, and Muller, 1998), both of which can potentially be deleterious for learning.

Yet, not all pedagogical agent research has been so clear cut. In fact, most pedagogical agent research to date has produced mixed results (Domagk, 2010; Heidig & Clarebout, 2011; Moreno, 2005). This has caused some scholars to argue that pedagogical agents may not be cost-effective (Choi & Clark, 2006), or claim that pedagogical agents may make the learning environment too complex (Clark & Choi, 2007). While some scholars have found that pedagogical agents can produce small, positive effects on learning (Schroeder, Adesope, & Barouch Gilbert, 2013), others have found that pedagogical agents do not seem to create significant differences in learning outcomes (Heidig & Clarebout, 2011; Moreno, Mayer, Lester, & Spires, 2001).Yet, it is important to note that most of the research to date has utilized learner-paced learning environments (Schroeder, Adesope, & Barouch Gilbert, 2013). As such, we do not know how agents will affect learning in either system-paced or LASP environments.

The mixed results surrounding pedagogical agents do not only refer to their influence on cognitive outcome scores, but also how agents affect learners' affective responses. For example, Louwerse et al.'s (2008) eye-tracking study found that participants spent more than half of their time looking at the agent, suggesting "this attention does not wane over time" (p. 1253). This finding clearly shows that pedagogical agents are not ignored over time as some have suggested (Moreno, 2005). Pedagogical agents may also act as a motivational tool, as some researchers have suggested that they may provide motivational effects in some situations (Gulz, 2004; van Mulken, André, and Muller, 1998). This could be beneficial for learning, as Moreno (2005) noted that if the motivational benefits outweigh the deleterious effects of distraction, learning will be enhanced.

To summarize, researchers are left to question if pedagogical agents can facilitate learning and affective outcomes. Heidig and Clarebout (2011) argued that this question is simply too broad, as researchers have examined a vast array of different pedagogical agents and learning environments. This study investigated if a pedagogical agent's appearance in a LASP learning environment could facilitate learning compared to a low verbal redundancy, non-agent condition.

B. Social Agency Theory.

Researchers have shown that learning is fostered more effectively in a social agency environment than one of merely pictures and text (Moreno et al., 2001). A social agency environment is one which provides social cues to the learner through its messages, which "can prime the social conversation schema in learners" (Mayer, Sobko, & Mautone, 2003, p. 419). In other words, to foster social agency we should create a human-computer interaction that approximates social human-human interactions.

Researchers have suggested that interactions between humans and computers are likely to be understood similarly by the learner as communication between actual people (Veletsianos, Miller, & Doering, 2009). Researchers have found evidence to support this claim. For instance, Kim, Baylor, and Shen (2007) found that pedagogical agents were seen as social models and were expected to have a personality. Further, Louwerse et al. (2008) found through eye-tracking research that agents were seen as conversational partners (Louwerse, et al., 2008). As such, it is plausible that the student could interpret the pedagogical agent as an instructor, peer, mentor, or coach. Since research has shown that pedagogical agents may be stereotyped by their appearance

(Moreno et al., 2002; Veletsianos, 2007; 2010), it is also plausible that the interpretation of the social interaction can be manipulated by how the agent appears, speaks, and behaves within the learning environment. Purposefully manipulating these variables allows the researcher to control the agent's contextual-relevance. Veletsianos (2007) argued that an agent's contextual-relevance is critical "because it may influence learners' attention and perceptions and degree of agent relevance, seriousness, and authenticity" (p. 374), a claim which the findings of his empirical follow up study reiterated (Veletsianos, 2010).

Examination of the literature showed that contextually-relevant agents have not been commonly researched. For example, Choi and Clark (2006) used a Genie to teach English as Second Language students about English-relative clauses. Other researchers have utilized Genie agent to teach medicine (Cheng et al., 2009), a parrot to teach mathematics or science (Atkinson, 2002; Kizilkaya & Askar, 2008) and an anthropomorphized bug to teach botany (Moreno et al., 2001). Following the definition of contextual-relevance cited earlier, it is easy to see how these agents could be characterized as not contextually-relevant. Furthermore, the broad range of agents used may, in part, explain the mixed findings surrounding the effectiveness of pedagogical agents' for learning (Veletsianos, 2007).

As earlier mentioned, one primary argument against pedagogical agent use is that they may cause distraction (Mayer et al., 2003; van Mulken, André, and Muller, 1998) or make the learning environment too complex for the learner to efficiently process (Clark & Choi, 2007). Both of these arguments hinge on cognitive load theory and its associated principles, which are discussed in the next section.

C. Cognitive Load Theory.

According to cognitive load theorists, the long-term memory acts as the central processor while the working memory processes the novel information brought into the brain from an individual's sensory processes (Kirschner, Sweller, & Clark, 2006; Sweller, 2005). The long-term memory then integrates and stores the new information in structures called schema (Sweller, 2005).

Cognitive load can place mental strain on the cognitive process through three means: intrinsic cognitive load, extraneous cognitive load, and germane cognitive load (Paas, Renkl, & Sweller, 2003; Sweller, 2005; 2010). Intrinsic cognitive load is the mental strain due to the complexity of the learning materials themselves, as intrinsic cognitive load depends on the interaction between the individual's prior knowledge and the novel materials (Paas, Renkl, & Sweller, 2003; Sweller, 2005; 2010). Alternatively, extraneous cognitive load is the result of how the material is presented to the learner, and thus has nothing to do with the materials themselves (Sweller, 2005; 2010). Finally, germane cognitive load can be thought of as useful mental strain, for it is due to the interaction between the learner's prior knowledge and the new information being integrated in the schema (Sweller, 2005).

Scholars who have argued that pedagogical agents may create distraction or create an overly complex learning environment may hinge their arguments on the basis of the agent creating a source of extraneous cognitive load for the learner. The split-attention principle, at face value, would support their claims. The principle suggests that in order to enhance learning outcome scores, all of the information the learner needs should be provided through one source rather than forcing them to split their attention between two sources of information (Ayers & Sweller, 2005). It is easy to see how pedagogical agents violate this principle. For example, Atkinson (2002) utilized a pedagogical agent and worked examples to help teach students about mathematics. Theoretically, this would lead to lower learning outcome scores for the students who worked with the pedagogical agent. Yet, Moreno's (2005) review found that the split-attention principles effects have not occurred in any pedagogical agent studies. According to cognitive load theory, information which is stored in the long-term memory does not utilize additional cognitive resources when the learner is re-exposed to it (Sweller, 2005). Thus, Moreno's hypothesis that the agent's image may be processed to a lesser degree over time is plausible.

III. Method.

A. Participants and Design.

The participants in this study were aspiring teachers taking courses within the College of Education at a large, public institution in the Pacific Northwest. Apriori sample size calculations indicated that in order to obtain a statistical power level of .80 with $\alpha = .05$ and a desired effect size of $d = .63$ (average effect size of the scores for person-like, instructor-like, and engaging extracted from Baylor & Ryu, 2003), at least 32 participants were needed per group. Accordingly, 79 aspiring teachers participated in this experiment for course credit. Thirty eight participants were randomly assigned to the control (non-agent) condition, while 41 participants were randomly assigned to the experimental (agent) condition.

The average age of the participants was 20.85 ($SD = 1.99$) years, and the sample was 77 percent female. The participants self-identified ethnicity data indicate that 76 percent of the sample was Caucasian, 9 percent reported multiple ethnicities, 8 percent was Hispanic, 4 percent was African American, and 1 percent was Native American. Two percent of the participants did not report their ethnicity. The average participant had completed two years of post-secondary education, and 94 percent spoke English as their first language. Five percent of the participants indicated Spanish was their first language, while 1 percent chose not to report their first language. The participants were, as a whole, moderately confident in their ability to use computers. The self-rated computer-efficacy of the participants was 69% ($M = 68.66$, $SD = 13.52$).

Eighty four percent of the participants indicated that they had not received formal instruction on multimedia learning theory. However, the participants indicated that they sometimes use multimedia when teaching ($M = 3.23$, $SD = .89$, where 1 is "never" and 5 is "almost always"). The participants average pretest score was 3% ($M = .48$, $SD = .78$). Accordingly, the participants were considered low prior knowledge learners.

B. Computer-based Materials.

The control group's learning environment (Figure 1) was created using Microsoft Movie Maker. The narration was provided by an American male's voice in a conversational style and provided instruction about multimedia learning theory. The voice was generated using Xtranormal's (2012) text-to-speech feature. In order to create the low verbal redundancy environment, keywords from the instructional materials were displayed on-screen in white text concurrently with the narration. The keywords displayed on-screen matched the main ideas which the students were asked to later recall and use for the post-tests, namely "modality principle", "split-attention principle", and "cognitive load theory" (Figure 1 provides an example).

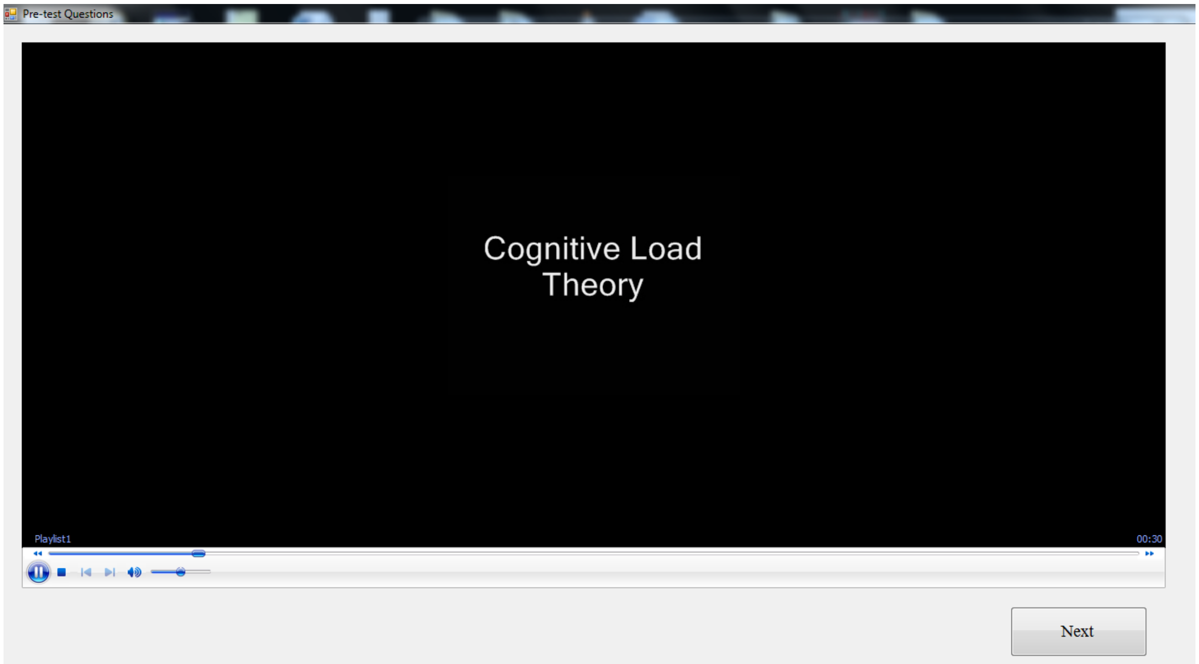

Figure 1. Screenshot of the control group's learning environment.

Xtranormal (2012), as described in the next section, was used to create the experimental condition. In order to create a contextually-relevant pedagogical agent, a male, peer pedagogical agent (Figure 2) was placed in a virtual classroom environment. The narration was identical to the control condition, and the agent's lips moved while it spoke. The pedagogical agent also gestured five times throughout the narrative. While the gestures did not reference any learning materials, they were provided by the agent due to research which has shown that gestures facilitate understanding (Hostetter, 2011) and may foster the agent's deictic believability (Lester, Voerman, Towns, & Callaway, 1999). The agent's deictic believability refers to its ability to move and gesture in relation to objects in the learning environment (Lester et al., 1999), which may facilitate the agent's ability to appear human-like.

The learners were allotted 600 seconds to watch a 240 second instructional video. The excess 360 seconds were provided so that the learners could rewind or pause the presentation as desired. The video was presented by a computer program designed specifically for this study which kept track of how long learners worked with the instructional video. The learners advanced to the post-tests by pressing the "Next" button.

Agent Design.

Xtranormal. While many software programs have been used to create pedagogical agents in the past, Xtranormal (2012)[3] provides an accessible and affordable solution to educators. Some institutions have begun using Xtranormal to a limited extent for online instruction (Miller, 2011; 2012; WSU eLearning Services, n.d.). As the excitement about this program spreads, it is plausible that programs such as Xtranormal will soon be incorporated into K-12 instruction as

[3] Since the writing of this manuscript, Xtranormal has shut down its website and no longer offers the services described in this manuscript.

the implementation of pedagogical agents requires fewer fiscal and knowledge resources than some of the other software options.

Xtranormal (2012) makes it very simple for a new user to create pedagogical agent-based learning environments. The program essentially uses a drag-and-drop methodology. In other words, you do not have to have any advanced computer or programming knowledge to utilize the software. For a description of how to design presentations with Xtranormal, please see Schroeder & Adesope (2012).

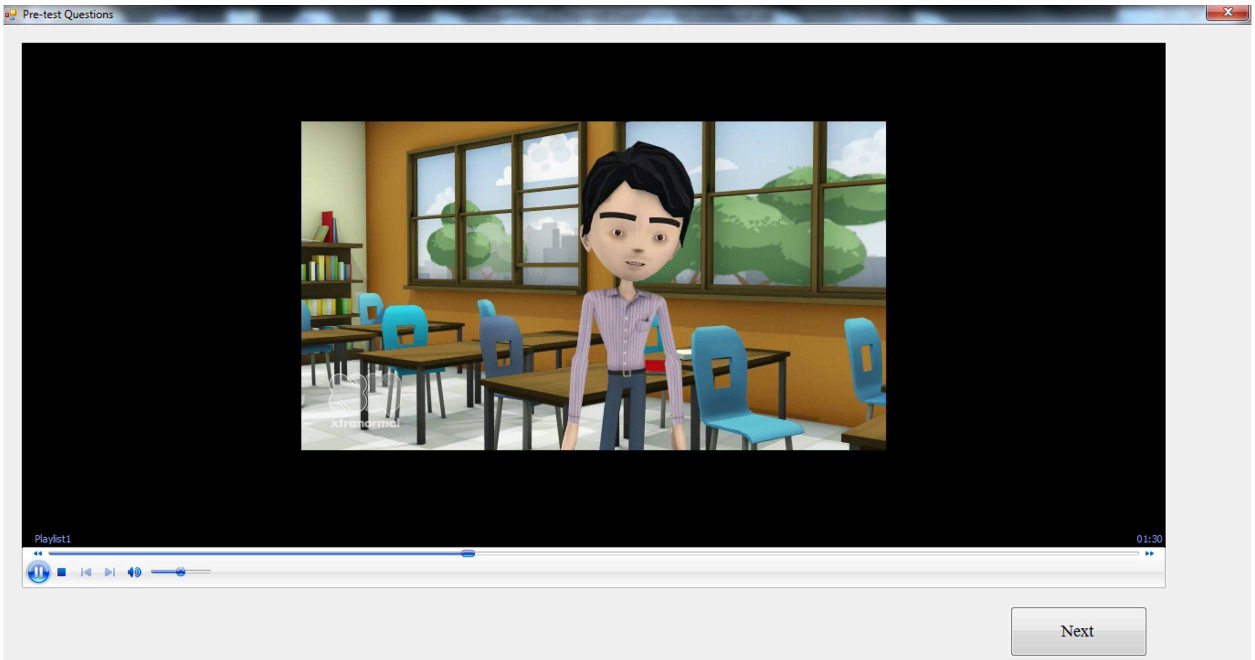

Figure 2. Screenshot from the male peer agent condition which appeared in experiment one and experiment two.

Peer Agents.

Most researchers have used instructor-type agents rather than peer agents in pedagogical agent research (Clarebout et al., 2002). Yet, Kim and Baylor (2006) claimed that "the benefits of peer interaction for learning and motivation in classrooms have been broadly demonstrated through empirical studies" (p. 569). Kim and Wei (2011) suggested that peer or role-model agents may be able to foster affective traits in the learner. This is plausible, as Kim and Baylor suggested that a peer agent could facilitate motivational and learning outcomes by acting as a social model. For instance, a peer agent has been used to foster the learner's attraction to an unpopular knowledge domain (Kim & Wei, 2011).

An ongoing issue in pedagogical agent research is that learners may perceive the agents as "more functional and more intelligent than they actually were" (Kim & Baylor, 2006, p. 573). This could be problematic for learners working with non-intelligent agents which cannot provide individual feedback. If the learner gets frustrated by the instructional monologue or the lack of interaction, it may lead to decreased engagement in the learning process. However, Kim and Baylor (2006) claimed that people derive more confidence from observing peers complete tasks than adults. Perhaps utilizing a peer agent can help deter the aforementioned problem by fostering other affective traits in the learner.

C. *Demographic Questionnaire.*

The demographic questionnaire consisted of eight questions which addressed the student's age, gender, ethnicity, and previous experiences with multimedia and multimedia learning theory.

D. Computer-efficacy Scale.

The learners' computer-efficacy was measured though the use of an adapted version of Compeau and Higgins (1995) computer self-efficacy scale. The scale consisted of 10 questions, answered through an 11 point Likert scale where 0 is "No", 1 is "Not at all confident" and 10 is "Totally confident". In the past, this scale has been found to be reliable with internal consistency reliability measures exceeding .80 (Compeau & Higgins, 1995). In this study, the scale's internal consistency reliability was found to be $\alpha = .92$.

Pre-test. The pre-test consisted of three free response questions concerning multimedia learning theory. The pre-test questions offered a maximum score of 14 points. For the first question, the learners earned one point for correctly identifying or describing each of the following ideas: working memory, long-term memory, schema, germane cognitive load, intrinsic cognitive load, and extraneous cognitive load, for a total of 12 possible points. For the second question, the participants earned one point for correctly describing the split-attention principle, and for the third question the participants earned one point for correctly describing the modality principle. Free response questions were used instead of multiple-choice questions in order to investigate if the participants had any prior knowledge about the learning materials while minimizing any error due to guessing.

Post-test. Three different types of questions were used to measure cognitive outcomes. After viewing the instructional video, participants first completed one free recall question. The question asked the learner to write down everything they could remember from the instructional video. A maximum of 18 points were possible for the free response question. Points were distributed for correctly identifying (1 point) and describing (1 point) the following concepts: germane cognitive load, schema, extraneous cognitive load, intrinsic cognitive load, cognitive load theory, long term memory, short term memory, the modality principle, and the split-attention principle.

Participants then completed thirty multiple choice questions. Each correct answer was worth one point. The questions were designed to test the learner's recollection of specific terms or ideas, as well as apply their knowledge to a hypothetical situation. The multiple choice questions internal consistency reliability was found to be $\alpha = .71$.

The final cognitive outcome test the participants completed was a free response transfer question. The question asked them to design a lesson plan utilizing cognitive load theory, the split-attention principle, and the modality principle. Scoring was identical to the scoring for the free response question.

Affective outcome scores were measured through the Agent Persona Instrument (Ryu & Baylor, 2005). The Agent Persona Instrument was designed to measure a learner's perceptions of the agent. Specifically, the instrument had 10 items which address how well the agent facilitated learning ($\alpha = .94$), five items which addressed how credible the agent was ($\alpha = .92$), five items which addressed how human-like the agent was (α = .87), and five items which addressed how engaging the agent was (α = .86) (Ryu & Baylor, 2005). Participants utilized a five point Likert scale, where 1 is “Strongly disagree” and 5 is “Strongly Agree” to respond to each question. In this study, the scale’s internal consistency reliability was found to be α = .94 for facilitated learning, α = .87 for credibility, α = .92 for human-like, and α = .91 for engaging.

E. Procedure.

We solicited volunteers from classes that were geared toward preparing aspiring teachers to obtain their teaching certification. On the day of the experiment, volunteers were brought into a classroom which contained 30 identical Dell computers with 19 inch screens. Each participant was given a set of headphones. The screen resolution was set to 1280x1024, the university’s default setting.

When the participants entered the classroom, they received a piece of paper with their name and user ID on it. The experiment was then introduced to the participants, and they were given the opportunity not to participate if they chose to opt-out. The participants then completed the experiment which took about 35 minutes to complete.

IV. Results and Discussion.

The purpose of this study was to compare the effects of learning with either a pedagogical agent or a low verbal redundancy control condition on learner’s cognitive and affective outcome scores. Further, we hoped to minimize any possible error by evaluating any possible influence of the participants’ computer-efficacy. Next, we delineate the results of the study in relation to each research question and situate the results in extant research.

Research Question One: How does incorporating a pedagogical agent affect learners’ free recall, multiple choice, and transfer scores in a LASP learning environment compared to a low verbal redundancy condition?

Examination of the graphs of the learner’s free recall scores, multiple choice scores, and transfer test scores showed that the data was normally distributed (Tabachnick & Fidell, 2013). Table 1 shows the means and standard deviations of the data.

Table 1. Results of cognitive measures for experiment one.

	Control (n = 38)		Agent (n = 41)	
	Mean	*SD*	*Mean*	*SD*
Pre-test	0.37	0.71	0.59	0.84
Free Recall	6.95	3.52	5.54	3.33
Multiple Choice	16.92	4.32	17.37	4.47
Transfer	3.39	2.55	3.54	2.47

Maximum possible scores: Pre-test: 14, Free Recall: 18, Multiple Choice: 30, Transfer: 18.

Multivariate analysis of variance (MANOVA) was conducted with the control condition and the agent condition as the fixed factor (i.e., independent variable) and the free recall, multiple choice, and transfer tests as the dependent variables. Box's $M = 3.135$ ($p > .05$), satisfied the assumption of homogeneity within the covariance matrices. Levene's tests revealed p values greater than .05, indicating that there was homogeneity within the error variances within the sample.

The MANOVA revealed that there were no statistically significant differences between groups on any of the cognitive outcome measures (Wilks' $\lambda = .916$, $F(3, 75) = 2.281$, $p > .05$). Even though three measures of learning were used, these results mirror the findings of Baylor and Ryu's (2003) study, as well as other pedagogical agent literature (for a review, see Heidig & Clarebout, 2011). These findings were somewhat surprising, as researchers have argued that contextually-relevant pedagogical agents may be more effective for learning than non-relevant agents such as the Genie used in many studies (Veletsianos, 2007). However the data show that a contextually-relevant, peer pedagogical agent's presence does not equate to increased learning outcome scores in a LASP learning environment.

These results provide important implications for multimedia learning theory. For example, the results show partial support for the presence principle. Even though there were no significant differences between the group which learned with the agent and the one which did not, it is important to note that this does not mean that the agent group was outperformed. Accordingly, it is plausible that the agent was neither distracting nor deleterious for learning compared to the non-agent group.

Our results do not support social agency theory. In previous research, social agency theory has been supported where gestures have been found to be helpful for learning or understanding (Hostetter, 2011; Moreno, Reislein, & Ozogul, 2010). However, in a LASP learning environment the inclusion of gestures did not provide any significant advantage for learning. We posit that this may have occurred because the gestures were not designed to be a salient part of the learning process. In Moreno et al.'s (2010) study, the agent used gestures to indicate which portion of the screen the learner should look at. Alternatively, in our study the gestures were added in an effort to increase the agent's deictic believability (Lester, Voerman, Towns, & Callaway, 1999). In the future, researchers should more thoroughly explore the use of gestures in relation to their purpose. Our results cause us to question if there is a maximum amount of social cues that a human processes when initiating the social conversation schema. Perhaps, as the presence principle suggests, only the verbal social cues rather than the visual social cues are necessary?

Yet, perhaps the most interesting contribution to theory from these results are those in regards to cognitive load theory. Some have argued that pedagogical agents may increase the extraneous cognitive load of the learning environment (Clark & Choi, 2007). Undoubtedly these scholars expressed a valid concern. It is plausible that agents which were not thoughtfully designed and implemented could cause extraneous cognitive load. For instance, Moreno (2005) suggested that the limited nature of the working memory may inhibit learning with a highly animated pedagogical agent. However, the results of this study show no difference in learning between groups, even though the agent was highly visible and animated. Accordingly, the agent's presence did not cause extraneous cognitive load. Despite these results, a few questions remain. For instance, did the agent create extraneous cognitive load at first, but then the load was lessened with time as Sweller (2005) suggests? Was the agent simply ignored (Moreno, 2005) because its gestures were not salient to the learning process? One final consideration is that perhaps our results are more reflective of the LASP pacing than the agent or non-agent conditions themselves. Regardless, one certainty is that future research has many fascinating directions to explore.

Research Question Two: How does incorporating a pedagogical agent affect a learner's perceptions of a LASP learning environment compared to a low-redundancy condition?

First, we examined a graphical representation of the data for the facilitated learning, credible, human-like, and engaging scales and compared them to a normal distribution (Tabachnick & Fidell, 2013). The examination showed that the data were normally distributed. The means and standard deviations of the data is presented by group and organized by scale in Table 2.

Table 2. Results of affective measures for experiment one.

	Control (n = 38)		Agent (n = 41)	
	Mean	SD	Mean	SD
Facilitated Learning	26.34	9.06	27.02	8.73
Credible	15.71	4.72	17.05	3.91
Human-Like	9.26	4.45	11.32	4.17
Engaging	10.26	4.29	11.80	4.32

Maximum possible scores: Facilitated Learning: 50, Credible: 25, Human-Like: 25, Engaging: 25.

MANOVA was conducted and the assumptions of homogeneity of covariance matrices (Box's $M = 10.561$, $p > .05$) and homogeneity of error variances (Levene's tests = $p > .05$) were satisfied. The MANOVA revealed no significant differences between groups in any of the affective measures (Wilks' $\lambda = .907$, $F(4, 74) = 1.907$, $p > .05$). Accordingly, the results show that the pedagogical agent did not enhance participants' affective response more effectively than the low verbal redundancy condition.

Our findings do not align with Baylor and Ryu's (2003) study, where the animated pedagogical agent was found to be significantly more engaging (d=.46), person-like (d=.47), and instructor-like (d=.86) than the non-agent condition. Yet, there are many plausible rationales as to why these differences may have occurred. For example, the instrument used in this study had both validity evidence for its use, as well as much higher reliability scores than the ones used in Baylor and Ryu's work. The internal consistency reliability of the scales in this study were exceeding α=.87 for all measures, while the scales used in Baylor and Ryu's study ranged from α=.68 to α=.74. Perhaps the psychometric differences between Baylor and Ryu's work and this study explain the different results?

It is also plausible that the pacing of the learning environment may have influenced the results of this study. For example, this study utilized a LASP learning environment, while the Baylor and Ryu's (2003) study appears to have used a learner-paced environment. The differences between the two learning environments should not be understated. For example, learner-paced environments require the learner to physically click on a button to bring them to the next segment of instruction. Due to this, the learner must be engaged with the learning environment at some level to even proceed through the learning materials. Alternatively, LASP learning environments merely give the learner the option to rewind, pause, or fast-forward. If the learner does not click on any of those buttons, the pedagogical agent provides an instructional monologue at a set speed from start to finish. Accordingly, it is possible in a LASP environment for a learner to proceed through the instructional materials in their entirety without ever engaging with the materials. Perhaps the increased interaction between the learner and the pedagogical agent in the learner-paced environment provides an affective advantage over the LASP environment? Future research can explore this question.

Our results indicate that the inclusion of a pedagogical agent did not lead to an increase in the learners' perceptive ratings of the system. In the past, researchers have found that pedagogical agents were easier to use and more enjoyable than the non-agent condition (Moundridou & Virvou, 2002), and that agents may be an effective option to increase a learner's affective response to the system (Kim & Wei, 2011). However, the differences between the agents used in previous research and those used in this study deserve close consideration. For instance, one study used artificially intelligent agents provided individualized instruction (Moundridou & Virvou, 2002), while this study used agents which could only provide an instructional monologue. We question if the use of individual responses by the agent through artificial intelligence is a key feature to ascertain improved affective responses from the learner.

Research Question Three: How does a learner's computer-efficacy influence cognitive and affective outcomes when learning with a pedagogical agent compared to a low-redundancy condition?

We first used an independent samples *t*-test to compare the mean scores of the groups on their self-rated computer-efficacy. The *t*-test revealed that there was no statistically significant difference between groups (t = -.68, df = 77, p > .05). As such, computer-efficacy did not produce a source of error in either the cognitive or affective outcomes in our sample.

Limitations. This study had two primary limitations, the voice which the agent used, and the confounding variables. The agent's voice was created using Xtranormal's (2012) speech generator. While we selected an American male voice to be paired with the agent, the voice was clearly created by a computer. In other words, the voice was a bit choppy, and the speech patterns did not flow as well as a native English speakers' might have. Accordingly, the computer generated voice may have impacted the learner's engagement with the learning material. For instance, a few participants commented on the quality of the agent's voice in the transfer or free recall questions, even though they were not prompted to do so. As such, is it plausible that a recorded, human voice may have been more effective for learning, as has been shown in other multimedia studies (Atkinson, Mayer, & Merrill, 2005; Harrison & Atkinson, 2009; Mayer, 2005; Mayer, Sabko, & Mauntone, 2003). In the future, researchers should compare the effects on learning and perception of an agent which uses computer generated speech compared to one which uses recorded human voices in a LASP environment.

As stated, confounding variables may have been present in this study as identified in previous research (Clark & Choi, 2005). In other words, the conditions in this study differed by more than only the agent's presence on the screen. For instance, the agent condition contained a virtual classroom as the background and the agent utilized gestures, while the control condition had neither of these features. Accordingly, if significant differences were found between groups it would have been impossible to relate learning or perceptive impacts to only the agent's presence alone. While this was not an important factor in this study, which sought to investigate the effectiveness of two different types of learning environment, it may be a factor in future research.

V. Conclusion.

At first glance, non-significant differences between groups may seem to be inconsequential. However, for the purposes of this study these findings are, in fact, very powerful. For instance, this study has shown that a pedagogical agent and a low verbal redundancy environment, when paired with LASP instruction, produced similar learning benefits. Previous research would not have predicted this outcome, as pedagogical agents have only been found to have a small effect compared to non-agent conditions (Schroeder, Adesope, & Barouch Gilbert, 2013), while low verbal redundancy environments have produced high effect sizes compared to voice only conditions (Adesope & Nesbit, 2012).

Findings of this study hold particular importance for teacher educators. Research has shown that instructors can act as role models by demonstrating how technology can be used effectively in the classroom (Tondeur et al., 2011). Accordingly, when looking for novel ways to integrate technology, an instructor may use pedagogical agents. For instance, it is tempting to incorporate a pedagogical agent into a learning environment because of their versatility and the novelty they provide. However, incorporating an agent may require more resources to develop and implement than a low verbal redundancy environment. This being the case, teacher educators should feel confident in their ability to use either option within a LASP learning environment, as they produced similar results in this study.

This study also holds importance for those who teach educational technology courses. For instance, an educational technology instructor's mission may be to teach pre-service teachers how to use technology effectively in their classroom. Hence, finding accessible technologies which students will find interesting is likely a key challenge faced. In this study, Xtranormal (2012) provided a very simple, easy to use software for the creation of pedagogical agents. While Xtranormal is no longer an active website, numerous other similar software packages exist such as GoAnimate (GoAnimate, 2013), SitePal (Oddcast Inc., 2013a) and Voki (Oddcast Inc., 2013b). As an educational technology instructor seeks out the most advanced, accessible technologies to teach their pre-service teachers, accessible pedagogical agent software may find its way into the coursework.

In sum, this study has raised more questions than it has answered. For instance, did the pedagogical agent perform better in a LASP environment than in previous studies, or was the low verbal redundancy environment simply not as effective? Future research should explore this question by also utilizing a voice only control group. Other questions raised by this study include, how did the participants' cognitive load influence their learning and perception scores? Did the pacing of the study cause more or less cognitive load for students than a traditional learner-paced or system-paced environment? Would participants with differing levels of computer-efficacy find different results from working with peer agents in a LASP learning environment? Future research can examine these questions in depth.

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The Journal of Teaching and Learning with Technology (JoTLT) is an international journal dedicated to exploring efforts to enhance student learning in higher education through the use of technology. The goal of this journal is to provide a platform for academicians all over the world to promote, share, and discuss what does and does not work when using technology in postsecondary instruction. Over the last few decades, faculty have progressively added more and more sophisticated technology into their courses. Today, the variety of technology and the creative ways in which technology is being used is simply astonishing, whether in-class, online, or in a blended format. In the final analysis, however, it isn't whether our students - or faculty members - like the technology that matters but whether the addition of these technological tools results in or expands access to quality student learning. JoTLT will play a prominent role in helping higher education professionals better understand and answer these questions.

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Style Sheet for the *Journal of Teaching and Learning with Technology*

John Dewey[1] and Marie Curie[2]

Abstract: This paper provides the style sheet for the Journal of Teaching and Learning with Technology. Manuscripts submitted for publication should adhere to these guidelines.

Keywords: clickers, iPad, tablet, retention, engagement.

I. General Guidelines for the Manuscript.

The final manuscript should be prepared in 12-point, Times New Roman, and single-spaced. Submissions being reviewed should be double-spaced. All margins should be 1 inch. The text should be fully left- and right-justified. The title (in 16 point bold) and author's name (in 12 pt. bold) should be at the top of the first page. The author's name should be followed by a footnote reference that provides the author's institutional affiliation and address. The abstract should be indented 0.5" left and right from the margins, and should be in italics.

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Pages should be unnumbered since they will be entered by the Journal editorial staff. We will also insert a header on the first page of the article, as above.

References should be incorporated in the text as authors name and date of publication (Coffin, 1993), with a reference section at the end of the manuscript (see below for the desired format for the references). Titles of articles should be included in the references in sentence case. Unless instructed otherwise in this Style Sheet, please use APA style formatting. Footnotes should incorporate material that is relevant, but not in the main text.

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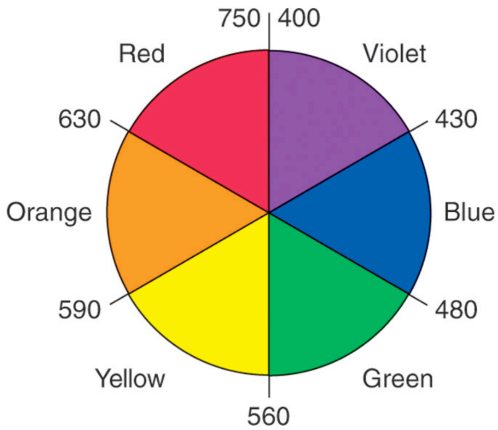

Figure 1. Color wheel with wavelengths indicated in millimicrons. Opposite colors are complementary.

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Appendix

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