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INFORMATION SYSTEMS EDUCATION JOURNAL

Relevance of Student Resources in a Flipped MIS Classroom

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Abstract

Flipped classrooms are gaining popularity in various educational settings as proponents report several benefits. In order for flipped classrooms to be successful, students must take responsibility for certain assignments outside of class time. In this study, Management Information Systems students were to learn textbook material by reading the chapter or lecture notes and/or listening to the audio lecture in preparation for a quiz at the beginning of class. Class time was then used for learning activities. Positive relationships were found between reading the textbook, reading the lecture notes, and time spent preparing for the quiz and the dependent variable, quiz grade. Discussion of results, limitations, and suggestions for future research are also included.

Keywords: flipped classroom, textbook reading, active learning, quizzes, learning styles

1. FLIPPED CLASSROOMS

Interest in flipped classrooms seems to be growing even though no established research base demonstrates that student learning is always positively impacted (Goodwin & Miller, 2013). A flipped classroom can be described in multiple ways. Often instructors may record lectures and post them online for students to view outside of class time (Goodwin & Miller, 2013). In addition, flipping a classroom allows class time for interactive engagement, peer teaching/learning, and collaboration during what was once the traditional lecture time in class (Berrett, 2012; Carpenter & Pease, 2012). Other reasons for flipping a classroom include students can work at their own pace, the availability of new technologies that support flexible learning, more student-teacher interaction and the more effective and creative use of classroom time (Fulton, 2012; Goodwin & Miller, 2013).

Some instructors pursue flipped classrooms as a way to transfer some responsibility for student learning back to students. Students in a flipped classroom are expected to view lectures or study material outside of class time (Berrett, 2012). A flipped classroom might increase student responsibility for learning as well as provide the avenue for class time active learning where students tend to learn more (Carpenter & Pease, 2012).

Bergmann and Sams (2012) recommend beginning a flipped classroom journey with one question: What's the best use of face-to-face time. The Management Information Systems (MIS) course at a Midwest regional state university was flipped to add active learning activities to the classroom. PowerPoint files with lecture notes and audio lectures had been created and posted for the online MIS class, and the links had been added to the course web sites for the sections that met on campus. Rather than lecturing over the PowerPoint slides in class, instructors decided to use class time to lead discussions over relevant topics, guide research activities, and facilitate collaborative learning tasks. Active learning allows students to engage with the material through discussion, application of prior knowledge, and connections between past experiences (Ueckert & Gess-Newsome, 2008).

2. ASSIGNMENTS

In order to use class time for active learning exercises, students need to complete assignments outside of class time. The assignments included reading a chapter from an MIS textbook, listening to an audio lecture, and/or reading the instructor lecture notes. Literature shows that students do not read for a variety of reasons including lack of motivation, poor study habits, time demands, and instructor behavior (Starcher & Proffitt, 2011). While educators are often frustrated with the low rate of reading completion, they often play a role in the poor completion rate. Some describe students' noncompliance with reading as part of a vicious cycle where instructors assign reading and then recognize that students don't complete it so they end up covering the material in class, thus reinforcing the idea that students do not need to complete reading assignments (Brost & Bradley, 2006). The quantity of reading may influence this cycle. If students feel like they have been assigned too much reading, they may look for a summary or wait for class to hear a synopsis (O'Connor, 2012). In another study where students were to read MIS textbook chapters, O'Connor (2012) found that the average number of minutes and the interest in the reading material decreased from the beginning to the end of the semester. Getting students to read the MIS textbook appears to be a challenge.

Quizzes seem to be the most commonly used assessment to motivate students to complete reading assignments, producing significantly higher rates of student completion of reading assignments. (Starcher & Proffitt, 2011). Carney, Fry, Gabriele, and Ballard (2008) found that quizzes motivated students to learn the material.

Instead of reading the textbook, students in the MIS course could use other teacher-generated materials to learn the most important content covered in the textbook chapters. The course instructors divided the textbook chapters and created a PowerPoint file with instructor notes for each chapter. To comply with recommended Quality Matters standards (for online classes), the instructor notes and the audio lecture used the same words to provide equivalent alternatives for auditory and visual content. Each audio lecture was approximately 10 minutes since research shows learners tend to check out after about 10 minutes (Goodwin & Miller, 2013). Another reason for providing multi-modal content is to recognize the role of various student learning styles (Birch, 2006). Students were encouraged to consider how they learn best and then use the study material that matched their learning style. Understandably the lecture notes and audio lecture did not have the same level of detail as the textbook chapters.

3. HYPOTHESES

The purpose of this study was to learn what support materials (textbook, teacher notes, and audio lecture) were positively related to the chapter quiz grades. In addition, the researcher wanted to know if simply briefly reviewing the chapter was enough preparation to do well on the quiz and whether greater amounts of time spent with the chapter material was associated with higher quiz grades.

The hypotheses for this study stated in null form include:

H1: There is no difference in quiz grades between subjects who read the textbook chapter and subjects who did not read the textbook chapter. Students are motivated to complete reading assignments when it impacts their grade (O'Connor, 2012). This hypothesis will test whether reading the textbook chapter impacts their quiz grade.

H2: There is no difference in quiz grades between subjects who read the instructor lecture notes and subjects who did not read the instructor lecture notes. These notes are generated for the audio lectures. Management Information Systems instructors want to know if the use of these notes positively impacts quiz grades.

H3: There is no difference in quiz grades between subjects who briefly reviewed the textbook chapters and subjects who did not briefly review the textbook chapters. This hypothesis tested to see if students who quickly looked through the chapter did better than those who did not. This option was added to the survey for those students who did not read the chapter or notes or listen to the lecture but did review the textbook before the quiz.

H4: There is no difference in quiz grades between subjects who listened to the audio lecture and subjects who did not listen to the audio lecture. Hypothesis results can help instructors know if recording the lectures is a worthwhile activity.

H5: There is no difference in quiz grades between subjects who prepared for the quiz and subjects who did not prepare for the quiz.

H6: There is no difference in quiz grades between subjects who prepared for the quiz for varying amounts of time. Hypotheses 5 and 6 could help validate whether the preparation outside of the classroom as expected in a flipped class has a relationship with quiz grades.

4. METHOD

Students in spring 2013 MIS sections were invited to participate in the study. The MIS course is a junior-level course in the common professional component for the business school. Students in the course are accounting, finance, economics, marketing, management, business education, business technology, international business, or management information systems majors. All students had copies of the course textbook since the university has a textbook rental system.

Students electing to participate in the study were offered a total of 10 points extra credit for completing all of the surveys. Students were assigned the chapters the class period before the chapter was covered in class. The same lectures and notes were available to students in all sections of the course. At the beginning of the next class period when the chapter was to be covered, students took a 10-question multiple-choice and true/false quiz over the material. The questions came from a test bank developed for all sections of the MIS course. Following the quiz, participating students completed a survey (Appendix A) regarding their preparation for the quiz. Students were identified by their student number which they wrote on each survey. They placed completed surveys in an envelope so instructors could not see the student responses to the survey, ensuring that student grades were not impacted by their responses to the survey.

A total of 83 students enrolled in the spring 2013 MIS campus-based sections agreed to participate in the study. While the MIS course is also offered online, the data in this paper only includes students who completed the course on campus. All nine chapters of an MIS textbook were covered in the class for a possible 747 surveys.

5. DATA ANALYSIS

A total of 660 surveys and quiz scores were used in the data analysis. Two classes had technical issues which impacted one quiz so the number of surveys and quiz scores was slightly fewer than the 747 expected.

In this study, the quiz grade was the one dependent variable. Quiz grades were grouped by letter grade, A, B, C, D, and F. The responses to the first 5 questions were grouped into two groups as subjects answered yes or no to indicate whether or not they participated in the activity. A chi-square test of independence was performed to examine the relation between the quiz grades and the use of the various study aids. In addition, a phi or Cramer's V test was computed to determine the strength of the association between statistically significant variables. A phi coefficient was used on the 2 x 2 variables while Cramer's V was used on the table larger than 2 x 2. Since sample size also influences significance, the additional test helped confirm the existence of a relationship (Muijs, 2004).

H1: There is no difference in quiz grades between subjects who read the textbook chapter and subjects who did not read the textbook chapter. There was a significant relation in these two variables, X^2 (4, N = 660) = 13.16, p = .001, Phi = .14. The null hypothesis is rejected, and the alternative hypothesis that higher quiz scores are associated with reading the chapter is accepted.

H2: There is no difference in quiz grades between subjects who read the instructor lecture notes and subjects who did not read the instructor lecture notes. There was a significant relation in these two variables, X^2 (4, N = 660) = 9.52, p = .049, phi = .12. The null hypothesis is rejected, and the alternative hypothesis that higher quiz scores are associated with reading the lecture notes is accepted.

H3: There is no difference in quiz grades between subjects who briefly reviewed the textbook chapters and subjects who did not briefly review the textbook chapters. The null hypothesis could not be rejected as there was no significant difference between the group who briefly reviewed the chapter and the group who did not, X^2 (4, N = 660) = 2.97, p = .563.

H4: There is no difference in quiz grades between subjects who listened to the audio lecture and subjects who did not listen to the audio lecture. There was a statistically significant relationship between the variables, X^2 (4, N = 660) = 20.29, p = .000, phi = .18 so the null hypothesis is rejected. The cross tabulation table showed the statistically significant relationship existed between listening to the audio lecture and lower quiz grades.

H5: There is no difference in quiz grades between subjects who prepared for the quiz and subjects who did not prepare for the quiz. This hypothesis tested to see if those students who did nothing to prepare for the quiz performed the same as those who did some preparation. There was a significant relation in these two variables, X^2 (4, N = 660) = 23.98, p = .000, phi = .19. The null hypothesis is rejected, and the alternative hypothesis that preparing for the quiz is positively related to the quiz grade is supported.

H6: There is no difference in quiz grade between subjects who prepared for the quiz for different amounts of time. Students selected one of the following choices for each chapter quiz: 0 minutes, 1-15 minutes, 16-30 minutes, 31-45 minutes, 46-60 minutes, or more than 60 minutes. There was a significant relation in these two variables, X^2 (20, N = 660) = 73.67, p = .000, Cramer's V = .17. The null hypothesis is rejected, and the alternative hypothesis that preparing for the quiz is positively related to the quiz grade is supported.

The Phi coefficient and Cramer's V score for each statistically significant relationship was between .1 and .3 indicating a modest relationship (Muijs, 2004).

6. DISCUSSION OF RESULTS

Students in this study read the assigned chapter prior to the class when it was discussed 47% of the time. Phillips and Phillips (2007) found that only 17% of students in an introductory accounting class read the assigned chapter before it was discussed in class. The percentage in this study was higher than expected but may be explained by the short chapters in the textbook as chapters are only approximately 20 pages each. In addition, the quiz at the beginning of the class period likely served as an incentive to read the chapter. Reading the lecture notes was also positively related to the quiz score. Only briefly reviewing the textbook prior to the chapter quiz did not positively impact the resulting quiz grade. Instructors can tell future MIS students that the use of the textbook and lecture notes were associated with higher quiz grades while only briefly reviewing the textbook or not preparing at all were not.

Surprisingly students in the study listened to the audio chapter only 18% of the time. The low audio usage rate was probably a factor in the unexpected direction of the statistical results. Given the expectation that an audio alternative be made available for students who need it, instructors will probably continue to provide this resource.

Students who spent more time preparing for the quiz earned higher quiz grades. This finding was expected and helps to validate the study aids and the quiz questions.

7. LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

Wording of a few items on the survey could be improved for future studies. The item "briefly reviewed the chapter" could have been interpreted by the students in various ways. Some students who read the chapter in its entirety may have also indicated that they briefly reviewed the chapter, perhaps right before the quiz. Others who did not prepare prior to class may have also indicated they briefly reviewed the chapter right before class started. The last question asked students to select a category related to the time they studied; this limited the data analysis to categorical tests. Another study could ask them to record the number of minutes they prepared. The questions on the quiz came from a test bank and may not have been the best measure of student learning.

Future research could examine other methods that students use to prepare for class assessments. One student shared with the researcher that students use online resources not provided by the instructor to prepare for the quiz. For example, on the web site quizlet.com, students can type in a course name and see if another student has created study materials for that class at their school.

Other studies that have examined student reading have used learning journals to get a better idea of exactly how students read the material (Phillips & Phillips, 2007). This could be done to see if students are reading at a surface level to memorize concepts or at a deeper level.

The reason for flipping the MIS classroom was to add collaborative, active learning activities to the class. The activities done in class were directly related to the essay questions on the next exam. A future study could examine student responses on those essay questions to determine if the learning activities are effective.

8. CONCLUSION

The results of this study have indicated there is value to reading the textbook and using the lecture notes provided by the instructor to learn material necessary to do well on the quizzes. While lecturing over the material in class might be the typical, traditional way to teach material, flipping this classroom increased student expectations, a necessary shift in college classrooms (Carpenter & Pease, 2012). Engaging students in meaningful dialogue over current events, scenarios, and research related to the course content can enhance the student classroom experience.

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This paper was selected for inclusion in the journal as a ISECON 2013 Meritorious Paper. The acceptance rate is typically 15% for this category of paper based on blind reviews from six or more peers including three or more former best papers authors who did not submit a paper in 2013.

Appendix A

Management Information Systems
Chapter Preparation

Snumber: __________________
Chapter: 1
I prepared for this chapter quiz by doing (check **ALL** that apply):

______ Listened to the audio lecture
______ Read the textbook chapter
______ Read the online instructor lecture notes
______ Briefly reviewed the chapter
______ Did not prepare for this chapter

The amount of time spent preparing for this chapter quiz is (check **ONE**)

______ 0
______ 1-15 minutes
______ 16-30 minutes
______ 31-45 minutes
______ 45 minutes – 1 hour
______ More than 1 hour

Access to On-line Learning: A SAD Case

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Abstract

As evident through recent litigation, Institutions of Higher Education are increasingly being held accountable for the federal mandates on ensuring equivalent access to online education for students with disabilities. This has strong implications for incorporating strategies to enhance accessibility and universal design into all courses from the beginning stages of development. The responsibility for this lies primarily with the Faculty Instructors and Instructional Designers. This Case Study demonstrates how the accessibility of an Information Systems course was improved through development as a fully online course.

Keywords: online, universal design, accessibility, information systems management, instructional design

1. INTRODUCTION

Recent events have highlighted the need for institutions of higher education to be better prepared to address emerging accessibility issues and expectations as teaching and learning migrates from the face-to-face environment of the classroom to the more virtual settings offered by on-line and blended courses. Such migration requires attention, not only to accessibility requirements, but also to accessibility *expectations* and *opportunities* - particularly in regard to online classes and the various aspects of information and instructional technology that support their development and delivery. A 2012 case brought by the National Federation for the Blind (NFB) against Pennsylvania State University (PSU) highlights the emphasis on compliance with 'requirements' and resulted in a settlement agreement that obliged PSU to meet accessibility compliance standards in a number of disparate areas by August 2014: they include the PSU learning management system, university websites, information technology, classroom technology, library services and technology procurement. Other institutions that have experienced similar accessibility compliance enforcement include Northwestern University, New York University, the California Community College System and Florida State University.

With advances in assistive technologies, students with disabilities now have improved opportunity to pursue higher education. This is a welcome trend that is facilitated by these technologies: the information systems discipline has provided tools that expand access to teaching and learning beyond the physical classroom setting - and beyond the bounds of its own programs. At our institution, we have observed increases in enrollment in the IS major and other programs by students with vision, hearing, learning, and physical disabilities, each of whom present individual and unique learning and technology access needs. These individual needs present a growing range and volume of challenges as the number of students rises and the diversity of their needs expands. However, they also present an opportunity to explore the technologies themselves and how they might be more fully exploited to meet the learning needs of the whole, and increasingly diverse, student population.

Due the nature of delivery of online courses, Web Accessibility becomes a key component to online course design; however, federal legislation, such as section 504 and 508 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act, does not outline specific accessibility standards or metrics for online or blended learning. The cases above make it clear that equal access includes online education – despite the fact that the regulations themselves predate the emergence of the (worldwide) web by 20 some years.

The issues and shortcomings that gave rise to these cases provide the basis to reflect on the strengths and limitations of regulations and other guidelines. That reflection prompts three complementary aims

- To identify gaps and overlaps in existing regulations and guidelines and propose a more cohesive framework more conducive to the development, delivery and assessment of courses in both traditional and non-classroom settings.
- To consider the teaching, learning and assessment challenges that emerge as the range of courses delivered in non-classroom settings expands to include those whose learning outcomes are more complex and 'multi-dimensional.'
- To articulate a shared design process in which faculty and instructional designers proactively explore and exploit opportunities to optimize accessibility for all.

Our experience shows how accessibility can be repositioned: rather than the basis for a 'checklist' of minimum requirements to ensure compliance with the law and other regulations, we see accessibility as an agenda. Rather than reacting to shortcomings and limitations and retrospectively addressing the needs of individual students with disabilities, course design can be driven by the opportunity to maximize accessibility for all students, whose learning abilities span an ever increasing range.

The following section considers the emergence of accessibility issues: the brief review of the literature highlights the universal emphasis on legislative compliance. It also highlights the particular challenges presented by courses that endeavor to teach design. The third section articulates these challenges for a particular course and provides an overview of the institution where the research and design were conducted; the fourth section describes the process that we developed to address these challenges and the penultimate section reports the outcomes of our initiative. The paper concludes with observations and recommendations for further research and development of best practice.

2. PRIOR RESEARCH

In this section we review prior work on accessibility and place it into the context of the teaching and learning challenges and opportunities that on-line course delivery offers. Our review of the literature narrows to focus on the challenges specific to one of the core courses in the undergraduate information systems curriculum (Topi et al, 2010).

Prior research on accessibility has focused primarily on the effects that technological advances in web design have had on accessibility for persons with disabilities. Sloan et al (2002) were commissioned to audit (sic) the accessibility of 11 web sites in the UK higher education sector. The design of this study – an *audit* – is itself revelatory: an *ex post* analysis of impacts that assumes technology to be the 'independent variable'.

The studies by Kim-Rupnow and Burgstahl (2004) and Hackett and Parmanto (2005) place similar emphasis on impacts and outcomes of technology use – a familiar emphasis in the information systems discipline (Bhattacherjee, 2001; Roca et al, 2006). The emphasis on outcomes is reinforced by the research designs that focus on longer-term impacts of the internet and other technologies for students with specific disabilities (Smith and Lind, 2010) and those transitioning into or through further and higher education (Hackett and Parmanto, 2005). The longitudinal emphasis is welcomed, as is the acknowledgement of skills as legitimate and important learning outcome in higher education. Nevertheless, there is a strong sense of technological determinism: prior research tends to focus either on compliance with regulatory change or on the acceptance of emerging information systems.

The focus on specific disabilities rather than the range of abilities in a normally distributed population of students – when combined with the *ex post* emphasis of audit and other research into the acceptance of given technologies tends to narrow the research agenda to reaction to technological change. It is our contention that 'design' in education is not as universal as Burgstahl and Cory (2008) propose. Accessibility is not just about students with 'disabilities'. Each of us have some limits to our ability when it comes to the rapidly evolving conceptual design challenges that contemporary information systems present (Hevner et al, 2004).

In an era when much emphasis is being placed on Science, Technology, Engineering and Mathematics (STEM) education, it is pertinent to reflect on the centrality and complexity of design in information systems. The complexity and conceptual richness of the design artifacts and process central to information systems is particularly evident in the Systems Analysis and Design (SAD) course (Avison and Fitzgerald, 2006; Topi et al, 2010) where students are first introduced to them.

Systems Analysis and Design is the gateway to undergraduate Information Systems programs. The concepts learned here are an essential prerequisite for successful completion of the major: they are also essential for mastery of the language, tools and techniques that enable their effective use in employment (Yourdon, 1993). The primary learning goal is mastery of a range of modeling techniques and their use as the basis for effective communication between user communities engaged in a particular business and the developers and programmers who build information systems to support the business. The course content is – and always has been - conceptually complex (Avison and Fitzgerald, 2006). This complexity has been compounded by the succession of (traditional) structured analysis and design methods, tools and techniques. The emergence of object-oriented analysis and design methods (Yourdon and Coad, 1991) presents a further cognitive challenge to both teachers and learners.

Object orientation represents a migration of the engineering and mathematics-dominated mind and tool sets that have prevailed since they emerged in the 1970s. Research has shown that structured methods act as a 'comfort blanket' (Fuller and Davis, 2008) and guide the cognitive sense making processes used during analysis and design. Such cognitive inertia can become a potential barrier to learning among both mature (post-experience) students and 'beginning' IS majors. The frames of reference for articulating business requirements provided by structured and object oriented methods are fundamentally different. The more holistic, systems science basis of object oriented techniques provide very different communication 'channels' (Fuller and Davis, 2008) and ways to 'make sense' of business scenarios This, in turn, radically alters the skill set needed to effectively use them.

The specific cognitive mechanisms underpinning sense making are beyond the scope of this paper. Interested readers might care to review the proposals put forward by Hevner et al (2013). However, the process of making sense is pertinent to the design, development and delivery of the Systems Analysis and Design course.

In addition to the concepts underpinning object oriented analysis and design tools and techniques such as Activity Diagrams and Behavioral State Machines, students are also introduced to the industry standard Universal Modeling Language (Rumbaugh et al, 2004) that is used to develop them. UML is taught using industry standard symbol sets and templates in Microsoft's Visio software suite. Thus the 'content' of the course and its learning outcomes comprise a tightly integrated mixture of cognate material and technical skills. The Systems Analysis and Design course is characterized by the 'multi dimensionality' of its learning outcomes.

Early on in the development of the on-line version of the course, accessibility loomed large as a factor critical to the success of the students. Unless they could 'access' the conceptual underpinnings of object orientation, they would be unable to effectively develop and share the various models that comprise the UML. Thus the access challenge is faced by students with a range of abilities, spanning mature, working students with decades of experience with structured methods, students new to the IS discipline as well as those with more specific disabilities.

Wallace (2003) identifies communication and interaction between students and instructors central to coaching the migration of mind and tool sets 'into' object orientation. This point is reinforced in the wide-ranging survey by Collins and van der Wende (2002): instructors who emphasized the delivery of content on-line found that there is 'not much in it' (on-line course delivery) for instructors. The need to coach the development of modeling skills persists, prompting many to abandon efforts to move to on-line and blended instructional methods and giving rise to instructional design inertia.

Such inertia is acknowledged by Kelly et al (2004), who note that the accessibility of e-learning presents additional challenges that may not be faced when providing access to other Web resources. We concur with their arguments that there is a need for a more sophisticated model for addressing e-learning accessibility which takes into account the usability of e-learning, pedagogic issues and student learning styles in addition to the cognitive issues discussed above and technical and resource issues. In the sections that follow we expand on these issues and propose a collaborative, holistic approach to the development of accessible e-learning resources through the application of the Quality Matters Accessibility Standard.

3. THE RESEARCH SETTING

The University of South Florida St. Petersburg (USFSP) offers a range of distinctive graduate and undergraduate programs in the arts and sciences, business, and education within a close-knit, student-centered learning community that welcomes individuals from the region, state, nation and world. We conduct wide-ranging, collaborative research to meet society's needs and engage in service projects and partnerships to enhance the university and community's social, economic and intellectual life. As an integral and complementary part of a multi-institutional system, USF St. Petersburg retains a separate identity and mission while contributing to and benefiting from the associations, cooperation, and shared resources of a premier national research university. The university's online learning is delivered through a learning management system; Canvas by Instructure.

The recent adoption of Quality Matters (Quality Matters, 2013), an online course quality management program, at USFSP has provided a set of specific standards that can be used to enhance the accessibility of courses. Quality Matters is a quality assurance program that facilitates a peer review process to recognize courses that follow best practices for design and promote student success in online education. Courses are reviewed using a rubric (Quality Matters, 2011) comprising a set of eight research-based standards for design, one of which is Accessibility.

4. THE COURSE DEVELOPMENT PROCESS

Kelly et al (2004) propose a conceptual model that advocates a holistic approach to e-learning accessibility. Figure 1 shows the conceptual structure they propose.

Figure 1 Holistic e-learning accessibility (after Kelly et al, 2004)

Within an encompassing emphasis on quality assurance, a number of course design, delivery and assessment criteria are identified. It is noteworthy that learner needs are central to the model: it is highly 'student centric'. It is also noteworthy that accessibility is given equal weight and prominence to aspects of course design that elsewhere tend to dominate.

Here, accessibility is seen as an equal and integral part of design and delivery as learning outcomes, technology infrastructure, usability and other factors. This multi-dimensional view of quality assurance provided a frame of reference for our efforts to operationalize the model – to balance emphasis on accessibility with other aspects of course design - as we considered the tools, techniques, standards and other guidelines available to us.

Quality Matters Standard 8 focuses on the Accessibility of online courses. "The accessibility standard incorporates the principles of Universal Design for Learning and is consistent with Web Content Accessibility Guidelines (WCAG)" (Quality Matters, 2011). Standard 8 encompasses four specific criteria that broadly outline the degree to which a course should be measured as accessible which includes employment of accessible technologies, guidance on how to obtain accommodation, alternatives to audio visual content, distraction reduced design, and compatibility with assistive technologies. Note that only the final criterion is 'limited' to those with specific disabilities.

As stated previously, we saw a holistic approach to accessibility as an agenda, and so throughout the development process, we used both sets of guidelines that QM Standard 8 is based on, UDI and WCAG, but in a pro-active manner, rather than merely 'following' them. We explored their complementarity as a means to fulfill their true intent and achieve the most technologically and pedagogically cohesive and accessible course possible.

Universal Design for Instruction (UDI) is a set of pedagogical principles that operate under the principle that, if you structure the curriculum with the appropriate supports and challenges, all students can learn (Scott et al, 2003) regardless of disability, age, gender, ethnicity, or other characteristics that might affect their learning. Dukes and Scott (2009) and the UDI Online Project at the University of Connecticut outline nine principles for achieving universally designed instruction for online and blended courses. The nine principles include equitable use, flexibility in use, simple and intuitive, perceptible information, tolerance for error, low physical effort, size and space for approach and use, a community of learners, instructional climate.

To better illustrate the UDI applications to the course design, the simple and intuitive principle can be seen in the course and module navigation. Upon entering the course, students encounter the home page which provides step-by-step instructions to orient themselves to the course and get started on the material: the left course navigation menu is reduced to display only the essential navigation options. This page and navigation structure is applied consistently in every course module. This element of our design benefits students who may have learning or processing disorders (visual and auditory); those who could be easily distracted by extraneous information; students who have physical impairments and may be using alternative computer access technologies for navigation, as well as students who have impaired vision and use screen reading technology to navigate the course. In addition to supporting this specific set of students with disabilities, streamlined navigation improves the usability and accessibility of the course for all students. Figure 2 shows the streamlined course and module navigation.

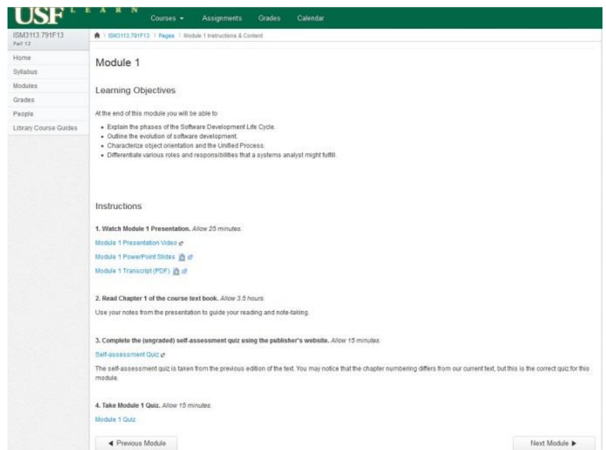

Figure 2 Example module navigation

Another UDI principle incorporated into this course that is of particular importance to the IS discipline was addressed through the inclusion of video and printable tutorials for the software programs required for the completion of practical assignments. Figure 3 shows an example of a video tutorial. Development of these assets allowed us an accessibility enhancement that was not achieved in the previous face-to-face iteration of this course. The inclusion of these tutorial materials meets the principle of tolerance for error. Students have 24/7 access to materials that can be retained and reviewed: the tutorials can be paced as needed so that, if they become stuck at any point in the process of completing the assignment, the student has immediate access to the instructions and visual demonstration. This enhancement has the potential to support students with learning disabilities that need to review information multiple times; it also provides support for students with visual or auditory processing disorders by providing access in video and written formats. It also provides support more universally: experience has shown that these exercises prompt the most questions for students. The conceptual complexity of the UML modeling tools, the modeling software and the concepts that underpin them accentuate the gap between the most and least able students. All have the opportunity to review the tutorial to 'answer' a quick question.

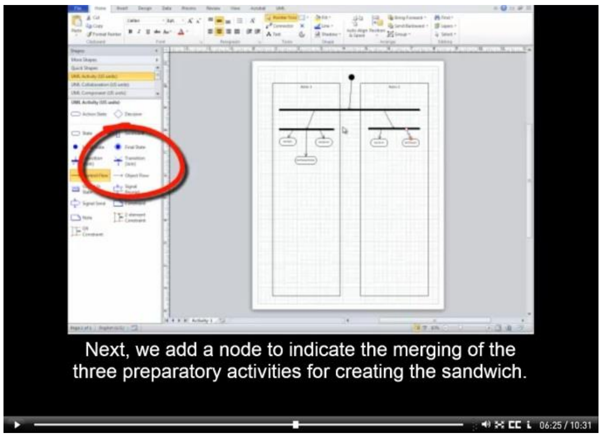

Figure 3 Closed captioned video tutorial

The second set of guidelines encompassed in QM Standard 8 is the WCAG developed by the World Wide Web Consortium. These guidelines strive to enhance technical accessibility to those students using assistive technology or needing alternative access to media elements to interact with the course. Following these guidelines makes content accessible to a wider range of people with disabilities and will often make Web content more usable to users in general (W3C, 2008). WCAG follows the POUR model of web design with four guiding principles to make the content Perceivable, Operable, Understandable and Robust.

One example of the WCAG applications within the course is the closed captioning and provision of transcript documents for all course videos. This meets the Perceivability principle to provide alternatives for non-text content and for time based media. Providing closed captions, which allows the students to turn captions on and off depending on preference and need, grants access to students who have hearing impairments, students with auditory processing disorders, and students with learning disabilities to aid in note-taking. Figure 3 gives an example of closed captioning for course videos. It also provides access to students who don't have disabilities, such as a student viewing lectures in a library or in a noisy environment as well as students who speak English as a second language. Providing the transcript document for the videos allows access to a more specific group of students, such as a student who may be deaf-blind and needs to convert the lecture into Braille format.

The idea behind the comprehensive incorporation of these two sets of guidelines is to create a course that is usable and meaningful to all students and, by building accessibility from the early stages in the process, to eliminate the burden on students with disabilities to arrange for accommodation and to the instructors to modify materials to meet the needs of those accommodations after the fact.

5. SUMMARY

The three examples in this case highlight the substantial benefits of adopting a more holistic view of the course development process and the opportunities that addressing accessibility issues present.

The range and depth of cognate materials in the SAD course - conceptual content of the UML techniques such as Class Diagrams; the complexity of the semantic toolsets used to create the various models and the complexity of the software environment (MS Visio) presents a substantial range of learning outcomes. Figure 1 above highlights that this range generates an equally wide range of accessibility issues.

Those issues can – and should – be seen as both opportunities and challenges. The 'multi-dimensional' learning that characterizes the SAD course presents opportunities and challenges that affect a wider range of students than classes with more traditional learning outcomes that span a narrower range. This is pertinent to both the range of student abilities *and* to their expectations. The learning outcomes for the SAD course require them to do much more than memorize material (Topi et al, 2010). Assessment of the learning outcomes for this course also increase the range of assessment techniques used.

Reflecting on the challenges that we and our students had faced when the course was delivered in a hybrid (blended) format presented us with an opportunity to anticipate and pre-empt those challenges. In turn, that enabled us to explore further opportunities to both improve and widen accessibility. Our experience shows that it is both more effective – more cohesive in terms of faculty and instructional designer time and effort – and easier to design with accessibility in mind from the beginning.

The importance of collaboration is a key factor not immediately evident from the work of Kelly et al (2010). In order to bring the model in Figure 1 into 'being', close collaboration was critical to the success of our endeavor. Without close collaboration, the issues raised by the conceptual richness that characterize the SAD course would not have been explored as fully. An open, two-way dialog provided the opportunity for faculty to realize opportunities to adapt materials and process for the wider benefit of all students, rather than merely respond retrospectively to the limited utility of their material for those with specific disabilities. Simultaneously, instructional designers realized opportunities to enrich other courses using media developed to address the complex, 'multi-dimensional' learning outcomes of the SAD course.

In its previous (hybrid) form, the major faculty emphasis was on the course learning outcomes and the maintenance of relevant and up-to-date materials to support them. This led to an imbalance of effort between the sectors of Figure 1: as a consequence, students who experienced difficulty – either as a consequence of a specific disability or simply the limits of their learning skills – were dealt with in an *ad hoc* fashion. Typically, faculty support was retrospective – prompted by notification of a specific need – and represented additional effort for both student and faculty.

Our experience provides useful insight for future course design. Adaptation of existing guidelines such as the QM rubric can provide comprehensive guidance that can be used to initiate changes in both form (instructional media) and practice (course development process). Rather than using them simply as 'check lists' to 'audit' courses, the guidelines can be used to actively bring faculty and instructional designers to a shared awareness of accessibility challenges and opportunities, highlighting their shared responsibilities. Figure 1 clearly infers the need for faculty, instructional designers and administrators to actively collaborate to optimize accessibility at universities.

We hope that this brief case has shown how such collaboration and (re-)defining roles and their responsibilities within the cyclic teaching, learning and assessment processes provides an opportunity to reconsider the timing of who does what in relation to accessibility, and at what points in course development, delivery and assessment.

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Computer Security Primer: Systems Architecture, Special Ontology and Cloud Virtual Machines

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Abstract

With the increasing proliferation of multitasking and Internet-connected devices, security has reemerged as a fundamental design concern in information systems. The shift of IS curricula toward a largely organizational perspective of security leaves little room for focus on its foundation in systems architecture, the computational underpinnings of processes and protection. Yet these architectural features are the foundation of systems security for all the layers above that they enable. They are also the prototypical mechanisms of protection that must be modeled throughout systems design to realize system security: confidentiality, integrity and availability. This paper presents a learning unit that proposes a special ontology of computer system architecture to explain computer security on the host-level and by extension the emerging standard security architecture of the cloud, the virtual machine. The ontology appears as a prose tutorial, a set theoretic model, and a two-page study reference that facilitates a security discussion ranging from host architecture to web-services. This treatment is a concise, self-contained module for standalone use or embedded in a systems course (analysis, modeling, design, database or systems architecture) where complete operating system or computer organization coverage may not be feasible.

Keywords: computer security, computer protection, special ontology of systems architecture, virtual machine, IS pedagogy

1. INTRODUCTION

The proliferation of multitasking personal devices and Internet-connected users thrusts security into the forefront of information system design considerations. Even casual computer users are beset with security concerns and must rely on the device and network designer for protection from violations of confidentiality, integrity or availability. Coincidentally, the shift of IS curricula toward a broader, organizational perspective on security leaves little room in curricula for a focus on the computational underpinnings of processes and protection that are the foundation of computer system security. (Topi, Valacich, Wright, Kaiser, Nunamaker, Sipior & de Vreede, 2010) These architectural features not only form the basis of systems security for all the system layers above them that they enable but, they also represent prototypical mechanisms of protection in organizational systems security. This computer security primer that follows offers an option to fill a curricular gap.

The primer begins with an abbreviated literature survey of the theory, policy and application of computer security as a context and a reading list for students who may wish to delve much deeper. Then follows the special ontology of systems architecture, a framework for explaining the role of protection in host computer security. That framework includes the protection provided by virtual machine architecture, the primary design platform for security in cloud computing. Finally there are some brief thoughts on applying the security primer as a learning unit in undergraduate curricula. The primer is a concise self-contained module suitable for use standalone or embedded in a systems course (analysis, modeling, design, database or systems architecture). Appendices provide a set-theoretic representation of the ontology and a two-page reference handout as a study guide.

2. WHAT IS COMPUTER SECURITY?

The model posed in (McCumber, 1991) has stood the test of time as the de facto definition for computer security (See Figure 1).

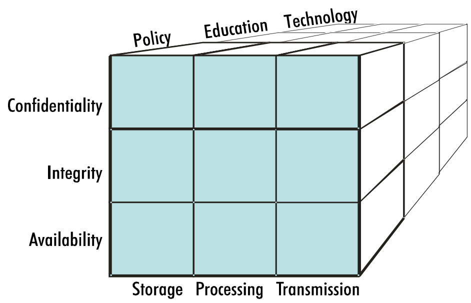

Figure 1 – IS Security Model: McCumber

Confidentiality, *integrity*, and *availability* express the trinity of properties that underpin virtually all the literature on computer security (Landwehr, 2001). The term computer security ranges over a large expanse of stakeholders, disciplines and theory often mediated by a particular stakeholder perspective. Those perspectives have shaped the security literature and settled into a layered decomposition of topics as indicated in (Bishop, 2003, p. 22). (See Figure 2)

Figure 2 – Hierarchic Model of Security

Much of the early attention to computer security focused on supporting governmental and military requirements for control of information. The seminal work casting security control in the formal, mathematical paradigm is (Bell & LaPadula, 1973). This multi-layered, military security policy addressing a four-tiered classification scheme (i.e. unclassified, confidential, secret, and top secret) received extensive research attention over decades focusing primarily on protecting confidentiality, the non-disclosure of sensitive information (Denning, 1976, McLean, 1985). Non-military or commercial asset concerns lean more toward integrity (the protection of information from loss or corruption). (Lipner, 1982) Denial-of-service (DoS) attacks exemplify attempts to compromise the availability property of security (Wikipedia, 2013). Information security is affected by social-economic factors that extend beyond the business stakeholders who directly interact with information systems. These indirect factors shape the motivations and often the response affecting security threats and influencing policy. In many instances socio-engineering efforts are preferable to expanded protection mechanisms. (Anderson, 2001)

Security modeling efforts reflect the desire to integrate security into design. (Basin, Doser & Lodderstaedt, 2006, Best, Jürjens & Nuseibeh, 2007) International standards for best practice in information security management emanate from ISO/IEC (the International Organisation for Standardization/the International Electrotechnical Commission. (ISO/IEC 27000, 2012)

3. A SPECIAL ONTOLOGY OF COMPUTER SYSTEMS ARCHITECTURE

The computer and information sciences adopt special ontologies to identify a domain of interest within which the elements of relevance may be defined and their relationships explored to demonstrate concepts or theories. The special ontology proposed herein is consistent with the practice in computer science and information science categorizing a domain of concepts (i.e. individuals, attributes, relationships and classes). (See Figure 3 below.) The ontology abstracts the elements of systems architecture pertinent to computer security at the design, implementation, and operations / maintenance layers of the security life cycle. This abstraction focuses on the security properties and relationships that are often obscured by idiosyncratic processor or process architecture implementations. (A somewhat more formal and concise exposition of the special ontology in its set theoretic form may be found in Appendix A.) (Waguespack, 1975, 1985)

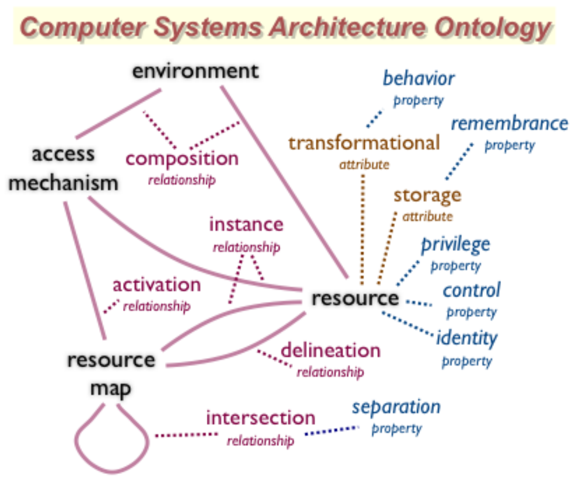

Figure 3 – A Special Ontology of Computer Systems Architecture

The reader is encouraged to envision resources at the hardware instruction set level in the descriptions that follow. Subsequently the exposition will expand that view to encompass all the layers indicated in the hierarchic model of security.

Individuals in this ontology are defined as *environment*, *resource*, *resource map*, and *access mechanism*. The *environment* is the union set of all other elements in a system and in fact defines the universe of interest and discourse as conceived by the stakeholders of the system. *Resources* encompass all the "namable" elements in the *environment* and thus are uniquely distinguishable, the property of *identity*. Two subsets of *resources* define the range and function of *resource* manipulation: 1) a *resource map* that *delineates* a resource subset called an *access scope,* and 2) an *access mechanism* that *activates* access to *resources* in an *access scope*.

Attributes characterize the individuals in the ontology. Storage resources exhibit the attribute of *remembrance*, the capacity to retain state information in the environment. Transformational resources exhibit the attribute of *behavior* operating on instances of storage resource to set, access, and/or modify state information. (The most common form of transformational resource is the machine instruction that interacts with state information sometimes accessing – sometimes modifying the state. In this special ontology state changes result exclusively through the behavior of transformational resources.)

Relationships define the interaction / interdependence of individuals in the special ontology. The environment is the *composition* of all resources. Both access mechanism(s) and resource map(s) are *instances of* resource. The relationship between a resource map and the set of all resources is the *delineation* of a subset of those resource instances, an *access scope*. The relationship between two resource maps defines an *intersection* of their access scopes. An intersection that is the null set defines the *separation* property of that intersection. The application of an *access mechanism* to a pertinent resource map *activates* an *access scope*. (It may be preferable to say an access mechanism *actuates* an access scope since resource *behavior* may be more naturally understood as animation or activity.)

An access scope may include instructions (transformational resources) and/or storage. The quintessential example of transformational resource activation is the application of the mechanism of *instruction execution cycle* to an access scope delineating an otherwise inanimate collection of instruction specification fusing their association into an executing *process*. Storage resources in the access scope remember the instructions, which one is current and the residual state at each instruction's completion.

A common example of storage activation is a virtual memory mechanism. The physical memory pages enumerated in a process's page table delineate its access scope of storage. Swapping activation from one process to another occurs by replacing the page table entries for one process by those of another process. (Saltzer & Schroeder 1975: p. 1286)

Classes distinguish resources whose function in the environment engenders control. Since all "activity" in an environment results from the application of an access mechanism to a resource map, those two specific resources jointly realize the instrument of "animation," the progression of state changes or "execution." Any resource that effects the initiation, sequencing, alteration or suspension of "animation" exhibits the property of *control*. Access to a process's resource map denotes the opportunity of controlling that process. Detecting attempts to access control resources is a key to managing computer systems security. This is the purpose of the *privilege* property in designating resources susceptible to potentially harmful application.

4. HOST PROCESS ARCHITECTURE

This section describes some common design choices found in contemporary computer systems. They illustrate how the special ontology describes a specific process execution environment. In most computing literature the unit of animation, execution, in a computer system is called a *process* and the environment in which the process executes is called the *host computer, host machine* or *host* (reminiscent of calculating machines). (A generous survey of computer architectures and their properties is found in (Blaauw & Brooks, 1997)).

Mono-processing is the execution of only a single process on a host. Process animation results from the association of access mechanism with resource map – the instruction execution cycle, a collaboration of resources combining state information with transformation. The state information specific to execution is delineated in the *process status vector* (psv) that indicates residual state information: (e.g. conditional comparison flags, error conditions, and what the next instruction to execute should be, etc.). Each instruction execution occurs in the state of the machine resulting from the previous instruction's execution, hence a "cycle." The psv also delineates the subset of storage resources accessible by the process. The psv realizes the special ontology's resource map delineating both the transformational and storage resources accessible by the process. (As indicated in the set theoretic ontology description in Appendix A, it is also common for the resource map to be realized as two discrete elements: one focusing on instruction execution and a second mapping the accessible storage space.) In the common case where external resources exist (i.e. input/output devices, networking), their design may be treated as additional namable resources. (An example of such a connection is the mapping of I/O interfaces as storage locations in the DEC PDP11 UNIBUS configuration.) (Blaauw & Brooks, 1997: p. 967)

Multiprogramming occurs in the presence of more than a single process residing on one host. Although there are multiple processes, there may exist only a single instruction execution cycle that is shared (by multiplexing) among them. This processing protocol requires a managing process usually called an operating system (OS) that includes supervisory and service components arranged as a collection of agent processes. These agents manage the association of the instruction execution cycle with the various processes one at a time. (The protocol for delegating execution among the various processes is called process scheduling and may be based upon various priority schemes to manage the progress of the individual processes respectively.) The agents may themselves be processes – each with its own resource map.

What distinguishes a process that is an OS is the privilege of an access scope including any and all host resources. Where the resource map of a non-OS process is denoted psv for process state vector, the resource map of an OS process is denoted csv, control state vector. The distinction highlights the OS as *in control* of the entire host.

A control resource is one that permits a process to assign the instruction execution cycle to a particular process or to access/modify the resource map of a process, including itself. The most common mechanism for enforcing the OS's prerogatives (privileges) is the *interrupt* that extends the behavior of the instruction execution cycle and permits the OS to gain access to the instruction execution cycle at will.

The normal course of the instruction execution cycle proceeds with each succeeding instruction determined by the current process's psv (i.e. the process's execution continues without interruption.) An *interrupt* mechanism is the detection and response to a condition signaling the need for a departure from the current sequence of execution (suspending the current process) and designating execution of the next instruction in a different process (activating another process). In a nominal OS design the interrupt would cause the sequence of instruction execution to transfer to an agent of the OS called the *interrupt handler*. Once an interrupt handler is activated its instructions determine the system's ensuing behavior. The result is a transfer of the sequence of instruction execution from the interrupted process to another, a *process swap*.

Interrupts are designed to support a variety of supervisory tasks. Interrupts may occur due to: external signals (i.e. input/output connections), execution exceptions (i.e. erroneous instruction specifications), attempts to access resources designated as privileged, access exceptions (i.e. attempts to access resources not delineated in the process's resource map), or solely to relinquish the instruction execution cycle. The interrupt mechanism's design incorporates state information (i.e. psv) to designate the precise process swap behavior (e.g. what state information is to be set in the suspended process). Hence, the psv is (in itself) a control resource. Whether or not interrupts are enabled or suppressed in the current process and which process is to be activated in the process swap is indicated in the csv, hence these are controlled by the OS.

Multiprocessing differs from the multiprogramming protocol in that more than one instruction execution cycle resource is available to associate with the processes present on the host. Multiple processes may concurrently execute their instructions. Each instruction execution cycle must manage a separate interrupt protocol. Individual process management in the presence of multiprocessing is not significantly different from multiprogramming unless concurrently executing processes are allowed to communicate and/or share resources. In which case inter-process communication and sharing require addition supervisory services that monitor and mediate process interactions.

5. OS AND PROCESS SECURITY

Monoprocessing is the least complex form of process management. It depends exclusively on the process's fidelity of programming to its specifications. The primary threat is programming error. (A monoprocessing system often includes OS services to offload I/O or job-scheduling tasks from individual processes. It earns trust from the quality assurance it receives. Regardless, any error in programming can compromise the system.)

Multiprogramming requires an OS that shares its attention with more than one process. Where the OS protects itself from the user process, it now must also protect user processes from the misbehavior of one another. *Encroachment* is the unauthorized access of one process's resources by another. Encroachment occurs due to errors/malice among the cohabitant processes.

Although the added instruction execution capabilities in a multiprocessing environment make resource management and coordination among processes more complicated, the basic principles of process closely resemble multiprogramming.

Separation is the major protection mechanism in a multiprogramming environment – to prevent the undesirable behavior of one process from causing the failure of or undue interference with the other processes. *Separation* is achieved by: 1) devising resource maps that delineate resources according to process, and 2) enforcing *complete mediation* where each access mechanism enforces adherence to its delineated resources by prohibiting unsanctioned access and, usually, by raising an interrupt condition when an attempt occurs (Bishop, 2003, p. 345). Effective separation eliminates the risk of encroachment.

Privilege denotes the supervisory authority of an OS to control the resources of individual processes. The supervisory functions of the OS (the *kernel* or *nucleus*) exercise *control* over every process in the system. Complete mediation also controls the number of consecutive instructions that a process may execute (based on either a real or virtual "clock," as prescribed in host csv). That prohibits any process from monopolizing the instruction execution (e.g. the infinite loop!). The OS kernel protects itself by managing the csv of the host to retain *control* over every process while at the same time it remains *separated* from all processes on the host except itself – a *secure operating system*.

6. VIRTUAL MACHINES IN THE CLOUD

The monoprocessing environment is the least complex and therefore, the most easily quality assured – trustworthy. That explains the growing preference for multiprocessing virtual machines as the security framework for cloud computing. (Rosenblum & Garfinkel, 2005)

A virtual machine is an execution environment in which the process that executes cannot determine if it resides on a (physical) host machine or is a "guest" on a simulation of that host. Each guest process can be treated as the sole process on that virtual machine. A layer of supervisory software, the virtual machine monitor (VMM), manages the execution environment of each guest by configuring the resource maps and the interrupt behavior of the access mechanisms to intercept any guest attempts to directly access control resources. When a guest needs access to resources that might compromise "safety," that access must be mediated by the VMM through a *reference monitor* that simulates the process's resource access by virtualizing that resource while protecting the VMM's control of the host. These protocols rely on *control* and *access mechanism* design. (Smith, J.E. & Nair, R., 2005)

Self-virtualizable: When a virtual machine appears identical to its underlying host, it can provide direct access to the exact same instruction set and access mechanisms of that host. We call this host architecture *self-virtualizable* because it can provide a complete replica of itself for guest process(s). (Waguespack, 1985) A guest process may execute at the same level of efficiency as it would if it were the sole process on the underlying host except for those resources that must be virtualized to maintain the VMM's control.

Host hardware design decisions make virtualization straightforward or complex. (Garfinkel & Rosenblum, 2005) Process control protocols prior to the advent of virtual machines focused primarily on facilitating a host-based OS's capacity to maintain control. Design decisions for processor hardware architecture did not always support *complete mediation*. When host instruction set designs include instructions that access control resources but are not designated as privileged they do not raise interrupt conditions even when executed in a process without privilege. There are two options that support virtual machines on these hosts. In one approach the VMM pre-scans all the process's instructions before execution and replaces "unsafe" instruction sequences with "safe" instructions – usually including instructions that do cause interrupts to allow the VMM to intercede and simulate the indicated service. Alternatively, the VMM simulates all instructions running on the virtual machine; an approach that results in a dramatic reduction in effective execution speed since simulation is orders of magnitude slower than direct host hardware execution. (Complete simulation is the common approach used to execute Java code. (Lindholm, Yellin, Bracha, & Buckley, 2013).)

The most efficient virtual machine realization requires that all control resources include the privilege property with appropriate interrupt conditions to allow a VMM to enforce complete mediation. Secondly all resource access attempts that would otherwise be directed to "hardware resources" (i.e. I/O and communication devices) need to be intercepted allowing the VMM to virtualize those resources through reference monitors. This combination of intercession provides the maximum guest performance with the minimum of VMM overhead.

Multiple OS's: The earliest implementations of VMM technology supported guest processes that themselves were OS's, guest OS's. The ability to run multiple versions of OS concurrently on the same physical host provided flexibility and cost savings. In the description of process swapping and control above the key resource designating process activation is the process state vector. (Waguespack, 1985) The privilege of designating which psv(s) is active determines control over the entire environment. Each virtual machine environment is a simulation of the physical host and thus as these guest OS's manage the processes that reside on them the OS's believe they are controlling the host. But their "control" is virtualized by the VMM with virtualized csv access. The VMM manages the VM's as its processes retaining control over all the physical host resources. This permits a multi-layered arrangement of virtual machines some supporting mono-processing, others supporting multiprogramming OS's and finally some supporting replicas of the VMM itself telescoping the illusion of host environment layer after layer limited only by physical of performance and resource virtualization capabilities.

Security through virtualization: Virtual machines provide a convenient architectural foundation for security. Each guest process (or virtual machine) resides in a naturally separated execution environment. Complete mediation through VM instruction execution and virtualized resource access facilitates connectivity beyond the boundaries of the virtual machine, but only through contractually defined protocols, VMM mediated services. (Garfinkel & Rosenblum, 2005)

Although initially virtual machines were intended to support concurrently executing OS's on a single host, guest VM's may also be VMM's in their own right. Such an arrangement permits a hierarchically encapsulated progression of secure execution environments. Virtualization enables sharing and protection protocols administered through complete mediation that both enables and structures security. VM architecture is the basis of cloud computing. VM's make possible the protections and scalability of system security in the cloud. (DeKeyrel, Waldbusser & Jones, 2012)

7. CONCLUSION

Security is an essential topic in IS education today. But, finding room for it in an already crowded curriculum is a challenge. The "shrinking real estate" for technical content in IS curricula will continue to require compactly designed primers (similar to this one on computer security structures) if our IS graduates will have any practical grounding to discern credible information systems capabilities and performance potential.

This primer addresses the key architectural security issues concisely. The primer is a useful pedagogical foundation for computer, network and Internet security discussions. It is suitable for embedding in a generic systems, networking or business process course for upper level undergraduates or graduate IS or MBA students. Teachers may use it as a survey, tutorial or as an outline for a student research project. It is appropriate for either an individual or a comparative system security study. The special ontology is applicable to the full range of computing architectures from Turing and von Neumann through the DEC, Cray, IBM, Motorola and Intel generations – as well as architectures of loosely coupled processors (e.g. the World Wide Web). (Turing, 1936, Bell & Newell, 1971, Blaauw & Brooks, 1997)

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Editor's Note:

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Appendix A – Set Theoretic Representation of the Special Ontology (Waguespack, 1975, 1985)

E → environment"→" reads "…is defined as…"

S → storage resources (all state information)

T → transformational resources (all computation capable of modifying the state)

E → {T, S} (all transformational and storage resources)

M → a machine, {Tm, Sm}, (i.e. M ⊆ E)

tb → the "map" delineating an access scope of transformation resources

[] → a mechanism (function) to access a resource access scope

T[]tb → a resource subset of T defined by tb (i.e. T[]tb ⊆ T)

sb → the "map" delineating an access scope of memory/storage resources

S[]sb → a partition of the resource S defined by sb (i.e. S[]sb ⊆ S)

{tb, sb} → {eb}; environment base: a composite access scope

E[]eb = {T[]tb, S[]sb} a program is a specification of transformational and storage resources

psw → the process status word of a program (process not yet initiated)

psv → the process status vector (word) as "idle" or suspended process

⧖ → the transformational resource that executes instructions in a process

⧖ (psv) → the process state word of an "active" program under execution

{T[]tb, S[]sb, psw} → an "idle" program (not yet initiated)

{T[]tb, S[]sb, psv} → an "idle" process (having been initiated but not currently active)

{T[]tb, S[]sb, ⧖ (psv)} → an "active" process currently executing

CSV → the control state vector enabling the control of a machine

Sm → all the memory/storage of M

Sm[]uj → the storage of M accessible by user j

Sm = {Sm[]csv, Sm[]u1, Sm[]u2, Sm[]u3, ... }

Sm[]csv → the storage that contains/accesses the CSV of M

Sm[]psv → the memory/storage that covers/accesses the PSV of a process

Sm[]u → {Sm[]csv ∩ Sm[]u = ∅ } the memory/storage not including the CSV of M

Tm → instruction set of M

Tm[]c → instruction set of M that can control M (also named C)

Tm[]u → { Tm - Tm[]c} (non-control) "user" instruction set of M (also named U)

E[]csv → {Sm[]csv, Tm[]c} the control state vector of E that designates "control" of E

{ E[]csv , ⧖ (csv)} → the "active" process that controls the entire environment, (e.g. VMM)

Appendix B – The Computer Security Green Card

Computer Systems Architecture and Security

Without a Language or Syntax!

What is computer systems security world all about?

Special Ontology of Computer Systems Architecture

This ontology is consistent with the practice in computer science and information science categorizing a domain of concepts (i.e. individuals, attributes, relationships and classes). This ontology is based upon a set-theoretic model of computer system resources defining the architectural elements of information systems characterized by executable program code and accessible storage resources. The ontology identifies the elements of a computerized information system and their relationships relevant to the definition and protection of resource security – *the state of being free from danger or threat.*

1. Individuals

A ***resource*** is a distinguishable element within the domain of discourse concerned with security. An ***environment*** is a stakeholder prescribed domain of interest defining the context and relevant elements of security concern; it is the set of all resources under consideration. A ***resource map*** is a specification of some subset of the *environment*. An ***access mechanism*** is an executive agent that effectuates *behavior* and/or mediates access to *resources* specified by a *resource map*.

2. Attributes

Each *resource* in an *environment* is uniquely distinguishable, the ***identity*** property. Each ***resource*** is either ***storage*** (the object of some behavior) or ***transformational*** (the instrument of some behavior). *Storage* resources exhibit the property of ***remembrance*** as they are associated with a value which may be retrieved or modified only through access to the *storage resource* itself. A *transformational resource* exhibits the property of ***behavior*** that acts upon a *storage resource* to modify its value (effect a change of "state").

3. Relationships

Relationships exist on two dimensions: behavioral and structural.

3.1. Behavioral Relationships

3.1.1. Activation

The application of an *access mechanism* to a *resource map* is an ***activation,*** resulting in animation within an *environment;* realizing behavior and any corresponding state changes. Any and all access to *resources* is realized through the application of an *access mechanism* to a *resource map*. The animation (or activity) realized by the composition of *access mechanism* to *resource map* is called a ***process*** or a ***thread.***

3.2. Structural Relationships

3.2.1. Composition

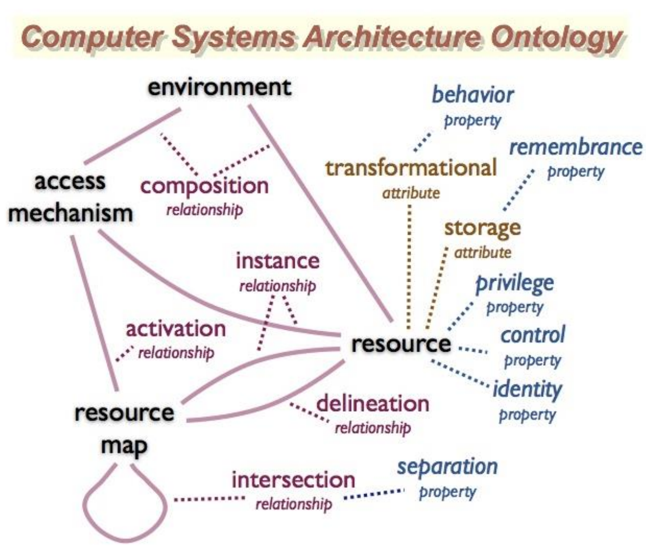
An *environment* is the composition, the union, of all *resources*, both *storage and transformational resources* (including all *access mechanism(s)*).

3.2.2. Instance

A *resource map* is an instance of *storage resource*. *Access mechanism* is an instance of *transformational resource* effectuating *behavior*.

3.2.3. Delineation

A *resource map* ***delineates*** a subset of resources called an ***access scope***; thus determining what storage resources are accessible and/or what behaviors are possible through *transformational resources*.



3.2.4. Intersection

Access scopes ***intersect*** if they share access to the same *resource*. The ***separation*** property denotes the absence of the *intersection* of accessibility. *Process* X is said to be ***separated from*** *Process* Y if the *resource map* of *Process* X is not delineated in the *access scope* of *Process* Y. If the *intersection* of two *access scopes* is null then they are said to be mutually ***separated***.

4. Classes

Resources enabling *activation* compose the class of ***control*** resources. All *resources* fall into either the class of ***control*** or ***non-control*** *resources*.

5. Security Apparatus

In the context of computerized systems, security is the state of being free from danger or threat ascribed to a stakeholder(s) whose interests are invested in the system behavior. That vestiture takes the form of agency – behavior within the system carried out on behalf of a stakeholder(s). Security breach includes disruption, incursion, or the hijacking of resources.

5.1. Process

A ***process*** results from *activating* the combination of the *transformational* and *storage resources* in its *access scope*. A *process* realizes behavior as the agent of a stakeholder(s). The ongoing application of host *access mechanism*(s) to a *process*'s *resource map*(s) denotes an ***active process***; withdrawing the host *access mechanism*(s) yields a ***suspended process***.

5.2. Process Control

Process Control refers to regulating *process* behavior (initiating, sequencing, suspending, and/or terminating behavior). *Process control* is effected through the manipulation of *access mechanisms* and/or a *process's resource map*. Process X is said to *control* Process Y if the *resource map* of Process Y is in the *access scope* of Process X. *Separation* precludes *process control*.

5.3. Encroachment

Encroachment (also called ***access violation***) is an access within a process's *access scope* by unauthorized *process*. *Process* X *encroaches* on *Process* Y if it accesses *Process* Y's *access scope* without *Process* Y's intentional cooperation.

5.4. Secure Process

Process X is ***protected from*** *Process* Y if *Process* X *is separated from Process* Y. A ***secure process*** is a *process* that *is separated from* all other *processes* in an *environment* and thus is free from danger of *encroachment.*

6. Operating System Principles

A ***host*** (sometime called ***machine***) is a computer architecture upon which a *process*(s) executes. An ***operating system*** is a collection of *processes* that *controls* and extends the native *resources* of a *host* architecture to facilitate one or more *processes* other its own. The *host* architecture may be physical or virtual.

6.1. Nucleus

The ***nucleus*** (sometimes called a ***kernel***) manages the *host resources* specific to *control* of the *host* realized as two functions: *interrupt handlers* (managing the instruction execution cycle) and *reference monitors* (mediating access to resources).

6.2. Secure Operating System

A *secure operating system* is a *secure process*(s) on a host with *control* of all *processes* on that *host* including itself.

6.3. Virtual Machine

A *virtual machine* is an execution environment in which any *process* that executes cannot determine if it resides on a (physical) *host* or on a simulation of that *host.*

6.4. Virtual Machine Monitor

A *virtual machine monitor* is a *nucleus* supporting *processes* that are themselves "guest" *virtual machines*. Each VM may either a single *process* or *operating system* managing multiple *processes*.

6.5. Self-Virtualizable Host

A *self-virtualizable host* supports *complete mediation* in the application of *access mechanisms* to *control resources* thus enabling a VMM to maintain its *control* as a *secure operating systems* and intercede by mediating "guest" access to virtual resources while allowing direct, benign access to native resources. A *self-virtualizable host* offers *virtual machine* efficiency comparable to that of the *host* for all unmediated *process* behavior.

Different Keystrokes for Different Folks: Addressing Learning Styles in Online Education

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Abstract

Online learning has become increasingly popular in recent years. This interest in online education has brought about new learning opportunities for both educators and learners. Technology has enabled higher education institutions the ability to provide quality education reaching learners that might otherwise be impossible. When developing online classes it is important to keep in mind the different types of learning styles. In this paper the VAK Learning Styles (Visual, Auditory, and Kinesthetic) were addressed. The authors also provided practical guidance for implementing the VAK model by reviewing several free online tools that can assist with building online learning experiences that address each learning style.

Keywords: online education, online learning, learning styles, teaching, e-learning

1. INTRODUCTION

Online learning has become increasingly popular in higher education in recent years. In 2013, the number of students in the United States taking at least one online course grew to 6.7 million, making the proportion of all U.S. students taking at least one online course an all-time high of 32% (Allen & Seaman, 2013).

A learning style is the way a person prefers to learn (Grasha, 1996). There is a rich body of literature surrounding the study and implementation of learning styles in face-to-face instruction (Kolb, 1984; McCarthy, 1987; Fleming & Mills, 1992; Gardner, 1993; Lawrence, 1993; Felder & Brent, 2005), and the benefits provided to learners when given opportunities to use their preferred learning style. However, there is a gap in the literature regarding practical methods for addressing learning styles in online instruction. Online learners do not have the face-to-face experience of the traditional classroom where they can often see and hear the interactions of the professor and other students, so in many cases, the online learning experience can seem very isolating. In this regard, it is arguably even more important in an online learning environment to address the learning styles of all types of students in order to help each student have the optimal chance to succeed in the course. Student learning styles should be taken into account during the instructional design of online courses (Zapalska & Brozik, 2006).

Zajac (2009) goes so far as to suggest that the future of online education may lie in the ability to choose not only the time and place of learning, but also the ability to personalize the forms and methods through which the learning content is delivered. This would allow students to self-select methods of online instruction that appeal to their own particular learning styles.

A variety of learning style models have been proposed since the 1980s. The authors will give a brief background of some of the more prominent learning style models, and will then focus on the popular VAK (Visual, Auditory and Kinesthetic) Learning Styles. While learners may have overlapping learning styles, most people will have a dominant style falling into either the visual, auditory, or kinesthetic categories. Each of these categories will be described in detail and related to the online learning experience.

In addition, the authors will then provide practical guidance for implementing the VAK model by reviewing several free online tools that can be utilized to build online learning experiences that address each learning style.

2. LEARNING STYLES

Background

Learning styles have been defined by educators in a variety of ways. Kolb (1984) defined a learning style as the process by which an individual retains new information or skills. Kolb (1984) developed an experiential learning style theory, comprised of four stages: getting involved in concrete experiences, reflective observation of the new experience, developing a new idea with an abstract conceptualization based on reflection, and active experimentation with the new idea.

McCarthy (1987) built upon Kolb's approach and developed the 4MAT model, identifying four different types of learners. The Type One learner performs imaginative learning with a focus on making connections. Type Two learners use analytic learning, focusing on formulating ideas. Type Three learners utilize common sense learning and focus on applying ideas. Finally, Type Four learners use dynamic learning, with a focus on creating original adaptations and learning by trial and error.

Until the 1980s, intelligence was primarily measured by I.Q. tests, and individuals who scored higher on these standard tests were considered to be more intelligent than others. Intelligence was, in fact, considered to be a single factor that was inherited and thus, unchangeable. The work of psychologist Howard Gardner (1993) challenged this notion, as Gardner believed that traditional I.Q. tests only measured the analytical portion of human intelligence. Gardner initially proposed seven ways through which humans could show intelligence, and later added an eighth, together comprising his paradigm-shifting multiple intelligences theory (Smith, 2008).

The eight intelligence areas that Gardner (1993) defined included:

1) Linguistic intelligence – sensitivity to the sounds and rhythms of spoken words as well as the meaning of words, written language, and the ability to use language effectively.
2) Logical-mathematical intelligence – the ability to detect patterns, think and analyze problems logically, and perform deductive reasoning.
3) Musical intelligence – the ability to compose, perform, or appreciate musical patterns, recognizing rhythm, pitch, and tone.
4) Bodily-kinesthetic intelligence – the capacity to use mental ability to coordinate movement of the body and to handle objects skillfully.
5) Spatial intelligence – the ability to perceive the visual world accurately and recognize spatial patterns.
6) Interpersonal intelligence – the capacity to discern the motivations, temperaments, intentions, and desires of others.
7) Intrapersonal intelligence – the ability to understand one's own feelings, motivations, fears, strengths, weaknesses, and behaviors.
8) Naturalistic intelligence – the capacity to recognize and categorize features of the world around us, understanding and drawing upon nature.

The theory of multiple intelligences has been widely used in the field of education, especially in the United States (Smith, 2008).

VAK/VARK Learning Styles

Over the years, Gardner's (1993) work on multiple intelligences has been filtered by the education community into a focus on three types of physiological learning styles. The VAK theory of learning styles derives its name from the three types of learners that it describes – visual, auditory, and kinesthetic. In recent years, the VAK learning styles have become quite popular, perhaps due to their simplicity.

Visual

Visual learners perceive information best when viewing (spatial) or reading (linguistic). Linguistic visual learners retain information better when reading the written word, while spatial visual learners tend to understand concepts more fully when they are presented as graphs, charts, pictures, or videos (Clark, 2000). Visual learners retain information from pictures, displays or how words appear on a page or chart.

Auditory

Auditory learners respond best when presented with learning material that they can listen to or discuss, and often read aloud or move their lips when reading (Clark, 2000). They tend to learn more through verbal instructions, lectures, or group discussions and by talking aloud as much as possible. To help with retention, the auditory learner prefers studying in a group and putting hard to remember items into a song or rhyme. For instance, in 1492, Columbus sailed the ocean blue.

Kinesthetic

Kinesthetic learners respond best when presented with situations where they can move, do, or experience something, and can lose concentration after long periods of no movement. They may use color highlighters to organize thoughts and take notes by drawing diagrams or pictures. Subsets of kinesthetic learners are actually tactile rather than kinesthetic, meaning that they learn best through handling or touching (Clark, 2000). These two categories, kinesthetic and tactile, are often grouped together. The authors will consider the kinesthetic learning style as inclusive of tactile learners, meaning that persons with this learning style will learn best by moving, doing, experiencing, handling or touching. Kinesthetic learners prefer hands-on activities in which they stay actively involved in the learning process.

Similar to the VAK Learning Styles, Fleming and Mills (1992) developed the VARK Learning Styles, consisting of visual learners, auditory learners, reading/writing learners, and kinesthetic learners. The addition of the reading/writing category to the VAK model addressed a distinction that Fleming found in visually oriented students, where some students clearly preferred the written word while others had a distinct preference for charts, graphs, or other symbolic representations (Fleming & Baume, 2006).

The VAK/VARK Learning Styles are often considered together and some authors describe subcategories within the VAK Visual Learning Style category to address linguistic versus spatial learners (Clark, 2000), which is comparable to the reading/writing learning style in the VARK model. The authors will utilize the more popular VAK Learning Styles model for further analysis in this paper.

Determining Learning Style

According to Pashler et al. (2008), learning styles refer to the view that different people learn information in different ways. Assessments of learning styles tend to ask people to evaluate information on the basis of preference. For example, does the person learn more from listening versus viewing pictures versus completing an activity? It is important for instructors and students alike to recognize their own learning styles. Instructors tend to structure lessons around their own learning preferences; awareness of this tendency could help instructors to plan lessons to purposefully appeal to a variety of learning styles.

Several learning style tests have been developed to help individuals recognize their learning styles. These tests are used to determine how learners process information so that they develop strategies to enhance their learning potential. Example questions from the learning style tests are:

1) I prefer classes in which the instructor:
   a) lectures and answers questions
   b) uses film and video.

2) To remember things best, I would prefer to:
   a) create a mental picture
   b) write it down.

If you would like to take a test to determine your learning style, please follow this link:

http://www.personal.psu.edu/bxb11/LSI/LSI.htm

3. RELATED RESEARCH

When developing classes for online education it can be very helpful to consider the different types of learners. Educators need to be aware of how students acquire and retain skills and information to help their progress. It can be expected that when different methods of learning are available, student acceptance of the information will be improved (Manochehr, 2007).

Bonk and Zhang (2006) introduced the R2D2 model for adapting online instruction to accommodate student learning styles. The model name, R2D2, stands for Read, Reflect, Display, and Do. The model was chosen specifically as a mnemonic device that would be easily memorable (due to its connection to the Star Wars movies), thus enhancing the probability of its use. The Read component of the model includes reading, listening, and knowledge acquisition and addresses students who are primarily verbal or auditory learners. The Reflect component asks students to reflect, typically in writing, on what they have learned or observed. It focuses on students who are observational learners. The third component, Display, focuses on visual learners and has students represent what they have learned through visual depictions or symbols. The final component of the R2D2 model, Do, focuses on kinesthetic learners who prefer hands-on experiences. It involves having students apply what they have learned through building or experimenting with what they have learned in a hands-on setting.

Manochehr (2007) conducted a study to investigate the impact of e-learning on student knowledge-based learning styles. In addition, the study also attempted to provide evidence that e-learning is more effective for those with a particular learning style. The study used Kolb's learning style model to measure the learning styles of students. Kolb's model (1984) consisted of four styles, the Assimilator (learns best through lecture, papers and analogies), the Converger (learns best through hands-on labs and field work), the Accommodator (learns best through simulations and case studies) and lastly the Diverger (learns best through brainstorming). The results of the study revealed that the Assimilator and Converger did better in e-learning methods, while the Assimilator and Accommodator performed better in traditional learning environments. In other words, those who learn better through brainstorming, watching and doing perform better in e-learning classes.

Kolb's learning style theory was tested by Esichaikul and Bechter (2010) to determine if there are differences between the learning types; Accommodators, Divergers, Assimilators, and Convergers in regard to online learning. Findings revealed that differences between the four learning types exist when students post to discussion boards, use communication tools, and in regard to problem solving. Divergers, compared to Convergers, prefer to challenge a point of view in the discussions and tend to ask the teacher for help. In contrast, Convergers prefer to analyze data and put things into a model framework. In regard to using learning tools in the classroom, Accommodators exchange email as a communication tool and tend to relate things to their own experiences. Assimilators like to have offline discussions via phone or personal meetings and introduce new perspectives into the discussion boards.

Zapalska and Brozik (2006) identify several teaching strategies for online instruction that take the VARK learning styles into account. Their first suggestion is to provide content in a variety of formats such as including audio narration with a PowerPoint presentation, as well as a written transcription of the audio. Their second suggestion is to build the online course environment so that it provides a hierarchical structure, but also allows students to have control with the ability to move through topics in random order. Their final suggestion is to encourage active collaboration between students, with both individual and group activities required for the same course.

Zajac (2009) investigated the possibility of providing methods for personalizing course content delivery within a virtual learning environment. The author suggests that a learning styles questionnaire be integrated into the online classroom, so that students can self-assess their own personal learning style. Then, students would be able to choose from a variety of course delivery methods aligned with their determined learning style.

While this handful of studies has addressed learning styles in relation to online education, there is clearly a need for further research. In particular, the technology tools that are available to assist with instructional design continue to evolve at a rapid pace. It may be helpful for instructors to incorporate new technologies into the classroom. The next sections will address some of the newer technology tools that are available to create learning experiences for each of the of the VAK learning styles. The tools mentioned in the next section are all freeware which can be accessed and used in the classroom at no charge to the educational institution.

4. TOOLS FOR VISUAL LEARNERS

This section will review free online tools that can be used to enhance online teaching in ways that appeal to the visual learner.

Mind Mapping

A mind map is a type of diagram that is used to represent ideas and relationships between those ideas. Mind maps are often used to help formulate and organize ideas or concepts to help in solving problems, organizing writing, or making decisions. Mind maps are also becoming a popular way for students to take notes and organize ideas. The diagramming approach is very appealing to students who tend to be visual learners.

In online education, mind maps can be useful tools for both the instructor and the student. Instructors might consider developing mind maps of concepts in addition to traditional written descriptions or lists in order to provide another dimension for concepts and appeal to students with visual learning tendencies. These mind maps could be displayed alongside lecture notes or presentation slides within the online learning environment. Students in an online course could also be asked to reflect on reading and develop a mind map of the concepts that they've learned. This could be done individually or as a group activity.

There are a variety of commercial and free mind mapping software tools available for installation on your computer. However, WiseMapping.com is a free web site that allows for the creation of visually appealing mind maps directly through a web-based interface. Students can collaborate on mind maps as well by sharing them with others, which is ideal for the online learner. You can try WiseMapping without a login to see if it may be useful for your purposes here: http://app.wisemapping.com/c/maps/3/try.

Screencasting

Screencasting is the process of recording your computer screen while you complete a task, often with audio narration or on-screen text-based narration, as a short video. In online education, screencasting can be an excellent tool for the visual learner, as well as the auditory learner if narration is provided. It is especially well suited to explaining "how-to" concepts in using computer software, performing tasks on the Internet, or other visually-oriented tasks that can be displayed on-screen. The ability to show and explain something in a video is often more effective for these types of tasks than attempting to explain what to do or where to click in written text. It is one of the situations where a picture is truly worth a thousand words.

In education, there are also other benefits to screencasting. If an instructor records a screencast video for a variety of tasks that students need to understand in the course, they have effectively provided not only a lecture, but a resource that can be reviewed by students over and over again until they understand the concept. For traditional lectures, some instructors might find that recording an entire lecture-length screencast is useful for their students. The authors have found through personal experience that screencasts of a technical how-to nature are most effective when they are recorded as short videos of five minutes or less. For example, programming or software tasks can be broken into small pieces and each recorded separately. These shorter videos seem to appeal very much to students, as they do not have to necessarily devote 30 or 60 minutes to watching a lecture but can get right to the content that they are looking for and quickly review it. In technical courses, even though these videos are quite short in length, students tend to view them a number of times until they are able to complete the tasks themselves.

Short, five minute screencasts can also be useful in online instruction as responses to questions posed by students in the online learning environment. When a student asks how to do something, the instructor could record a screencast with the response and post it into the online classroom for that student as well as others to see and review. Over time, this library of short videos will become a useful resource for future online courses.

There are many commercial software packages available for developing online learning modules and complex, lengthy screencasts. Two of the most prominent are Adobe Captivate and TechSmith Camtasia Studio. However, one extremely useful, and free, tool for creating screencasts is TechSmith Jing (www.techsmith.com/jing). Jing is a simple, web-based tool that allows you to create screencast videos that are under five minutes in length. From simple movements of your mouse on the computer screen to specific regions of focus, Jing allows you to easily develop short screencasts, with or without audio narration. You can also choose to share your finished screencasts through the sharing mechanism provided by TechSmith, or you can embed your screencasts directly into your own online learning environment.

5. TOOLS FOR AUDITORY LEARNERS

This section will review free online tools that can be used to enhance online teaching in ways that appeal to the auditory learner.

Voki

Voki is an excellent way to add audio to the classroom. Voki is a tool that allows users to create their own talking character which can then be imported into the classroom, blog, website, email or profile. It enables the instructor to add audio to an announcement, assignment or discussion. It is way to introduce technology in a fun way while engaging students with interactive lessons (Voki, 2013).

By using Voki the user is able to choose a character that can look like the user or choose an identity from a list of characters that include animals, people, monsters or vegetables to name a few. Once the character is chosen the user can customize the character by adding clothes, glasses, hats, backgrounds and adding a voice. Adding a voice to the animation is simple. The user can choose from one of the character voices available within Voki or they can add their own voice via phone, microphone, text to speech or by uploading a file. Once the user is happy with the animation it is ready to publish in the classroom. This simple way to add sound to the classroom will help the auditory learner in understanding short instructions for assignments, announcements, and discussions.

Setting up an account with Voki is extremely easy. Simply log on to www.voki.com and start customizing characters to implement into the classroom. An example of a Voki character can be seen below in Figure 1.

Figure 1: Sample Voki Character

Audacity

Audacity is a multilingual audio editor and recorder which records live audio, converts tapes and records into digital recordings or CDs, edits Ogg Vorbis, MP3, WAV or AIFF sound files while allowing the user to mix sounds together (Audicity, 2013). Audacity has created versions to support Windows, Mac and GNU/Linux so that all users can access the software.

Audacity can easily record live audio through a microphone on a computer or mixer. This tool also allows the recorder to dub over existing tracks and has level meters which can monitor volume levels during or after the recording. The sound quality supports 16-bit, 24-bit and 32-bit samples which will records up to 192,000 Hz and up to 384,000 Hz for high resolution devices. Tracks and selections can be manipulated using the keyboard. The user can import sound files, edit the files and then combine them with existing files or new recordings. After the file is created the recordings can be exported into the classroom. Audacity is a great way to personalize the online classroom in discussions, weekly lectures and lessons. Instructors can record lessons that the auditory learner can easily follow.

Audacity provides detailed training manuals which will explain each feature as depicted in Figure 2 below which shows a screenshot of sound being recorded using the software. Tutorials are available in multiple languages and support is provided.

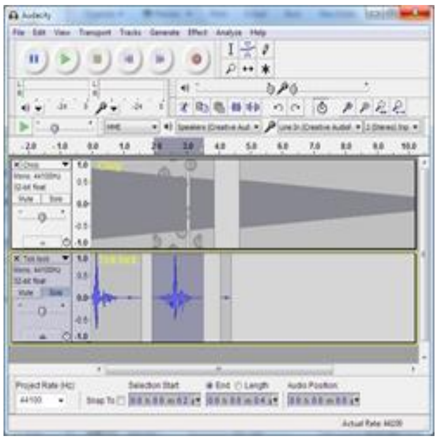

Figure 2: Audacity Sound Recording

6. TOOLS FOR KINESTHETIC LEARNERS

This section will review free online tools that can be used to enhance online teaching in ways that appeal to the kinesthetic learner.

Zooming Presentations

Prezi is a tool that brings a refreshing zooming animation style to screen-based presentations. The tool was launched in 2009 at Prezi.com, and is primarily web-based, meaning that you create content using an online editor rather than software that is installed on your computer. Prezi is truly innovative in terms of changing the way presenters display information. Rather than organizing content into slides as is the typical paradigm for presentations supported by Powerpoint, Keynote, and other office productivity tools, Prezi is much more visually oriented and organizes content into a large canvas. Concepts are placed into frames (areas) within the canvas that can then be animated in any sequence chosen by the creator. The presentation view then "zooms" around the canvas to present the concepts in the chosen order. The animation itself is quite smooth and modern, and the tool allows you to turn content frames and re-orient the view with each zoom, making the presentation an extremely appealing visual experience. You can also adjust the size of frames on the canvas, making some of them quite small, in effect nesting frames inside of one another. During presentation mode, this allows you to literally "zoom in" to a concept in one frame, and see the details of that concept inside of it, which is very useful for showing hierarchy of concepts.

But, aside from the slick modern animation technique, how does Prezi differ significantly from the traditional PowerPoint slidedeck model? In some ways, it doesn't. The content within the presentation will likely be the same in many cases. But for visual learners, the idea of seeing the "big picture" first and then delving into different parts of it can be a mind opening experience. Prezi functions in a non-linear fashion, quite like a mind map, and appeals to many students for this reason (Conboy et al., 2012).

In addition, due to the prevalence of PowerPoint presentations in higher education, students have often reported "Powerpoint boredom." In some cases where Powerpoint is used extensively during classroom lectures, students have been known to justify missing a lecture because they know that they can simply read the Powerpoint slides at a later time of their choosing. In contrast, Prezi presentations can sometimes follow a defined path setup by the instructor, but other times can veer off of the path, allowing the instructor to easily jump out of order or delve into different areas depending upon the classroom discussion. Prezi presentations can give students the sense that they have to attend a lecture in order to see the full explanation of the Prezi (Conboy et al., 2012). In online instruction, this could possibly be a negative rather than a positive. However, in an effort to address as many learning styles as possible in online instruction, an instructor could address this issue by recording audio narration of the Prezi, either as an audio media file inserted into the Prezi itself or by recording a screencast of the Prezi presentation.

So, if Prezi is such an exciting and appealing new visual presentation tool, why have the authors chosen to include it in the kinesthetic learning style category? Well, though the visual appeal of Prezi is quite striking and worth a full explanation, another use of Prezi even more suited to online education is what struck the authors as most important to include here. Since Prezi is a web-based tool, it offers very simple collaboration options for co-building or co-editing a Prezi presentation. Students simply have to sign up for a Prezi account, and then once a Prezi presentation is created, the creator can invite others to collaborate, giving them full edit rights. The collaboration experience is truly real-time, and students will see avatars of others who are currently working on the presentation within the area where they are working. The experience of building a Prezi presentation can be somewhat time consuming, even when starting with one of the useful pre-built templates. It requires reflection about what the visual big picture should look like, and how the pieces of the concept should fit together before beginning. The tool itself is very intuitive and responsive to on-the-fly changes in the display path, providing an extremely hands-on experience of truly developing a concept.

Prezi could be useful in online instruction in many ways, as an appealing and exciting presentation viewing experience for visual and auditory learners, and as an individual or group collaboration project with a full hands-on experience that could apply to a variety of teaching disciplines. Prezi is available for use at Prezi.com. An account is required to use the tool, but a complimentary free education account is available to all students and instructors. An example introductory Prezi presentation can be viewed here: http://prezi.com/5_auptg6wjic/prezi-example/

Quizlet

Quizlet is an excellent tool for the kinesthetic learner. The learner defines what they need to learn and Quizlet provides the tools to accomplish that goal (Quizlet, 2013). Educators and students alike can create lessons based on the weekly material. Some learners create flashcards when it comes time to study for an exam or quiz. Quizlet allows the instructor or students to create flashcards along with tests and games to assist with learning the material. The flash cards are an electronic version of using index cards where the question is written on one side of the card and the answer on the other. After reading the question students will click to flip the card to show the answer. An option is available in which students can see both sides of the card while learning the material.

Other features within Quizlet include Scatter which is a matching game in which terms and definitions are randomly scattered across the screen. Students are to match the correct answers to the appropriate definition in as little time as possible. Using the race of time students can play Space Race in which they can play with other students in the class to test their skills. Additionally, students can play the same game using Voice Space Race which uses the Spoken Language System (SLS) created by the MIT Computer Science and Artificial Intelligence Laboratory. Students can answer the questions aloud and the voice recognition system will determine if the answer is correct.

The software allows the student to match words to definitions with fellow classmates, take a practice exam that will be automatically graded and play games in which they are being timed to see how long it will take them to answer the questions. This tool allows students to work in and out of the classroom on their lessons on any device including smart phones and tablets. This tool will keep the kinesthetic learner involved and active in the learning process while serving as a memory aid.

7. CONCLUSION

For the purposes of this paper, the researchers used the VAK Learning Styles (Visual, Auditory, & Kinesthetic) as a framework for addressing the learning needs of online students. In doing so, attributes were discussed to differentiate the different types of learners. Online free tools that can create audio, video, sound, hands-on activities and more were featured to showcase the plethora of tools that are available to enhance the online classroom. These tools are freely available and can provide a wealth of opportunities for making the online learning experience more effective for students with each learning style. In order to provide quality online instruction, the learning styles of students should be addressed by online educators and curriculum developers.

Few studies were found addressing learning styles and online learners. With the increase in online classes, future research is needed in this growing area.

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Student Perception of Social Media as a Course Tool

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Abstract

If a technology provides features that are useful then it will have a positive impact on performance. Social media has morphed into one of the preferred methods of communication for many people; much has been written to proclaim its benefits including its usefulness as a tool to help students achieve success within the classroom. But is it perceived by students to be a tool to aid in their education or is it a distraction to the learning process?

Task-technology fit theory defines a model that has been used to explain information systems utilization in many different contexts. Prior research describes the relationship between the task requirements of the user and the functionality provided by the technology with the resulting impact on performance. Resultant studies concluded that perceived usefulness and perceived ease of use have a significant impact on utilization. Additionally, task-technology fit identified several factors that impact the use of technology.

We use the task-technology fit theoretical model to test the impact of social media as a learning tool for business students. Students from three universities were surveyed and the results present significant empirical evidence of utilization and the factors that impact social media use in the classroom. This research extends the existing body of task-technology fit research to include social media technologies. It also provides a theoretical construct to test the use of social media technologies.

Keywords: Social Media, Task-technology fit

1. INTRODUCTION

Social media usage has exploded in the past ten years. Its widespread adoption is reinforced with the news and entertainment media that remind their viewers to *follow us on Facebook or Twitter*. Social media tools have become an integral part of student life. This research explores the question: Is social media used as a tool to aid in student learning or is it merely a distraction? Is social media a tool that is perceived to add value and help students in the completion of tasks or is it merely a means of communication?

The question of whether information technology is utilized because it is perceived to add genuine value has been widely studied in the past twenty years. There are several theories that have resulted in hundreds of research studies. These include the Theory of Reasoned Action (Fishbein & Ajzen, 1975), Theory of Planned Behavior (Ajzen, 1985 & 1991), Task-Technology Fit (Goodhue & Thompson, 1995), Technology Acceptance Model (Davis, 1989), and the Unified Theory of Acceptance and Use of Technology (Venkatesh, Morris, Davis, & Davis, 2003). One of the most widely studied theories of information technology use is task-technology fit. This study utilizes the theory of task-technology fit to investigate if business students are utilizing social media tools as a means to aid in the student learning experience. The paper is organized as follows: First, the theory of task-technology fit is presented along with a summary of subsequent studies related to utilization. Second, a brief summary of prior research of social media in education is discussed. We then present our research methodology and research model. We conclude with a discussion of our findings.

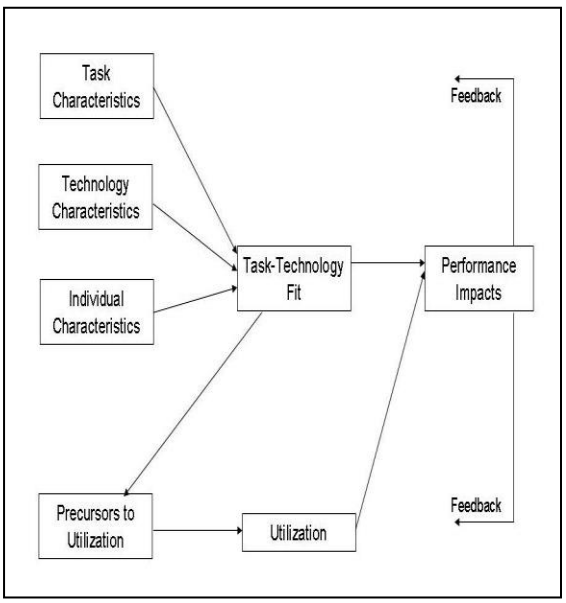

Figure 1. Goodhue and Thompson's (1995) Technology t Performance Chain Model

2. TASK-TECHNOLOGY FIT RESEARCH

Goodhue and Thompson (1995) proposed that for information technology to have a positive impact on individual performance the technology must be utilized and it must be a good fit with the task that it supports. Goodhue and Thompson (1995) built upon DeLone and McLean's (1992) work on information systems success by developing the *Technology-to-Performance Chain Model* (TPC) to investigate how technologies can impact individual performance. Within the TPC model, Goodhue and Thompson defined task-technology fit (TTF) as a measure of the degree to which tasks are supported by technology. The TPC model is shown in Figure 1.

In Goodhue and Thompson's (1995) study, task-technology fit was operationalized as user evaluation. Measuring perceived performance impacts operationalized performance impacts. A user rating of dependency on particular systems operationalized utilization. Goodhue and Thompson (1995) found that certain individual and task characteristics impacted utilization which then had a direct impact on the perception of performance.

3. SUBSEQUENT TASK-TECHNOLOGY FIT RESEARCH

Cane and McCarthy (2009) provide a summarization and categorization of over 100 subsequent task-technology fit research studies. A brief summary of the research pertinent to our study is presented herein.

Goodhue (1998) discussed the development and measurement validity of the task-technology fit instrument used in previous studies by pointing out that when looking for performance measures for system implementations, there are only a few uni-dimensional choices from which to choose. For example, *use* as a measure of evaluation may be problematic as it is possible that greater use could be the result of poor systems.

The user in Goodhue's (1998) research is defined as an individual who uses data personally in decision-making, or accesses it and passes it on to a decision-maker, and is *not* strictly defined as the "end-user who directly interacts with the computer" (p. 107). The research focused on testing the dimensions of the task-technology fit construct. He replaced *technology characteristics* used in prior research with the term *information systems and services*.

Belanger, Collins and Cheney (2001), in a field research project studying work group communication, surveyed telecommuters to determine telecommuting success based on availability of advanced information system technologies, availability of advanced communication technologies, and communication patterns.

D'Ambra and Rice (2001) found a direct relationship between high performance and a high level of task-technology fit. D'Ambra and Wilson (2004a, 2004b) developed two models that include uncertainty reduction as a dimension in the task-technology fit construct, and as a construct in the task-technology fit model.

Nance and Straub's (1996) task-technology fit is based on Venkatraman's fit as matching (1989, in Nance and Straub), in which the individual characteristics are removed from the characterization of fit, and evaluated as an antecedent to an individual's IT usage choices. Their study hypothesizes that volume of data determines IT usage choices. Nance and Straub's results showed that fit (defined as selecting information technology for high-volume data tasks and manual procedures for low-volume data tasks) appears to influence task-level IT choices.

Dishaw and Strong (1998a) define task-technology fit as "the matching of the functional capability of available software with the activity demands of the task" (p. 109), and is modeled using Venkatraman's (1989) interaction approach to fit. They developed a method to compute task-technology fit as the computation of the interaction of task and technology characteristics.

There are two dimensions of task-technology fit in the Dishaw and Strong (1998b) model: production fit and coordination fit. Production fit is the interaction of analysis, representation and transformation, with the maintenance tasks of understanding and modification (planning, knowledge building, diagnosis, and modification). Coordination fit is the interaction of cooperation and control. Their research supported two hypotheses. First, higher production fit is associated with higher tool use, and second, higher coordination fit is associated with higher tool use.

Dishaw and Strong (2003) continued their work with their evaluation of factors in utilization of software maintenance tools. From this prior usage was added as a moderator of utilization.
Dishaw and Strong (2003) found prior useage was significant. Strong, Dishaw and Bandy (2006), further extend the task-technology fit model by adding computer self-efficacy (CSE) as an individual characteristic. As in prior research (Dishaw & Strong, 1998b, 1999, 2003), task-technology fit is computed as an interaction. Results showed that including CSE increases the model's explanatory power, and CSE has an effect on utilization.
Murthy and Kerr (2000) tested several hypotheses on the task-technology fit of group support systems, investigating effectiveness of face-to-face communication compared to group support system-mediated communication under increasing information richness requirements. Tasks were identified as idea generation and problem solving. Their results indicated that for problem-solving tasks, subjects performed better when communicating face-to-face. There was no statistically significant difference in performance for idea generating tasks.

4. APPLICATIONS OF TASK-TECHNOLOGY FIT THEORY

Ferratt and Vlahos (1998) compared the task-technology fit of computer-based information systems (CBIS) across managers in Greece and the United States. Lim and Benbasat (2000) investigated task-representation fit and its effect on reducing information equivocality, which is defined as "the multiplicity of meaning conveyed by information about organizational activities" (Daft and Lengel, 1986, p. 211, in Lim & Benbasat, p. 451). The key task characteristic was analyzability, the key characteristic of representation was level of richness of presentation medium.

McCarthy, Aronson and Claffey (2002) studied enterprise data warehousing environments. Task characteristics were affected by information quality, reliability, business rule source, availability and timeliness. Individual characteristics were affected by ease of use, training, information usefulness, and the end user's relationship with the technology team. McCarthy et al. (2002) found that quality, training, reliability, business rule source, system availability, end user relationship with IT, and ease of use were all significant dimensions of task-technology fit for data warehousing systems.

Lightner (2002) found that combinations of technology and individual characteristics (age and domain knowledge) affect task performance using animated graphical displays.

McCarthy and Aronson (2003) tested task-technology fit in the context of knowledge management systems. They defined task characteristics as reliability, accessibility, right knowledge (quality), and compatibility; they defined individual characteristics as affecting ease of use, training, usefulness of the knowledge, and right level of knowledge. Task-technology fit was operationalized as the combination of individual characteristics and task characteristics.

Grossman, Aronson, & McCarthy (2004) evaluated the task-technology fit of the Unified Modeling Language (UML) for use in systems development using Goodhue's task-technology fit instrument (Goodhue, 1998, in Grossman, et al. (2004)). They reported a wide variety of opinions on UML, indicating inconsistency with new technologies.

Lee, Cheng & Cheng (2007) studied task-technology fit, focusing on individual differences in the use of personal digital assistant (PDA) for mobile commerce. Lee et al. found that computer experience, cognitive style, and computer self-efficacy affect PDA usage.

The numerous studies of task-technology fit have validated that if user perceives that a technology will add value then they will use it. We look to apply this to the use of social media as an aid for a student's educational experience.

5. SOCIAL MEDIA

Social media has been defined as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0 and that allow the creation and exchange of user-generated content" (Kaplan and Haenlein, 2010). Tadros (2011) defines social media as "any media that help integrate technology into the lives of people for the purpose of communication" (p. 84).

Social media use has exploded in the past decade. As a result, Wankel (2011) states social media is increasingly intersecting with education. Social media technologies enhance participation because it is viewed as the social construction of knowledge. When social media is used to enhance learning outcomes the context of the learning extends beyond the classroom into any learning environment that the student participates in (Wankel, 2011).

Olofsson, Lindberg and Stodberg (2011) identify that research in the use of social media among online higher education students is linked to educational technology and includes technologies such as wikis, blogs, video, and social tagging. They found that shared video and blogging facilitate communication and reflection amongst students. Koohang, Floyd, Smith and Skovira (2010), posit that although social media provides a community, it does not provide a learning community because members do not have a commitment to creating and sharing knowledge. Wankel and Wankel (2011) note that social media provides the potential opportunity to enhance university life and community development.

Young (2010) reports that one of the advantages of social media for students is that unlike course management systems, they already know how to use it. A survey of students at Los Medanos College in California found that 83% of the students approved of professors using Facebook for class updates. Suggestions for social media use at San Jose State University included: (1).Ask students to do role-playing exercises using Facebook or Twitter, (2).Use YouTube tracking to track posted lectures, and (3).Send students one minute video reminders for assignments.

In a demographic survey of 182 students and 64 faculty, Records, Pritchard, and Behling (2011) reported that 41.6% utilize Facebook for academic usage, 31.6% use LinkedIn and 12% use Twitter. They also reported that 82.7% use Facebook for personal usage, 35.75% use LinkedIn, and 30% use Twitter. Further they reported that advantages of using social media in the classroom include: "connectivity, communication, participation, group work, real-time use anywhere, real world examples, for people who are uncomfortable speaking in class, being able to participate in class when sick, and one comment 'ability to cheat on tests'" (p.177). The reported disadvantages were disruption and distraction.

Does social media create opportunities for students who grew up in a generation of hyperlinks and massive volumes of disconnected information, to be more engaged in their own learning? Is it perceived by students to be a tool to more effectively express their views than they might otherwise within a classroom? Tadros (2011) states "technology creates a more engaging and innovative classroom experience that makes students more interested in the learning process if the correct tools are used. Social media tools give students the ability to think critically and creatively" (p. 83). There is compelling anecdotal evidence that experts believe that social media is perceived by students to provide a tool to be more engaged in the classroom thereby improving their performance. However, to date, this has not been empirically studied.

6. METHODOLOGY

Based upon the prior task-technology fit research which has extensively looked at the use of technology in many different contexts our research question was "Does social media provide a tool that helps students in their studies or is it viewed as a distraction". The question arose from anecdotally observed claims that social media is an essential tool used by students as a means to enhance their studies. To date, we found no research to substantiate that claim. The task-technology fit model provides a sound theoretical basis to test this assertion. Therefore the two research questions that arose from this were:

1. Do students perceive the use of social media technologies as having a positive impact on their performance?

2. What factors affect the use of social media in the classroom?

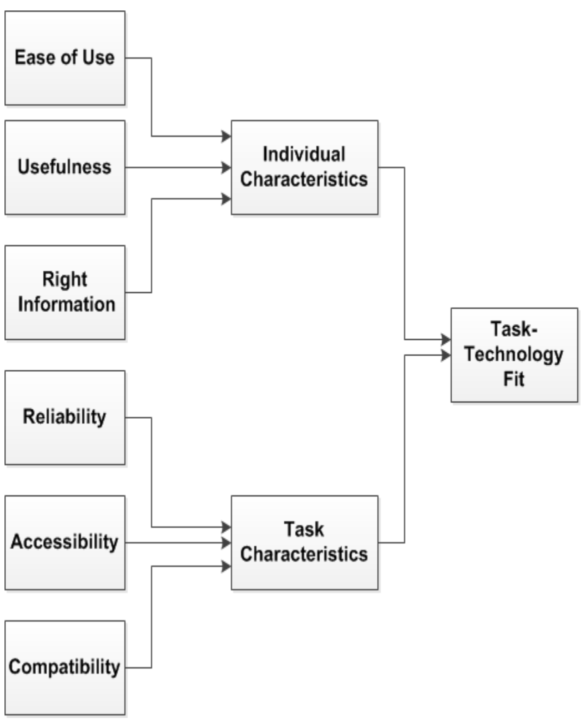

Figure 2. Research Model

There has been extensive study of task-technology fit that has led many researchers to conclude it serves as a surrogate for information systems success and therefore the stronger the task-technology fit the greater the impact on performance. Although much of the research on task-technology fit has centered on identifying additional variables that impact task or individual characteristics, there are several that are common across much of the literature (Cane and McCarthy, 2009). These include ease of use, usefulness, providing the right information, accessibility, reliability and compatibility. As a result our research model for this study is:

The survey instrument developed by Goodhue and Thompson (1995) was modified to apply to the use of social media technologies. An initial pre-test was performed with twenty-two undergraduate students from a northeastern university computer information systems class. The purpose of this pre-test was to validate the clarity of the survey instructions and the questions. Participants were asked to comment on any question that was unclear, and to indicate why. Two questions were modified as a result. The results of the pre-test were incorporated into the final questionnaire. This pre-test was personally administered. The data were not used as part of content analysis or to determine construct validity.

The survey was administered to business and information systems students who were taking introductory information systems courses at three universities within the United States. The survey was online and the students were provided a link to the survey from their instructor. Participation in the survey was optional and not part of the administration or curriculum for the course. Each of the questions within the survey was part of a construct representing either a task or individual characteristic. In addition, there were questions that asked for the student to describe their personal use of social media as well as their use within courses if applicable.

7. RESULTS

There were a total of 137 responses received from a total of 246 students across the three universities that were surveyed. One response was incomplete and not used in the final analysis, yielding a response rate of 55%.

Students were asked which social media site they use most often. The results (presented in Figure 3) demonstrate a very strong preference for Facebook (in comparison, no student responded MySpace).

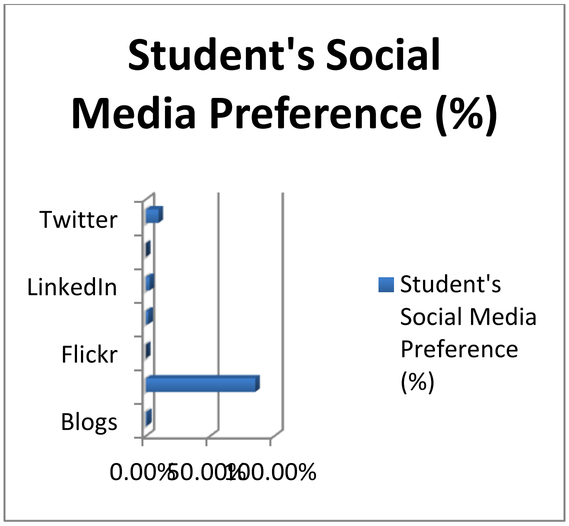

Figure 3. Social Media Most Often Used

Sixty-seven of 136 respondents (48.5%) indicated social media use as part of a college course. This group was the set that was used to analyze the task-technology fit as they represent the sample population of concern for our study. These students were asked which social media website was used in the classroom (presented in Figure 4). In some cases multiple sites were used.

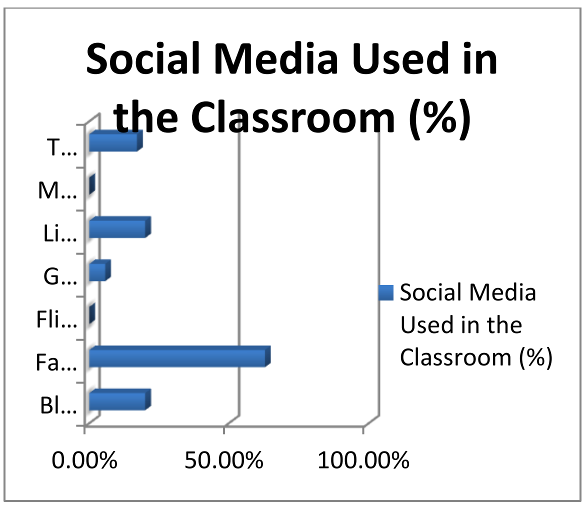

Figure 4. Social Media Used in the Classroom

There were several distinct ways in which social media was used within the classroom. In several cases it was used as a means to connect with outside constituents involved in service learning projects. In other cases it was used to interact with the professor and others in the class for case studies, creating blogs and analyzing social media campaigns. Blogs were used to describe and discuss issues related to the course, while GoogleDocs was used to share program files for a programming course.

A confirmatory factor analysis was performed on the questions that comprised each variable. One question had a factor less than .5 and was eliminated from further analysis. Construct validity of the questions pertaining to the variables was tested using a Cronbach's Alpha test. The results of the Cronbach's Alpha test are presented in Table 1. Each of the variables exhibited an alpha score > .70 and were therefore included in the analysis of the results.

Table 1. Cronbach's Alpha

Construct	Alpha
Ease of Use	0.82
Usefullness	0.84
Right Information	0.81
Reliability	0.76
Accesibility	0.74
Compatibility	0.79

Multiple linear regression has been used in many of the prior task-technology fit studies (Cane and McCarthy, 2009) because it is appropriate when a single dependent variable is related to multiple independent variables. The individual and task characteristics variables meet this criterion. In a multiple regression model, the increment of the R^2 attribute to the linear interaction between the individual and task characteristics and the task-technology fit variable was tested at a significance level of .01. The R^2 coefficient was .442.

In addition to the survey questions students were asked to comment on their views of the use of social media in the classroom. The responses were mixed. Several commented that social media use would be ineffective in the classroom. They pointed out they use social media to "connect with fiends and voice their personal opinions". Students' indicated there was a line between their personal life and their school life and did not want them to intersect. In response to this survey, one student commented, "I hate that this school is trying to involve social media in the classroom".

There were an almost equal number of comments in favor of the use of social media within the classroom. Several students commented that they would check social media sites much more often than Blackboard or Web Advisor. They commented that although it can be distracting, it was an effective way to reach a large number of users. Examples included using Facebook as a means to reach a wide group of people to support social causes that were the basis of part of the student's educational experiences. One student commented that they were using social media to identify survey participants for a research project that they were currently working on with a professor. Students also commented that Facebook is useful for connecting with team members on group projects. The students noted they would like to see Twitter used to update students when assignments are due. Finally, one student who has a dual accounting and information systems major indicated he/she use social media far more extensively in their information systems courses.

8. DISCUSSION

Based upon our survey results there is a task-technology fit when social media is used to support business classes in a university environment. This research is significant because it provide empirical evidence of the fit of the technology that extends beyond the anecdotal observations described in popular literature to date.

The individual and task characteristics that were tested (ease of use, usefulness, right information, accessibility, reliability, compatibility) provided a strong relationship of the fit of the social media technology in support of business courses. This is significant because it was the first time that task-technology fit was tested using social media as a context. Accessibility and reliability in particular are two variables that have yielded strong results in tests of task-technology fit. This is likely the result of continued improvements in both the technology itself and the network infrastructure that supports the technology. A longitudinal analysis of these variables could be conducted to determine if this is the reason.

Based upon the continuous reports of social media amongst the younger generations in the United States, it is not surprising that ease of use and compatibility contribute to the task-technology fit for the use of social media for coursework. However, this study contributes to the literature on the use and effectiveness of social media because it also demonstrates that in this context students perceive it to provide the right information and that that information is useful.

It is further significant to note that the technology was used not only as a means for students to collaborate with each other and their professor (which would only make it a surrogate for learning management systems), but it also enabled students to reach constituents beyond the classroom to support activities that are an important part of their educational experience. This research supports the contention of Dishaw and Strong (2003) that prior use impacts task-technology fit. One of the advantages of social media technology over learning management systems for freshman students is their familiarity with the technology. The participants identified Facebook as the mostly widely used technology for both personal and course work use. Its worldwide adoption has in part been driven by its ease of use and therefore does not require additional training on the part of the student to utilize. This has been universally acclaimed. This research contributes to the literature by providing empirical support of the task-technology fit for social media technology use in the classroom.

9. FUTURE WORK

One of the limitations of our study was that it only included students from universities within the United States. Further the three universities surveyed were traditional four-year institutions, where the average student's age who took the survey was 20 years old. We would like to expand this study to include international universities and to study of differences exist in both the fit of the technology and how it is used. It would also be interesting to compare these results to universities whose student body was comprised of more non-traditional students. Additionally, our results show a small number of social media technologies comprise the majority of the use. It would be interesting to conduct a more detailed study to determine if significant differences exist between the types of social media technology that are used.

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A Comparison of Faculty and Student Perceptions of Cyberbullying

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Abstract

Cyberbullying is a concern for any college or university. Digital harassment incidents continue to be featured frequently in the news. The authors of this study compare the perceptions of faculty and students on cyberbullying at an urban university. From the findings of surveys distributed to faculty and students in all schools of the university, the authors learn of high levels of perceptions on incidents as an issue, but low levels of perceptions on infrastructural and instructional methods of preemption and resolution, at the university. This study will be beneficial to field researchers, as cyberbullying is considered an issue more often in high schools than in colleges and universities.

Keywords: cyberbullying, cyberharassment, hostility, Internet, privacy, social networking, technology, and victimization

1. BACKGROUND

Cyberbullying is the abuse of choice of the "cyberimmersion generation" (Englander, 2009). Cyberbullying is "any behavior performed through digital or electronic media by [a college student or groups of college students or by faculty] that repeatedly [over time] communicates aggressive or hostile messages intended to inflict discomfort or harm on [another faculty or student or other students]" (Tokunaga, 2010). Cyberbullying is about control (Roome, 2012) or dominance (Olthof, Goossens, Vermande, Aleva, & Van Der Meulen, 2011) over another faculty or student. This control is an attempt by the attacker to demeaning the other faculty or student, and to improve the attacker's esteem (Fertik & Thompson, 2010). In brief, cyberbullying is "bullying [through] the Internet" (Vandebosch & Van Cleemput, 2008) – "a common risk" confronting students (Palfrey, Boyd, & Sacco, 2009) and faculty in "a new school yard" (Burnham, Wright, & Houser, 2011).

The attacker is empowered by the Internet. The behavior of attackers is evident in the following forms of cyberbullying:

- Cellular or digital imaging messages considered derogatory, harmful or mean to another faculty or student;
- Discussion board messages considered harmful or mean-spirited to another faculty or student;
- E-mails, instant messages, pictures, photographs or "sexting" of videos considered homophobic, racist or sexual if not humiliating and offensive to another faculty, student or students;

- "Flaming" or messaging on profiles on gaming or social networking sites considered offensive to another faculty, student or students; and
- Impersonating or messaging on gossip, personal polling or virtual reality sites or systems and "outing" or targeting other faculty members or students if not stalking and threatening them (Reynolds, 2012).

This behavior may be initiated by a direct form of an attacker attacking the other faculty or student, or an indirect form of an attacker engaging [faculty or] students in attacking the other faculty or student (Wong-Lo, Bullock, & Gable, 2009). The cyberbullying messaging of the attacker may be forwarded instantaneously to others to be bystander observers of the attacked faculty or student. The attacker may be cyberbullying on-line even other faculty or students without the increased risk (Dempsey, Sulkowski, Nichols, & Storch, 2009) that was evident when the bullying was off-line without the Internet. The bullying is moreover "non-stop" (Mishna, Saini, & Solomon, 2009), as the cyberbullying may be continuing beyond the location of the school. Impact is in increased internalizing psychological problems manifested in cyberbullied students (Grene, 2003, & Faryadi, 2011) – problems that may be resulting in school shootings (Chapell, Hasselman, Kitchin, Lomon, MacIver, & Sarullo, 2006) if not suicides. Clearly cyberbullying is not the "fact of life" or "kids are kids" that bullying was without the Internet (Scott, 2012).

Estimates in a consensus of the literature disclose that cyberbullying is experienced by 21% of high school students – 21.8% of female and 19.5% of male students (Patchin & Hinduja, 2012). 17% of high and middle school students experienced one or more incidents 2 to 3 times in the last 30 days, and 14% of these students experienced incidents in generic hurtful or mean-spirited messaging. In addition, 16.8% of high and middle school students were attackers or perpetrators of cyberbullying (Patchin & Hindjua, 2012). Literature discloses college students may experience that cyberbullying as frequently. A recent study (Indiana State University, 2011) showed that 22% of college students – 22% of female and 21.9% of male students – experienced cyberbullying with 25% of incidents instances on social networking sites. Also, 8.6% of college students were perpetrators (MacDonald & Roberts-Pittman, 2010), the bulk of whom were already middle, high or elementary school perpetrators or victims (Walker, Sockman, & Koehn, 2011). Literature discloses even female students to be more involved in both perpetration and victimization (Snell & Englander, 2010), though male students may be more involved in perpetration than female students (Chapell, Casey, De La Cruz, Ferrell, Forman, Lipkin, Newsham, Sterling, & Whittaker, 2004). However the literature on cyberbullying is focused frequently on high school and middle school students. The impression may be that cyberbullying is a feature of life in high and middle school students and not of college students, who are considered adults, or faculty (Zacchilli & Valerio, 2011). Therefore, the authors of this study examine the perceptions of faculty and students on cyberbullying at an urban university in the United States.

2. INTRODUCTION TO STUDY

In 2011 the authors completed a study of students in the Seidenberg School of Computer Science and Information Systems at the PACE University (Molluzzo & Lawler, 2011). The limitation of the 2011 study was that students of the other schools of the university were not included. Though the results were generally consistent with the literature, the 2011 study, being limited to the students of one school of the university, limited the perceptions learned from that study. The authors, therefore, conducted a more general survey in 2012 that included all the university's students and another survey of the university's entire faculty. The results of the faculty perceptions on cyberbullying were presented at ISECON 2012 (Molluzzo & Lawler, 2012). The authors will publish in 2013 (Molluzzo, Lawler, & Desai, 2013) a full analysis of perceptions of students across the entire university. From these studies, the authors learned that cyberbullying was perceived as an issue on the Internet and was managed insensitively by institutional methods of non-pro-action of the university. In this paper, the authors compare the perceptions of students and faculty based on the 2012 surveys.

This paper posits the following considerations on cyberbullying at PACE University:

- The extent to which faculty members and students agree that cyberbullying is a generic issue in society and in a university;
- The extent to which faculty members and students agree that cyberbullying is a specific issue whereby students known to

them were victimized by other faculty or students in the university;

- The extent to which faculty members and students agree that the culture of discussion of cyberbullying and cyberethics is a fabric of infrastructure and instruction in the university;
- The extent to which faculty members and students agree that the culture of pro-action of pre-emption and resolution of cyberbullying by chair, department and institutional officials in the university; and
- The extent to which faculty members and students agree on proposed recommendations of sensitivity solutions to cyberbullying in the university.

This paper is critical in learning the culture of cyberbullying in an urban university, as papers in the academic field concentrate more on cyberbullying prior to university (Zacchilli & Valerio, 2011). Cyberbullying is evident more in the practitioner publications, as in the sensational Tyler Clementi and Dharun Ravi story (Bazelon, 2012, Glaberson, 2012, & Rouba, 2011). Increased incident reporting of students may indicate the increased seriousness of cyberbullying (Patchin & Hindjua, 2012). Faculty members and officials of a university need to be in a position to protectively but realistically respond to cyberbullying if faculty or students perceive perpetration problems, otherwise there may be liability potential (Willard, 2012) with the reality of victimization. Staff needs to respond in reinforcement and safety solutions (Snakenborg, Van Acker, & Gable, 2011), software systems, (Lieberman, Dinakar, & Jones, 2011) and support shared with faculty members and students.

(Resources for further cyberbullying study are furnished in Table 1 of the Appendix.)

3. FOCUS OF STUDY

The focus of the authors is to compare the perceptions of faculty and students on cyberbullying in all schools of PACE University, a recognized urban institution of learning in the northeast corridor of the United States. The new study furnishes input into the prevalence of cyberbullying. This comparison of students and faculty will be beneficial to faculty members and staff in all schools of a university, in considering the growing issue of cyberbullying. The prevalence of cyberbullying, and the seriousness or non-seriousness of cyberbullying as an issue, learned from the perceptions of the faculty and the students of PACE University will be reflected in the analysis of the findings of this new study.

4. RESEARCH METHODOLOGY

The research methodology of this new study consisted of a survey of the perceptions of 433 faculty members and 7807 students, both undergraduate and graduate of PACE University.

The surveys consisted of a cyberbullying definition (Tokunaga, 2010) and 47 items:

- 6 demographic questions;
- 7 fundamental knowledge of cyberbullying questions;
- 9 knowledge and perception of group or individual incidents and methods of cyberbullying perpetration questions;
- 14 knowledge and perception of cyberbullying institutional response questions; and
- 11 perception of seriousness or non-seriousness of cyberbullying as an issue at the university questions.

The surveys were distributed to the faculty members and to the students in the March to May 2012 through the university e-mail, and the questions were furnished through the Qualtrics software survey system. The responses returned to the authors were anonymous, and the faculty members and the students were assured of anonymity on the instrument of survey. The authors reviewed the responses for statistical interpretation (McClave, Sincich, & Mendenhall, 2007) using SPSS tools in May to June 2012.

The instruments of the surveys were reviewed for feasibility and integrity by the university Internal Review Board (IRB), and were approved by the Dean for Students and the Provost for distribution to the populations in the studies. The surveys are too long to include both in this paper. We do, however, include the faculty survey in Figure 1 of the Appendix. All questions referred to in the following discussion are included in this survey. Note that the question numbering was that imposed on the questionnaire by the Qualtrics survey software.

5. ANALYSIS OF FINDINGS –COMPARISONS OF FACULTY AND STUDENTS

The student survey was distributed to over 7,807 undergraduate and graduate students. The number of valid responses received was 355, which is a return rate of 4.5%. (The low student response rate could be due to the number of questions in the survey.) The faculty survey was distributed to all 433 faculty in the university. The number of valid responses was 79, which is a return rate of 18.2%.

Faculty Demographic Data

Of the respondent faculty, 46% were full-time and 54% part-time; 51% were female and 49% were male. The university has two main campuses – one in a large city and one in the suburbs of that city. Of the faculty responding 51% were from the suburban campus and 49% were from the city campus. 59% of the faculty respondents were in the liberal arts school, and 41% were in the professional schools (Business, Computing, Education, and Health Professions.)

Student Demographic Data

73% of the student respondents were female, 27% male. 53% were in the liberal arts school and 47% in the professional schools. 38% of the respondents were Freshmen or Sophomores, 34% were Juniors or Seniors, and 28% were graduate students. 64% of the student respondents were from the urban campus and 37% of the respondents were from the suburban campus.

The surveys asked several questions on a 5-point Likert scale. Because our sample sizes were relatively small, having five Likert categories did not yield statistically valid results. It was felt that the Strongly Agree and Agree responses basically meant the same thing, and the other three responses meant the opposite – the respondent did not agree with the statement. Therefore, we combined these categories into two responses, which enabled a chi-squared test of independence on 2x2 cross-tabs. Following is an analysis of some of the statistically significant results organized along some of the demographic categories of the respondents. The Yes-No questions were similarly analyzed using a chi-squared test of independence on 2x2 cross-tabs.

Differences Between All Students and All Faculty

Table 2 summarizes the significant differences between faculty and student perceptions towards cyberbullying. On the question Q9: "Cyberbullying is a serious issue for you." a significantly greater number of students (47.4%) than faculty (26.6%) responded Yes, which is not surprising given that students are usually (although not always) the ones being bullied. Also, on Q10: "You are aware of cyberbullying at other schools." again students had a higher percentage of Yes answers (16.0%) than faculty (6.3%).

The University Core requires that all students take UNIV 101, which introduces them to college life, fosters good study habits, etc. On Q48: "Should cyberbullying be discussed in UNIV 101." significantly more faculty (97.4%) than students (84.7%) responded Yes. This could mean that faculty feel stronger that this course is a good venue to discuss the issues of cyberbullying.

Question Q53: "The university should publicize more its policy on cyberbullying" is sort of a trick question. At the time of the survey the university had no explicit policy on cyberbullying. Instead, the university relied on a code of behavior published in its student handbook. On this question, a greater number of the faculty (94.7%) than students (84.4%) agreed that the cyberbullying policy should be publicized more.

The survey showed that 76.3% of students and 55.6% of faculty agree with Q64: "The university is sensitive to the problems of cyberbullying". On one hand this is a tribute to the handling of cyberbullying incidents by the administration of the university, and on the other an indication that the faculty is not aware of what the administration does to handle these problems.

Differences Between Male Students and Male Faculty

The literature supports the belief that there is a difference between males and females in their perceptions and incidents of cyberbullying. Significant differences between male students and male faculty are summarized in Table 3. As in the general population, cyberbullying was more of a serious issue (Q9) among students (59.8%) as opposed to faculty (36.8%). In addition significantly more male faculty (94.3%)

than male students (72.8%) believe that cyberbullying should be discussed in UNIV 101 (Q48), although both percentages are very high.

In addition to the University Core requiring UNIV 101, it also requires all students to take CIS 101, a required computer technology course. The survey asked (Q49) if the faculty believed that cyberbullying should be discussed in these courses. As with UNIV 101, significantly more male faculty (82.4%) than male students (64.1%) believe that cyberbullying should be discussed in CIS 101.

The next three questions dealt with the perception of how the university deals with the issue of cyberbullying. On questions Q53 and Q54 significantly more male faculty (91.9% on both questions than male students (70.8% and 76.4%, respectively) believed the university should publicize the issue of cyberbullying. However, on Q64, significantly more male students (76.6%) than male faculty (51.4%) believed the university is sensitive to the problems of cyberbullying.

Differences Between Female Students and Female Faculty

Table 4 summarizes the significant differences between female students and female faculty. As might be expected among the female student population (they tend to be the victims of cyberbullying more than males), significantly more female students believed that cyberbulying was a serious issue for them (Q9) than female faculty (42.2% to 12.5%), and more female students (76.4%) believed that the university is sensitive to issues of cyberbullying (Q64) than female faculty (58.3%). As to the question of whether cyberbullying should be discussed in UNIV 101 (Q48), 100% of the female faculty agreed while 89.5% of the female students agreed.

Differences Between Urban Students and Urban Faculty

Pace University has two campuses. One campus is in downtown Manhattan and the other in suburban Westchester. The campus settings are quite different and each campus attracts demographically different sets of students. It is, therefore, interesting to consider the differences in these populations. The significant differences between urban students and urban faculty are summarized in Table 5. The next subsection discusses the differences between the corresponding suburban populations.

Among the urban students and faculty, there were only two significant differences. 85.5% of the urban campus students claimed they were aware of the official policies of the university on cyberbullying as opposed to 72.2% of the urban campus faculty. Also, 78.4 % of the urban campus students believed the university is sensitive to the problems of cyberbullying as opposed to 58.3% of the urban campus faculty.

Differences Between Suburban Students and Suburban Faculty

Table 6 summarizes the significant differences between suburban students and suburban faculty. Significantly more suburban students (47.2%) consider cyberbullying a serious issue (Q9) than suburban faculty (20.0%). On the other hand, all suburban faculty (100%) believe that cyberbullying should be discussed in UNIV 101 as opposed to 89.6% of suburban students.

Differences Between Liberal Arts Students and Liberal Arts Faculty

Approximately half of each of our samples were from the liberal arts school and half from the professional schools. Therefore, it is interesting to consider these populations separately. Table 7 summarizes the differences between students and faculty in the liberal arts school of the university. Significantly more liberal arts faculty (97.8%) believed that cyberbulying should be taught in UNIV 101 (Q48) than liberal arts students (79.8%). Also, more the liberal arts faculty (93.7%) believe the university should publicize more its cyberbullying policy (Q53) than liberal arts students (84.6%). However, significantly more liberal arts students (77.6%) believe the university is more sensitive to the problems of cyberbullying (Q64) than liberal arts faculty (58.1%).

Differences Between Professional School Students and Professional School Faculty

The significant differences between students in the professional schools and faculty in the professional schools are summarized in Table 8. Significantly more professional school students (56.5) consider cyberbullying a serious issue (Q9) than do professional school faculty (25.8%). Significantly more professional school students than professional school faculty (63.0%) believe that the administration of the university is knowledgeable of cyberbullying as an activity that is harmful to students (Q60) than professional school faculty (37.9%). Also more of professional school students (74.4%) believe the university is sensitive to the problems of cyberbullying (Q64) than professional school faculty (51.7%).

6. IMPLICATIONS OF STUDY

In all cases where there is a significant difference on Q9 (Cyberbullying is a serious issue for you), students consider cyberbullying as a serious issue for themselves. This is not surprising because students are more likely than faculty to be victims of cyberbullying. (Note that in Molluzzo and Lawler (2012) it was noted that some faculty were victims of cyberbullying.)

Also, on Q64 (The university is sensitive to the problems of cyberbullying) in all cases where there is a significant difference, students agree more than faculty. This indicates that students more than faculty believe the university is doing a good job in addressing the issues of cyberbullying. Although we have no data to substantiate, this could be the result of students learning of the university response to such issues through their peers. Faculty would normally not be privy to such reports.

It is also interesting to note that on all significant differences on Q48 (Should Cyberbullying be discussed in UNIV 101?) more faculty believe that cyberbullying should be taught in UNIV 101. As mentioned previously, all undergraduate students are required to take UNIV 101. The instructors of this course are drawn from all departments of the university that have undergraduate programs. Many of the faculty across the university have taught the course and consider it an important part of students' introduction to academic life. Therefore, it is not surprising that more faculty than students consider the course as an appropriate venue in which to discuss the problems associated with cyberbullying.

Although a vast majority of all respondents believe that the university should publicize its cyberbullying policy, whenever there is a significant difference on Q53 (Should the university publicize more its policy on cyberbullying?), it is the faculty who agree more. This indicates that the university population, faculty more than students, are not aware of the cyberbullying policy of the university. Recall that at the time of the survey the university had no official policy on cyberbullying.

7. LIMITATIONS AND OPPORTUNITIES FOR FURTHER STUDY

The findings from populations at one university may not be generalized without caution. The difficulty of a cyberbullying survey is in potential respondent sensitivity to questions that may obscure perpetration in the populations of the surveys (Cole, Cornell, & Sheras, 2006, even of faculty populations in a university. The extent of victimization in a urban university moreover may not be as representative of cyberstalking vulnerability as in a suburban university (Daniloff, 2009).

The opportunity in this field is fruitful however for further study (Mishna, Cook, Saini, Wu, & MacFadden, 2009). Research in this field is relatively limited in the post-secondary setting of universities. This university is interested in partnering with other universities in the United States in a larger population and setting study that might be performed in a longitudinal survey annually, as perceptions of faculty and students might shift on the topic with novel usage of the technology.

8. CONCLUSION

This study shows that the problems associated with cyberbullying are not confined to pre-college aged students. 9% of the student respondents and 10% of the faculty respondents were cyberbullied at the university. Also 12%of students and 14% of the faculty consider it a serious issue at the university. However, only 24% of student respondents and 45% of the faculty believe the university is sensitive to cyberbullying. It is, therefore, important for universities to have a clearly stated anti-cyberbullying policy that is well-publicized to students and faculty. As a result of the authors' surveys and their collaboration with June Chisholm, a professor of Physchology, and Marijo Russel-O'Grady, Dean for Students on the New York Campus, PACE University is working towards adopting such a policy.

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Appendix

Figure 1: Instrument of Survey: Note that the numbering of the survey questions is that imposed by the survey software.

Q6 To which school of the university do you belong?

- Liberal Arts (1)
- Education (2)
- College of Health Professions and Nursing
- School of Business (4)
- School of Computing (5)

Q5 Which is your "home" campus?

- New York (1)
- Pleasantville (2)
- White Plains (3)

Q71 What is your faculty status?

Full-time (1)

Part-time (Adjunct) (2)

Q72 What is your faculty rank?

Full Professor (1)

Associate Professor (2)

Assistant Professor (3)

Instructor/Lecturer (4)

Q73 How long have you been a faculty member at the university?

1-5 years (1)

6-10 years (2)

11-15 years (3)

16-20 years (4)

21 or more years (5)

Q4 Gender?

Male (1)

Female (2)

Q7 Cyber-bullying is any behavior performed through electronic or digital media by individuals or groups that repeatedly communicates hostile or aggressive messages intended to inflict harm or discomfort on others. In cyber-bullying experiences, the identity of the bully may or may not be known. Cyber-bullying can occur through electronically-mediated communication at school; however, cyber-bullying behaviors commonly occur outside school as well.

Q8 You are aware of cyber-bullying as an activity on the Internet
- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q9 Cyber-bullying is a serious issue for you.
- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q74 Cyber-bullying is a serious issue for your students.
- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q10 You are aware of cyber-bullying activities at other schools (for example the Rutgers student who committed suicide as a result of cyber-bullying)?
- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q46 Might it be acceptable for freshman or sophomore students to be cyber-bullied by junior or senior students>
- Yes (1)
- No (2)

Q47 Have you discussed issues of cyber-bullying in your department or at the University?
- Yes (1)
- No (2)

Q48 Should cyber-bullying be discussed in UNIV 101?
- Yes (1)
- No (2)

Q49 Should cyber-bullying be discussed in CIS 101?
- Yes (1)
- No (2)

Q75 Are you aware of instances of cyber-bullying at the university?
- Yes (1)
- No (2)

Q76 Have you discussed cyber-bullying in any of your classes?
- Yes (1)
- No (2)

Q50 Do you know if professors at the university, other than yourself, have discussed incidents or issues of cyber-bullying in their classes?
- Yes (1)
- No (2)

Q51 How many professors have done so?

Q52 Should the university do any of the following? Please respond to all.

Q53 Publicize more its policy on cyber-bullying.
❍ Yes (1) ❍ No (2)

Q54 Publicize more the problems of cyber-bullying as an activity harmful to students.
❍ Yes (1) ❍ No (2)

Q55 Sponsor seminars for students on the problems of cyber-bullying as an activity harmful to students.
❍ Yes (1) ❍ No (2)

Q56 Sponsor sensitivity seminars for professors on the problems of cyber-bullying as an activity harmful to students.
❍ Yes (1) ❍ No (2)

Q57 Sponsor sensitivity seminars for staff on the problems of cyber-bullying as an activity harmful to students.
❍ Yes (1) ❍ No (2)

Q58 What should be the penalty for perpetrators of cyber-bullying? Choose as many as appropriate.
❑ No penalty by the University (1)
❑ Warning sent to the student by the University (2)
❑ University informs police of the incident (3)
❑ Student is suspended by the University (4)
❑ University immediately expels the student (5)

Q59 Ifa student of yours is a victim of cyber-bullying, whom would you contact. Choose as many as appropriate.
❑ The President of The university (1)
❑ The Dean of Students (2)
❑ The Dean of your school (3)
❑ The Chair of your department (4)
❑ The Counseling Center (5)
❑ The Security Department (6)
❑ Your local Police Department (7)
❑ Your fraternity or sorority (8)
❑ Your best friend (9)
❑ Your parents (10)
❑ No one (11)

Q60 The administration of the university is knowledgeable of cyber-bullying as a activity that is harmful to students.
❍ Strongly Disagree (1)
❍ Disagree (2)
❍ Neither Agree nor Disagree (3)
❍ Agree (4)
❍ Strongly Agree (5)

Q77 My dean is knowledgeable of cyber-bullying as a activity that is harmful to students.
- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q78 My chairperson is knowledgeable of cyber-bullying as an activity that is harmful to students.
- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q61 Cyber-bullying is a serious issue at the university.
- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q62 Professors at the university are knowledgeable on cyber-bullying as an activity that is harmful to students.
- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q79 Professors in my school are knowledgeable on cyber-bullying as an activity that is harmful to students.
- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q80 Professors in my department are knowledgeable on cyber-bullying as an activity that is harmful to students.
- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q63 You are aware of the official policies of the university on cyber-bullying.
- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q64 The university, as an institution, is sensitive to the problems of cyber-bullying.
- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q81 My school, as an organization within the university, is sensitive to the problems of cyber-bullying.
- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q82 My department, as an organization within the university, is sensitive to the problems of cyber-bullying.
- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q65 You are knowledgeable of the laws on cyber-bullying in the United States.
- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q66 Cyber-bullying is a violation of privacy, regardless of the intent of the perpetrator.
- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q67 Cyber-bullying, pure and simple, is wrong.
- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q11 Are you aware of incidents of cyber-bullying at the university?
- Yes (1)
- No (2)

Q12 Of how many incidents are you aware?

Q13 How many perpetrators were involved?

Q14 How many victims were involved?

Q15 Have you ever consciously or unconsciously been a perpetrator of cyber-bullying?
❍ Yes (1) ❍ No (2)

Q16 Have you ever been a victim of cyber-bullying at The university?
❍ Yes (1) ❍ No (2)

Q17 How many times were you victimized?

Q18 How many perpetrators were there?

Q20 Which method was used to cyber-bully you. Choose as many as appropriate.
- ❑ Looking in to your cell phone (1)
- ❑ Looking in to your email (2)
- ❑ Sending you harassing emails (3)
- ❑ Sending you harassing pictures (4)
- ❑ Sending you pornographic images (5)
- ❑ Posting harassing messages on a social networking site (6)
- ❑ Posting harassing pictures on a social networking site (7)
- ❑ Preventing a friend from contacting others on a social networking site (8)
- ❑ Sexting (9)
- ❑ Other (10)

Q21 Have you ever been a victim of cyber-bullying outside the university - at another university, in high school, or at work?
❍ Yes (1) ❍ No (2)

Q23 How many perpetrators were there?

Q25 Which method was used to cyber-bully you. Choose as many as appropriate.
- ❑ Looking in to your cell phone (1)
- ❑ Looking in to your email (2)
- ❑ Sending you harassing emails (3)
- ❑ Sending you harassing pictures (4)
- ❑ Sending you pornographic images (5)
- ❑ Posting harassing messages on a social networking site (6)
- ❑ Posting harassing pictures on a social networking site (7)
- ❑ preventing a friend from contacting others on a social networking site (8)
- ❑ Sexting (9)
- ❑ Other (10)

Q26 Are you aware of cyber-bullying of any of the following groups at the university? Choose as many as appropriate.
- ❑ Male students (1)
- ❑ Female students (2)
- ❑ Asian students (3)
- ❑ Gay students (4)
- ❑ Lesbian students (5)
- ❑ Physically disabled students (6)
- ❑ African-American students (7)
- ❑ Hispanic students (8)
- ❑ Muslim students (9)
- ❑ African students (10)

- ❑ Developmentally disabled (11)
- ❑ Other (12)

Q28 For each of the following pairs, choose the one you think is more likely to be a VICTIM of cyber-bullying at the university.

Q29
❍ Male (1) ❍ Female (2)

Q30
❍ Foreign (1) ❍ Non-foreign (2)

Q31
❍ Gay (1) ❍ Straight (2)

Q32
❍ Lesbian (1) ❍ Straight (2)

Q33
❍ Disabled (1) ❍ Non-disabled (2)

Q34
❍ African-American (1) ❍ White (2

Q35
❍ Hispanic (1) ❍ White (2)

Q36
❍ Muslim (1) ❍ White (2)

Q69
❍ Asian (1) ❍ White (2)

Q37 For each of the following pairs, choose the one you think is more likely to be a PERPETRATOR of cyber-bullying at the university.

Q38
❍ Male (1) ❍ Female (2)

Q39
❍ Foreign (1) ❍ Non-foreign (2)

Q40
❍ Gay (1) ❍ Straight (2)

Q41
❍ Lesbian (1) ❍ Straight (2)

Q42
❍ Disabled (1) ❍ Non-disabled (2)

Q43
❍ African-American (1) ❍ White (2)

Q44
- Hispanic (1)
- White (2)

Q45
- Muslim (1)
- White (2)

Q70
- Asian (1)
- White (2)

Table 1
Cyberbullying Resources for Faculty and Staff

www.bullyonline.org
www.bullysafeusa.com
www.cyberbully.org
www.cyberbullying.us
www.cyberbullying-news.com
www.cyberbully411.com
www.cybersmart.org
www.digizen.org
www.ikeepsafe.org
www.isafe.org
www.lifeafteradultbullying.com
www.MARCcenter.org
www.ncpc.org/cyberbullying
www.stopbullying.gov
www.wiredsafety.com

Table 2
Significant Differences Between All Students and All Faculty

Survey Question	p < 0.05	p < 0.01	p < 0.001
Q9: Cyberbullying is a serious issue for you.			0.001
Q10: You are aware of cyberbullying at other schools.	0.026		
Q48: Should Cyberbullying be discussed in UNIV 101?		0.003	
Q53: Should the university publicize more its policy on cyberbullying?	0.09		
Q64: The university is sensitive to the problems of cyberbullying.			0.000

Table 3
Significant Differences Between Male Students and Male Faculty

Survey Question	p < 0.05	p < 0.01
Q9: Cyberbullying is a serious issue for you.	0.017	
Q48: Should Cyberbullying be discussed in UNIV 101?		0.008
Q49: Should cyberbullying be discusses in CIS 101?	0.050	
Q53: Should the university publicize more its policy on cyberbullying.		0.010
Q54: Should the university publicize more the problems of cyberbullying as an activity harmful to students?	0.044	
Q64: The university is sensitive to the problems of cyberbullying.		0.008

Table 4
Significant Differences Between Female Students and Female Faculty

Survey Question	p < 0.05	p < 0.01
Q9: Cyberbullying is a serious issue for you.		0.003
Q48: Should Cyberbullying be discussed in UNIV 101?	0.032	
Q64: The university is sensitive to the problems of cyberbullying.	0.023	

Table 5
Significant Differences Between Urban Students and Urban Faculty

Survey Question	p < 0.05	p < 0.01
Q63: You are aware of the official policies of the university on cyberbullying	0.049	
Q64: The university is sensitive to the problems of cyberbullying.		0.010

Table 6
Significant Differences Between Suburban Students and Suburban Faculty

Survey Question	p < 0.05	p < 0.01
Q9: Cyberbullying is a serious issue for you.		0.002
Q48: Should Cyberbullying be discussed in UNIV 101?	0.036	

Table 7
Significant Differences Between Liberal Arts Students and Liberal Arts Faculty

Survey Question	p < 0.05	p < 0.01
Q48: Should Cyberbullying be discussed in UNIV 101?		0.003
Q53: Should the university publicize more its policy on cyberbullying.	0.048	
Q64: The university is sensitive to the problems of cyberbullying.		0.01

Table 8
Significant Differences Between Professional School Students and Professional School Faculty

Survey Question	p < 0.05	p < 0.01
Q9: Cyberbullying is a serious issue for you.		0.002
Q60: The administration of the university is knowledgeable of cyberbullying as an activity that is harmful to students.	0.013	
Q64: The university is sensitive to the problems of cyberbullying.	0.015	

A Learning Theory Conceptual Foundation for Using Capture Technology in Teaching

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Abstract

Lecture capture technologies are increasingly being used by instructors, programs, and institutions to deliver online lectures and courses. This lecture capture movement is important as it increases access to education opportunities that were not possible before, it can improve efficiency, and it can increase student engagement. However, this is just the start for how capture technology can be used as it only considers an objectivist learning theory approach in deployment. As a result, it is essentially a modern version of "sage on the stage" where an expert projects information for consumption by students. Capture technologies, though, hold promise to go beyond this basic implementation as they can fit into the constructivist learning paradigm too, which requires students to take what they have learned and apply it to new concerns of importance to them. In addition, capture technology can be used to develop learning support resources, known as scaffolds, and be used to improve assignment integrity and assurance of learning. Ideas for how capture technology can be used to address these important learning concerns are presented and discussed.

Keywords: Lecture Capture, Learning Theories, Objectivist Learning, Constructivist Learning, Scaffolding, Assurance of Learning, Instructional Design

1. INTRODUCTION

The promise of the internet and technology-mediated teaching to revolutionize education has been hyped for more than a decade but until now the ability of technology to fundamentally alter teaching and learning has largely gone unfulfilled (Wiley, 2000). This time, though, may well be different. Online courses and programs are seeing large enrollment gains while new entrants like the Khan Academy or Coursera, Udacity, and EdX, known as MOOCs (Massively Open Online Courses), are challenging traditional education institutions and instructors (Youngberg, 2012; Deneen, 2013).

Recorded lectures are a key feature of these new educational structures (Kay, Reimann, Diebold, and Kummerfeld, 2013) and the lecture capture technology used is seeing "acceptance rates that are remarkably positive" (Greenberg and Nilssen, 2009). Lecture capture systems are fast evolving with capabilities that exceed simple recording of video to capturing a host of media and inputs, and as such, will often be referred to more generally as capture technology.

For the most part, the focus on using capture technologies in education has been where an expert records something for viewing by students. While this is an important application, it is effectively just a modern version of the "sage on the stage", or in learning theory terms, it is *objectivist learning*, where students are expected to remember and repeat what has been presented to them.

Capture technology has potential to go beyond passive, objectivist learning to enable active student participation and content creation. Assignments and courses can be designed to encourage *constructivist learning* where students are challenged to extend what they are being taught to solve new problems of interest and importance to them. Traditionally this might be accomplished by having students discuss in class or write about why and how what they are learning can be applied in their lives; and these are still important. But with capture technologies, the opportunities are expanded, with additional benefits possible as well. For example, capture technology can be used to enhance assignment integrity and assist in assurance of learning efforts too as students record themselves completing assignments.

Designing assignments and courses using capture technologies in concert with learning theory and concerns, not only makes good academic sense, it has practical value too. A survey of employers conducted by Hart Research Associates (2013) for The Association of American Colleges and Universities, shows employers strongly support a blended model of liberal and applied learning. Nearly 93 percent of employers agree "a candidate's demonstrated capacity to think critically, communicate clearly, and solve complex problems is more important than their undergraduate major" (Hart Research Associates, 2013, p. 1). In addition, "more than four in five employers say an electronic portfolio would be useful to them in ensuring that job applicants have the knowledge and skills they need to succeed in their company or organization" (Hart Research Associates, 2013, p. 3).

Given the promise of lecture capture, this paper considers a learning theory approach to how capture technologies can be used in teaching that has been missing from the literature to date. In this effort, an emphasis is made to illustrate how capture technologies can be applied in practice as a means to facilitate adoption by others.

The remainder of the paper is organized as follows. Section two overviews the current use of lecture capture in the literature. Then, a review of learning theories and concerns is presented. This includes objectivist learning, constructivist learning, social constructivism, assurance of learning and ensuring assignment integrity. Section three presents ways in which capture technology can be utilized to meet the tenets of these learning theory and concerns.

2. LITERATURE REVIEW

Lecture Capture

The use of lecture capture systems in higher education has been an active area of research with many dozens of articles in the literature. The vast majority of these works focus on how instructor-generated material is received by students and how it impacts their learning experience in terms of satisfaction, performance, attendance for in-person meetings, and video usage. Interested readers are directed to works by Pursel and Fang (2012), Owston, Lupshenyuk, and Wideman (2011), and Green, Pinder-Grover, and Millunchick (2012) for useful reviews and reference lists. Generally, the research finds that students use and appreciate the availability of videos, believe it helps their performance, and the availability of videos does not reduce student attendance. These works, however, concentrate at the lower levels of learning taxonomy and on an objectivist learning approach.

The use of student-generated lecture capture in higher education is much less pervasive even though it holds promise for higher-level, constructivist learning. At the university level, student-generated capture approaches appear focused on recording student oral presentations and in teacher education programs.

Smith and Sodano (2011) investigate the use of lecture capture for increasing presentation skills through self-assessment and review of recorded speeches. Tazijan, Rahim, Halim, Abdullah, Ismail, and Cochrane (2012), meanwhile, show positive impact from using lecture capture technology to improve presentations in English as a Second Language (ESL) students.

In teacher education, Otrel-Cass, Khoo, and Cowie (2012), investigate how to use videos for learner support, known as scaffolding, by science teachers. Forbes (2011), meanwhile, reports positive results with using student-generated podcasts for reflecting on learning.

Shafer (2010) utilizes student-generated screencasts for teaching mathematical proofs to education majors. The students recorded themselves presenting a proof, which were reviewed and critiqued by the instructor and then used in class for peer review and critique. This work by Shafer (2010) is significant in that it explicitly considers learning theory, Bloom's taxonomy, in deploying capture technology.

Learning Theory and Concerns

Bloom's Taxonomy of Learning

Bloom's taxonomy of learning, first proposed in 1956, identifies a learning hierarchy of lower and higher order concerns (Bloom & Krathwohl, 1956). Updated by Anderson and Krathwohl (2001), the lower levels of the hierarchy include remembering and understanding while higher order concerns included analyzing, evaluating, and creating. With student-generated capture assignments and approaches, high-order learning can be targeted. Most lecture capture applications in the published literature, though, are essentially just electronic lectures that address the lower levels of this hierarchy. Moreover, using capture technology in this manner aligns with objectivist learning theory.

Objectivist Learning

Objectivism theorizes that knowledge is an externality and thus independent of learners. As Hannafin, Hannafin, Land & Oliver (1997) reaffirm, learners learn by "decoding the established meaning of various objects and events […], provided by the learning systems designer" (p. 108). As such, objectivism is sometimes viewed as "regurgitation," with students expected to "expel" what has been ingrained in them by the expert. Furthermore, the onus of learning is viewed as falling on the instructor, and if students do not recall effectively, the instructor must adapt means and measures of learning so that students can do so the next time (Cronjé, 2006; Jonassen, Collins, Campbell & Bannan Haag, 1995). This is what many lecture capture implementations try to do. A student watches a lecture, then takes a quiz for understanding. If the student fails, they may be guided to repeat the lecture or brought to a different video lecture on the topic, and then retested.

This is not to say that objectivist learning approaches and lower order learning concerns are trivial, because they are important and they have their place. It is, however, more a factor of missed opportunities for capture technology teaching approaches where the full potential to enable high-level and constructivist learning are not considered much less achieved.

Constructivist Learning

The basic premise of constructivist theories is that humans "construct" their own understanding, and ultimately their knowledge, of the world around them via a process of active experimentation (Chickering & Gamson, 1991; Kolb & Kolb, 2005; Knowles, 1988). When reflecting thereupon, they either alter their current understanding or transformatively construct anew (Mezirow, 1997).

In a constructivist paradigm, one thing is clear, students must be active participants in their education experience. Otherwise, their constructed learning, and indeed their overall constructed knowledge, will be diminished and affect their continued development as they move through their academic program. Therefore, the "test" of whether learning has taken place in constructivist paradigms is the response and performance of students as they progress through the educational ranks: can they solve appropriate, new problems using what they have acquired through their studies to that point.

The constructivist approach to learning also changes the role of the instructor. Rather than merely being a "sage on the stage" the instructor is charged with developing a conducive learning environment with meaningful learning experiences and structures. In the words of Meyers and Nulty (2009), "'High quality' learning outcomes should result from the interplay between students' learning efforts, the curricula and the teaching methods used" (p. 566). In such a conducive learning environment, constructivism accommodates and promotes a variety of teaching approaches that invariably encourage students to actively experiment—to breakout of the sterility of the classroom and into the world of work—to facilitate true reflection on their observations, and to do so either individually or in collaboration with others.

Social Constructivism

Social constructivism extends the constructivist approach to include the ability to work well with others to accomplish a goal. Following social constructivism, it is incumbent upon instructors and those responsible for the development of academic programs to cultivate such abilities in students. Vygotsky (1978) posits that the collaborative aspect of learning is important to constructivism believing that knowledge is incrementally constructed via social or cultural interaction, termed 'social constructivism.' In practical application, this is often seen through group or team projects and presentations, class discussions and debates, or through service learning and experiential assignments and courses.

Scaffolding Learner Support

Using constructivist theory, facilitative teachers are able to appreciate where students "start" and then guide them through these new experiences, enabling students themselves to build new understanding and, with further experimentation, competency. An important aspect of this support is scaffolding, which is the development of a support structure to facilitate learning. Scaffolding is a process through which the instructor (or a more competent peer) provides guidance and support to the learner, and then systematically tapers it off as the learner becomes more capable (Balaban, 1995).

Capture technologies can be used to develop student support materials, scaffolds, with content accessible to students even when an instructor is not present to help. Students can then access remedial content or revisit a topic, through a learning management system such as Blackboard or Moodle as they desire, giving the student control in their learning. For example, remedial content focused on ensuring students have the technical knowledge and skills needed to not only begin a course but to succeed in it can be made available before the course actually begins.

While it is clear that capture technologies can play an important part in both traditional and online courses, it will take thought and effort to deploy them in a manner that adds value beyond simply increasing access and efficiency. Ellis & Goodyear (2010) state that "[t]eachers who focus on the development of student understanding and have richer conceptions of learning technologies, not only integrate e-learning into their approach to teaching, but also stress the importance of the integration of learning across physical and virtual spaces" (p. 104). Often, though, this is not seen to be the case. Thorpe (2002) claimed that "[t]raditionally, learner support is seen as that which happens after the course materials have been made" (p. 106), or as Lee, Srinivasan, Trail, Lewis and Lopez (2011) framed it "as an add-on to pre-designed courses, but it has since been recognized that it should be considered and integrated into course design" (p. 158).

Assurance of Learning and Assignment Integrity

Regardless of the theoretical approach used, the technology employed, or whether the work is performed alone by students or in collaboration, it is fair to say that educators and employers alike are interested to assure that learning has occurred. In constructivism, learning is often prized as a unique experience, even during group or team-based projects, and therefore one that has individual results and traditionally this is hard to measure (Arum & Roksa, 2012).

Capture technologies not only enable a new approach to individualized learning during collaborative efforts but facilitate a personalized documentation and performance history as well, thereby aiding the measurement of learning. As students incrementally develop their capabilities, and these are captured, this evidence can not only be viewed and evaluated by the instructor but students can share this evidence with both current and/or prospective employers and others as they decide. Throughout the entire program, student learning can be documented so every course has something to contribute to the student learning portfolio. Capture technologies can facilitate truly modern e-portfolios, which employers value in accessing candidates for hire (Hart Research Associates, 2013).

Ensuring that students actually complete assignments themselves, and within the rules set forth by the instructor, is an important component of learning efficacy. It has been found that most college students admit to some form of cheating (McCabe & Trevino, 1993) with business students being more likely to do so than other majors (McCabe, Butterfield, & Trevino, 2006). While cheating appears to be more prevalent in online courses, a survey by Lanier (2006) reassuringly found rates lower than previous studies. LoSchiavo and Shatz (2011), on the other hand, found most students cheated on at least one online quiz and honor codes appeared to have no impact on cheating by fully online, asynchronous students. Some institutions have begun to address the issue of cheating on outside exams by employing e-proctoring services like ProctorU (www.proctoru.com) that use webcams and a verification process to increase exam integrity. Similarly, lecture capture technology can be used to record exam completion as a means to discourage cheating.

Pedagogically, then, capture technology underscores and neatly aligns with extant learning theory. Capture-based approaches can improve student engagement with the material and increase instructor efficiency. Furthermore, it can play a role in achieving not only objectivist learning but aligns well with constructivist and social constructivist learning too. By engaging students in the creation process, high-level, deep learning can be achieved, documented, and made available for use, as desired.

3. LECTURE CAPTURE APPLICATIONS

This section presents ideas on how capture technologies can be employed in concert with the aforementioned learning theories. The applications vary in focus and intent, have relevance to a wide range of courses, and effort is made to show how others can use these approaches in their courses. First, though, a short discussion of the lecture capture programs used by the authors is presented.

The lecture capture applications that follow can all be accomplished using readily available programs. The authors are currently using three different lecture capture programs: TechSmith Jing, Adobe Captivate, and Panopto. Jing, is a free, basic screen capture and recorder program. It is useful for student-generated content but is limited to five-minute videos with no editing capabilities. Adobe Captivate is a full-featured capture and editing system that can be purchased standalone or as part of Adobe's eLearning Suite. Captivate is a powerful program, with commensurate complexity, that can be used individually or as an organization-wide system and is particularly useful for instructor-generated content. Panopto, meanwhile, is an institutional-level system that can be used to create individual videos or video repositories by students, instructors, and institutions alike.

Pre-Recorded Lecture Videos

As noted earlier, pre-recorded lecture videos are a common use of capture technologies spanning from the Khan Academy and MOOCs to individual instructors developing videos for their courses. Pre-recorded lectures—especially when coupled with assessment capabilities—provides an efficient and scalable means to reach students and to achieve the low-level learning objectives of remembering and understanding in an objectivist manner. Using capture technology in this way is ubiquitous and important because it applies to virtually any subject or course where basic or foundation material must be communicated, repeatedly.

Pre-Recorded Solution Videos

Developing pre-recorded solution videos is a way to use capture technology for teaching complex problem-solving activities, especially quantitative, computer-based problems. In its most basic form, this application is still primarily an objectivist approach that addresses the lowest two levels of Bloom's learning taxonomy. However, with good assignment and video structure, as called for by Myers and Nulty (2009), the higher learning levels of analyzing and evaluating can be reached. In addition, students can be encouraged to think in a constructivist fashion.

Consider, for example, an operations management course that challenges students to model and solve problems such as location analysis, forecasting, inventory systems, statistical process control and process capability. Instead of solving individual textbook problems by hand, each area is investigated in a more holistic, workshop-like approach. Students are challenged to construct and complete sophisticated spreadsheet implementations as a way to develop valuable technical skills beyond the basic course content. For example, students use the solver in Excel for optimization, perform and evaluate multiple regressions, and use many mathematical, statistical, and lookup functions. In addition, students learn how to structure spreadsheets for decision making, sensitivity analysis and error trapping, all within the context of the operations management concepts.

Interactive videos, complete with pausing and annotations, guide online students through these implementations as a means to follow the workshop approach employed by the in-person version of the class. Using lecture capture in this way follows the objectivist learning approach but the problems are designed and presented in a manner to facilitate the transference to practical and common work concerns, thereby encouraging students to think in a constructivist manner. Once the spreadsheets are built, students are challenged to analyze the results to evaluate what the practical consequences are and what decisions should be made as a result.

Live Class Capture

In many contemporary classrooms, the student profile has changed from decades past. More non-traditional students are returning to complete their degrees with work and family obligations often interfering. Indeed, it is estimated that nontraditional students now account for three-quarters of all college students (Complete College America, 2011). Of great importance, these non-traditional and over-committed students are often at risk for not completing their degree, especially when they have gaps in their studies (Complete College America, 2011). Of course instructors have always been concerned with student success, but with the recent surge in outcomes-based funding in higher education (Jones, 2013), the issue takes on increased importance.

Typically, if a student missed a class meeting, their primary recourse was to get notes from another student. With capture technology, recording live classes for review by students is possible. This can be a valuable scaffold or learner support, not only for those who get sick or must miss class for a work or family obligation, but also for students who find the material difficult and desire additional engagement.

Learning Support Repositories

Nontraditional students returning to school, and part-time students who may take breaks between learning stints, mean programs can expect students who have significant gaps between taking sequenced courses. This can be especially problematic in technical and computer-oriented courses where competencies evolve rapidly and build upon themselves. Additionally, the push to curtail or eliminate remedial education funding subsidies, and to place at-risk students directly in credit-bearing courses (Jones, 2013) makes the development of learning support repositories prudent.

Lecture capture technology can play an important role in providing an objectivist approach to developing scaffolds of learner support repositories. Instructor developed videos with tutorials and remedial assignments can be made available to students before a course begins so incoming students who need to review foundation material and concepts can do so on an as-needed, self-study basis.

Student-Created Course Materials

While instructor-recorded lectures and course materials are a popular use of capture technologies, engaging students in the course content creation is a way to achieve higher-level learning from a constructivist perspective. At the same time, useful learner support materials for future students are developed.

Consider, for example, an upper division MIS course that requires students to learn how to use Microsoft Access™ and Excel™ to solve business problems. Students entering the course have widely differing skill and experience levels, and not all students are from the MIS discipline. As part of the course, some assignments are designed to require students to create learning resources (tutorial videos) for inclusion in the course repository. Students provide their own perspective on the application as well as on the tips, tricks, and traps for the material. As an extension, requiring students to identify and propose areas with which they struggled as a basis for the materials they generate, engages students with the content in a personally meaningful, high-level learning manner.

Student-Created Documentation and Instruction Manuals

Experiential learning courses, such as internships or those that complete projects for external clients, often require documentation and instruction manuals so clients can use the student-created programs and processes after the course or internship ends. Capture technology is particularly useful in these efforts.

As part of the project documentation, students can incorporate recorded demonstrations and explanations of complex processes into manuals or handbooks. These can then be saved to the organization’s network for secure access, typically via hyperlinks in the documentation file. As a result of both the project and the recorded documentation, students reach the highest level of Bloom’s taxonomy, creating, in a constructivist approach as they develop scaffolding and learning support materials for others to use.

Student Presentations

Student presentations are a traditional way to engage students with the course material and each other. In terms of Bloom's taxonomy, this technique often reaches beyond mere understanding to include the higher level learning concerns of analyzing and evaluating as students must provide their own interpretations to the findings. Furthermore, student presentations represent the constructivist and social constructivist approaches as students interact in the development process or during the presentation via questioning and discussion. Capture technology is useful for student presentations too, where rather than giving the presentation in person, they record it.

One approach is to have students create and record a presentation, including relevant discussion points. The class watches these peer-developed recordings on their own and prepares discussion questions for debate in the next in-person meeting. The student presenters then lead the discussion, becoming in effect, the instructor of the material. As a result, the students become active participants in achieving the course learning objectives, while identifying and explaining relevant examples and connections of interest to them. As an added benefit, the captured presentation becomes a resource for assurance of learning purposes.

Documentation of Exam Completion

As noted, assurance of learning and assignment integrity are important concerns in education, especially for online courses where students are not physically present during exams or for courses with out-of-class assignments. Lecture capture technology can play a role here too.

Consider, for example, a database course, where students must demonstrate proficiency on practical exams by creating tables, modifying relationships, developing forms, etc. As students complete the assignment outside of class, they are required to record themselves, complete with verbal explanations of what they are doing and why. With the exam completion videos, the instructor can not only evaluate the submitted files and work but can view the completion process as desired. Not only is this useful for evaluation or review, it is a positive step in eliminating concerns with completion authenticity and assignment integrity for work completed outside of the classroom.

Course- and Program-Level Knowledge Base

Given the myriad of ways capture technologies can be deployed and the increasing capability to capture any manner of media and input, higher education could well be entering what can be thought of as an 'omnicapture' phase of teaching and learning. In such an all-encompassing capture environment, new resources such as course-level and program-level knowledge bases become possible. The multimedia assets created, such as those discussed above, could be aggregated for use in teaching, used by students for e-portfolios, and to serve as learning documentation or even as a program's bona fides.

Consider, for example, extending the potential of student-created course materials discussed above as part of the course structure itself. Instead of having students simply read a textbook and take an exam, instructors could include assignments where students must identify areas they desire to investigate in more depth and then use capture technologies to create engaging, multimedia resources for use by others. Students would be charged with finding open-source and non-proprietary resources and to include proper citation and referencing. Instructor and peer reviews would be used to vet the correctness of the work, while a user-rating system could be employed to allow future users to vote on each work, thereby enabling the highest-rated material to surface over time. Each semester, every student and class would incrementally add to the knowledgebase, filling in underserved areas and improving upon others. Ultimately, this student-generated knowledgebase could become the foundation for not only course materials but also how the course itself is taught.

4. CONCLUSIONS

The use of lecture capture technology is becoming widespread in education. To date, though, most of the focus on using capture technologies has centered on increasing student access and instructor efficiency as lectures are recorded for students to download and watch. As such, this use is primarily a modern twist on the traditional lecture model that only reaches the lower levels of the learning hierarchy using an objectivist learning approach. In other words, the instructor projects information to the students and they are expected to retain and recall it on demand.

This paper proposes that capture technology holds promise to obviate high-order learning concerns and that it can be deployed in the constructivist and social constructivist learning paradigms where students are active participants in the learning process. Students can use the capture technology to generate new content and knowledge of importance to them, individually or in concert with others. Assignment integrity and assurance of learning concerns are inherently enhanced during this process as the recordings themselves become a record of student achievement. Ideas for how to accomplish this are discussed.

With the rapid advancements in capture technology to easily and efficiently record a host of inputs and media, the ability to develop comprehensive repositories of student-developed materials and knowledge is becoming a reality. Such an 'omnicapture' learning environment appears promising and worthy of consideration. To move towards this end, though, teaching methods, assignments, and even course and program design must be considered in concert with established learning theories and technology. It does not seem so farfetched that this time, maybe technology truly will begin to reach its promise to fundamentally impact education, teaching, and learning.

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