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INFORMATION SYSTEMS EDUCATION JOURNAL

Differences in Males and Females in When and Why They Become Interested in Information Systems Majors

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Abstract

Determining when and why students become interested in careers in information systems is a critical step in filling the pipeline of majors to become information systems workers. Although students who have chosen a particular major may find it difficult to indicate or even understand all of the reasons for their choice, it is possible to tease out several criteria that seem to significantly affect such choices. For computing and STEM (Science, Technology, Engineering and Math) majors in particular, a person's comfort level with STEM coursework perhaps as early as in elementary school seems to play a role. Also, their perceptions of how intellectually stimulating STEM courses were for them throughout their school years seems to affect their choice of a major. This paper aims at distinguishing when and why such majors are chosen through a survey instrument geared toward STEM majors and separates the results by gender and major, identifying when and why each group selected the major they did. The potential value of this research is in determining where efforts could be more specifically focused to recruit into STEM majors.

Keywords: STEM interest, STEM majors, computing majors, information systems.

1. INTRODUCTION

Assurance of STEM majors and graduates flowing through and from American universities is critical to the success of the US economy. As technology becomes increasingly embedded in society, a technologically literate workforce will be necessary. The shortage of STEM student, and in particular, IS and CS (Information Systems and Computer Science) students, has been well documented in both the research and practitioner literature. The reasons proposed for students not studying information systems include: lack of interest, perceived difficulty of subject, the image of the IS worker, worries about outsourcing/offshoring, poor job prospects, negative experiences with a teacher or class, and financial considerations. Several of these reasons have been exposed as unimportant in the literature. Reasons students have for going into the field of information systems include: personal interest, excelling in classes, prestige of profession, positive job outlook and growth, influence of parent/teacher/counselor, starting salary, and ongoing training.

The authors of this paper take previous studies and results and use them to construct a survey instrument to attempt to discover when and where students become interested in information systems (and, in general, STEM fields). The authors present results about gender differences in interest level (in studying information systems), influences on major field selection, and when (elementary, middle, high school, or college) students became intellectually stimulated to study information systems.

2. LITERATURE REVIEW

The shortage of students studying STEM disciplines has been extensively documented (Feder, 2012; Khazan, 2012; Tabatabaei, & Tehrani, 2010) since the term was coined by Judith Ramaley while serving as a director at the NSF in 2001 (Donahoe, 2013). STEM was actually a rearrangement of SMET, an acronym that dates back to the latter part of the 20th century (Donahoe, 2013). In particular, the shortage of information systems (IS) students is at a critical level (Burns, Gao, Sherman, Vengerov, & Klein, 2014; Downey, McGaughey, & Roach, 2011) and the dearth of females studying for IS careers in the US is of particular concern (Croasdell, McLeod, & Simkin, 2011; Mishra, Kavanaugh, & Cellante, 2013; Mishra, Draus, Caputo, Leone, Kohun, & Repack, 2014).

This shortage in female IS majors comes even as the percentage of female students enrolled at US colleges continues to surpass that of males, and the gap is predicted to widen over the next decade (Kena, Aud, Johnson, Want, Zhang, Rathbun, Wilkinson-Flicker, & Kristapovich, 2014). When and where to best attract students into an IS discipline is an open research question. Various authors have studied gender differences in major selection (Mishra, Cellante, & Kavanaugh, 2014; Croasdell, et al., 2011) and have found that the influence of family members, interest in the subject, job prospects, and having a respected career are motivating factors in IS career selection (Croasdell, et al., 2011). Mishra, Draus, Caputo, Leone, Kohum, and Repack (2014) determined that females need more mentoring (especially by "a person who can influence theory decisions about college majors" p. 45), and that advice from family members or friends who were in the IS field were especially influential in major selection. Mishra, et al. also found that exposure to computing activities when young (K-12) encouraged female students to study computing in a post-secondary setting.

Lack of information about computing disciplines is another reason students are not entering the fields (Computer Science and Computer Information Systems). This is particularly acute in the IS arena as many authors have reported that students are unaware of IS (or only marginally aware) when they enter post-secondary education (Walstrom, Schamback, Jones, & Crampton, 2008; Mishra, Cellante, & Kavanaugh, 2014; Burns, et al., 2014)

There are many influences in a student's life that could impact their decisions to major in a computing discipline. Personal interest in the field ranks first with family influences, career opportunities (salary, job security, job prestige), and ease of subject following closely (Crampton, Walstrom, & Schambach, 2006; Burns et al., 2014). Conversely, Pollicia and Lomerson (2006) found that lack of information on IS careers, the perception of difficulty of the subject, and personal (non) interest led students away from IS as a major. Not surprisingly, personal interest in a subject was found by many authors to drive field of study choices as well (Burns, et al., 2014; Mishra, Cellante, & Kavanaugh, 2014; Snyder & Slauson, 2013; Crampton, et al., 2006).

While there is no clear dividing line between internal and external influences to major selection (Downey, et al., 2009), personal interest along with intellectual stimulation can, arguably, be considered an internal stimulation. Many authors have found that personal interest is a leading factor in selecting a major in a STEM or, in particular, an IS discipline (Downey, et al., 2009; Snyder & Slauson, 2014; Burns, et al., 2014; Beyer, 2008; Walstrom, et al., 2008). The importance of personal interest cannot be overstated, and determining when, where, and how this interest is stimulated is critical to attracting majors to STEM disciplines.

The following statement, made by a 14 year old female sums up her perspective on when students (in particular female students) become interested in computing disciplines.

> I've seen the software industry's efforts to recruit more women in college, and sometimes high school. Let me tell you, that's way too late. We're making up our minds now – in seventh grade or even sixth. My teachers have (too often) expounded that during our middle school years we grow more than any other time of our lives outside of infancy. It is the perfect time to present software as a career, at the moment when we are most malleable. (Platt, 2014, p. 80)

This anecdotal statement reveals that females could be ready for career selection – based on personal interest – as early as middle school.

3. METHODOLOGY

A survey instrument was developed in the fall semester of 2013 then distributed to STEM majors in a mid-sized western university in the spring semester of 2014. One of the main elements of the survey design was to determine the point at which students became interested in STEM disciplines. In addition, the major influences and influencers were listed on the survey in an attempt to discover how students became interested in STEM disciplines. Many of these questions were generated from previous survey work which was mentioned in the literature review. The survey was composed of demographic questions, interest level questions, and a series of Likert scale questions that extract information concerning elementary, middle, high school, and college STEM classes. Finally, a series of Likert scale questions concerning influencing factors for the choice of major were included. See Appendix A for the complete survey instrument.

Students in mathematics, computer science, and information systems courses were surveyed. There were 168 surveys collected, of which three were removed due to missing information. This yielded an n of 165 for the study.

4. RESULTS

There were 132 males and 33 females in the respondents, verifying what other authors have found, that females are underrepresented (20%) in STEM fields (Downey, et al., 2013; Croasdell, et al., 2011). Table 1 lists the survey respondents according to their major field of study and gender.

Field of Study	Female	Male	Total	Percent Female
CISB*	7	21	28	25%
CSCI*	7	72	79	8.9%
Math	12	8	20	60%
ME*	7	29	36	19.4%
Other	0	2	2	0%

Table 1
Field of study and gender
* CISB = Computer Information Systems, CSCI = Computer Science, ME = Mechanical Engineering

Table 1 illustrates what others have discovered, that females are 20% of the STEM population, but only 13.1% of the students studying computing sciences. These statistics are alarming, as Mishra, Draus, Caputo, Leone, Kohun, and Repack (2014) point out, we are losing a significant resource in the information systems workforce, the female contingent. A Chi-square test confirms what Table 1 is illustrating, that females are underrepresented in computing disciplines and overrepresented in mathematics in this sample; χ^2 (4) = 27.07, $p <$ 0.001.

When and where to encourage females (indeed any student) into the computing arena is a topic addressed by this survey. Burns, et al. (2014) report that 88.5% of their survey respondents had decided on a major by the time they were sophomores in college. Table 2, which lists majors by year in school tells a different story, particularly when evaluating the CISB respondents.

Major	Freshman	Sophomore	Junior	Senior	Other
CISB	0	3	8	17	0
CSCI	16	18	16	28	1
Math	2	10	3	5	0
ME	15	12	8	1	0
Other	0	1	1	0	0

Table 2
Year in school and major

Table 2 suggests that even as college students, few enroll in the CISB major or have selected it as a major field of study, especially in the freshman and sophomore years. A chi-square test,
χ^2 (9) = 41.40, $p < 0.001$, indicates that there are dependencies between year in school and major. There are fewer CISB freshmen and an over-abundance of mechanical engineering freshmen. This points to an "awareness" issue between the disciplines. Students do not know much about CISB (it is a relatively new discipline) and know a great deal about engineering (it is perceived as an interesting, lucrative field).

Table 3 gives information concerning when (elementary, middle, high school, or college) students became interested in STEM disciplines, when they discovered they were good at STEM classes, and when they considered a STEM major.

When	First discovered STEM interest	
	F	**M**
Elementary	11 (33%)	36 (27%)
Middle	5 (15%)	27 (20%)
High	10 (30%)	49 (37%)
College	5 (15%)	14 (11%)
Work	2 (6%)	3 (2%)
Home		1 (1%)
Blank		2 (2%)
	First discovered good at STEM disciplines	
	F	**M**
Elementary	12 (36%)	26 (20%)
Middle	7 (21%)	27 (20%)
High	6 (18%)	49 (37%)
College	6 (18%)	22 (17%)
Work	2 (6%)	6 (5%)
Home		1 (1%)
Blank		1 (1%)
	First considered STEM discipline as a major	
	F	**M**
Elementary	2 (6%)	5 (4%)
Middle	5 (15%)	13 (10%)
High	14 (42%)	64 (48%)
College	8 (24%)	40 (30%)
Work	4 (12%)	7 (5%)
Blank		3 (2%)

Table 3
Interest level in STEM disciplines

Table 3 indicates that a higher percentage of females seem to have discovered STEM disciplines as elementary school students, and considered it as a major earlier that their male counterparts. This could have been in a mathematics or science class, but the interest seemed to be initiated in the earlier years of their education. Further along, it can be seen that a consideration to major in STEM was primarily cultivated in high school and college, indicating that a continuum of support (elementary school to college) is necessary to begin, maintain, and cultivate an interest in STEM disciplines. This is reinforced by the lack of remediation for students in STEM disciplines. A minority of the students surveyed (19.5%) needed no remediation, indicating sufficient preparation (and sufficient support in schools) for studying STEM disciplines. Females had a 15.2% remediation rate, while males had a 20.6% remediation rate. These students compare favorably to the institution remediation rate of 36.2% and a state-wide remediation rate of 20.3% (CDHE, 2013). Table 4 lists the type of remediation necessary for students in this survey group.

Gender	Math	English	Reading	Math and English	English and Reading	Math and English and Reading	None
Male	12	4	1	7	2	1	105
Female	2	2	0	1	0	0	28

Table 4
Remediation necessary for college level classes

When	First discovered STEM interest	
	F	**M**
Elementary	2 (14%)	26 (28%)
Middle	1 (7%)	17 (18%)
High	5 (36%)	35 (38%)
College	4 (28%)	10 (11%)
Work	2 (14%)	3 (3%)
Home		1 (1%)
Blank		1 (1%)
	First discovered good at STEM disciplines	
	F	**M**
Elementary	1 (7%)	18 (19%)
Middle	1 (7%)	15 (16%)
High	5 (36%)	36 (39%)
College	5 (36%)	18 (19%)
Work	2 (14%)	5 (5%)
Home		1 (1%)
	First considered STEM discipline as a major	
	F	**M**
Elementary	0 (0%)	3 (3%)
Middle	0 (0%)	8 (9%)
High	4 (29%)	43 (46%)
College	6 (43%)	34 (37%)
Work	4 (29%)	4 (4%)
Blank		1 (1%)

Table 5
Interest level in STEM disciplines by students studying computing disciplines

Table 5 summarizes the responses for survey respondents who are studying computing disciplines from Table 3 (F = 14, M = 93, n = 107)

Table 5 indicates that male computing students parallel male STEM students in when they became interested in computing disciplines, while female computing students differ in that they discovered that they were good at computing disciplines, and considered them as a major later in their educational experience – in high school and college. This could be due to the lack of "formal" computing education in the lower grades, the lack of educators trained in the computational sciences in elementary and middle school, or encouragement/discouragement by teachers or other influencers. It could also signify that computers are penetrating the lower grade levels to a greater extent and the results of this penetration have yet to be seen. It is also interesting to note that while a small number of females reported discovering STEM fields in the workplace, none (zero!) reported discovering their interest, aptitude, or major at home. This indicates that parents (especially parents who are employed in the technology industry) need to do a better job recruiting as well, supporting the findings of Croasdell, et al. (2010).

Parents, teachers, and mentors can influence a student's choice of field of study or occupation (Pollacia & Lomerson, 2006; Croasdell, et al., 2010; Mishra, Cellante, & Kavanaugh, 2014). Table 6 lists the influences on the choice of STEM disciplines from this study group.

Influence	Average*
Personal interest	4.5
Probability of working in field after graduation	4.4
Salary	3.8
Parents	2.1
Friends	1.9
Teacher/Counselor	2.2
Performance in courses in major	3.2
Intellectually stimulating	4.3
Good at computing/math	4.3

Table 6
Influences on selection of STEM major
* 1 = not important, 5 = very important

Table 6 yields both confirmation of previous results as well as some surprises. Personal interest, probability of working in the field, and aptitude for the subject rank at the top of the list for why students study STEM disciplines, confirming what other authors have found (Crampton, et al., 2006; Burns, et al., 2014; Walstrom, et al., 2008). Surprisingly, the influence of parents and friends dropped significantly compared to other studies (Crampton, et al., 2006; Burns, et al., 2014; Pollicia & Lomerson, 2006; Croasdell, et al., 2010). If students reported that teachers, counselors, or performance influenced their choice of major, females seemed to have that experience a bit earlier than males (grade 10 vs. grade 11). Table 7 breaks out the data by gender, and tests the hypothesis that gender ratings will be the same.

Influence	Male	Female	p-value
Personal interest	4.5	4.4	
Probability of working in field after graduation	4.4	4.3	
Salary	3.8	3.6	
Parents	2.1	2.0	
Friends	1.9	1.6	$p < .10$
Teacher/ Counselor	2.1	2.6	$p < .10$
Performance in courses in major	3.0	3.8	$p < .02$
Intellectually stimulating	4.2	4.4	
Good at computing/math	4.3	4.3	

Table 7
Influences on selection of STEM major by gender (p-value listed if significantly different)
1 = not important, 5 = very important

Table 7 illustrates that friends have slightly more influence on males than females, while counselors have slightly more influence on STEM selection by females. Also, females seem to have a greater tendency to major in subjects after performing well in than subject area.

Table 8 tells us that parental influence and teacher/counselor influence is not as important to computing majors as to other STEM disciplines. The influences computing students have in selecting their major appears to be personal interest in the subject, the probability of work in the field, intellectually stimulating content, and being good at the subject. Separating out computing students and performing a gender analysis revealed no difference in the categories listed in Table 8. It did reveal that when teachers, counselors or course performance played a part, males experienced this early in 11th grade, while females experienced it in late 11th to 12th grade.

Influence	Computing Major	Non-computing Major	p-value
Personal interest	4.5	4.5	
Probability of working in field after graduation	4.4	4.3	
Salary	3.7	3.8	
Parents	1.9	2.6	p<0.01
Friends	1.8	2.0	
Teacher/ Counselor	1.9	2.8	p<.01
Performance in courses in major	2.9	3.6	p<.01
Intellectually stimulating	4.3	4.2	
Good at computing/math	4.3	4.4	

Table 8
Influences on selection of STEM major by discipline (computing vs. non-computing)
1 = not important, 5 = very important

The survey contained 105 students whose parents were not in STEM fields and 60 students whose parents were in STEM fields. Table 9 reports the influences for these two demographic groups.

Table 9 points at the parental influence in students' selection of major in college. If the parents are in a STEM field, students are more likely to count that as an influencing factor in their decision to major in a STEM field. Further, if a student has a parent working in a STEM field, they are more likely to self-evaluate as being good at computing or mathematics. Analyzing the students whose parents are in STEM fields by gender yields Table 10.

Table 10 indicates that females, whose parents are employed in STEM fields, are influenced less by friends, and more by their performance in courses germane to their major. Beyond external influences, the survey instrument measured when (elementary, middle, or high school) students became intellectually stimulated by STEM courses, and how difficult students perceived their STEM coursework in school. Table 11 lists the results for the entire sample group.

Influence	Parent in STEM	Parent not in STEM	p-value
Personal interest	4.5	4.5	
Probability of working in field after graduation	4.4	4.3	
Salary	3.7	3.8	
Parents	2.4	1.9	p<.01
Friends	2.0	1.8	
Teacher/ Counselor	2.2	2.2	
Performance in courses in major	3.2	3.1	
Intellectually stimulating	4.4	4.2	
Good at computing/math	4.5	4.2	p<.10

Table 9
Influences on selection of STEM major by parent occupation
1 = not important, 5 = very important

Influence	Male	Female	p-value
Personal interest	4.5	4.4	
Probability of working in field after graduation	4.4	4.4	
Salary	3.7	3.7	
Parents	2.5	2.4	
Friends	2.1	1.5	p<.10
Teacher/ Counselor	2.1	2.6	
Performance in courses in major	3.0	3.9	p<.05
Intellectually stimulating	4.3	4.4	
Good at computing/math	4.4	4.5	

Table 10
Influences on selection of STEM major if parents in STEM discipline by gender
1 = not important, 5 = very important

Table 11 indicates an increasing level of intellectual stimulation as students progress through the grades in a traditional educational setting. It also shows a constant level of difficulty as students transition between elementary, middle, and high school.

Perception of Intellectual Stimulation and Difficulty of Coursework	1 = not intellectually stimulating, 5 = intellectually stimulating
High School STEM intellectual stimulation	3.8
Middle School STEM intellectual stimulation	3.2
Elementary School STEM intellectual stimulation	3.0
	1 = difficult, 5 = easy
High School STEM easiness vs difficulty	3.7
Middle School STEM easiness vs difficulty	3.7
Elementary STEM easiness vs difficulty	3.7

Table 11
Intellectual stimulation and ease of curriculum for STEM classes

Perception of Intellectual Stimulation and Difficulty of Coursework	Females	Males	p-value if statistically significant
	1 = not intellectually stimulating, 5 = intellectually stimulating		
High School STEM intellectual stimulation	3.9	3.7	
Middle School STEM intellectual stimulation	3.5	3.1	$p < 0.10$
Elementary School STEM intellectual stimulation	3.5	2.9	$p < 0.05$
	1 = difficult, 5 = easy		
High School STEM easiness vs difficulty	4.0	3.6	
Middle School STEM easiness vs difficulty	4.1	3.6	$p < 0.05$
Elementary STEM easiness vs difficulty	4.1	3.6	$p < 0.05$

Table 12
Intellectual stimulation and ease of curriculum for STEM classes by gender

Table 12 identifies gender differences in intellectual stimulation and difficulty of STEM courses. These differences appear earlier in the curriculum than in other studies. It can be seen that females perceive more intellectual stimulation in STEM topics in elementary school and middle school than do males. The same is true of easiness, females find STEM topics easier than males in the earlier grades. Again, this indicates that females should be encouraged (mentored, guided, coached) to pursue STEM disciplines earlier in their education. Table 13 separates the data by discipline, computing majors versus non-computing majors.

Perception of Intellectual Stimulation and Difficulty of Coursework	Computing Majors	Non-computing Majors	p-value if statistically significant
	1 = not intellectually stimulating, 5 = intellectually stimulating		
High School STEM intellectual stimulation	3.6	4.1	$p < 0.01$
Middle School STEM intellectual stimulation	3.1	3.5	$p < 0.05$
Elementary School STEM intellectual stimulation	2.8	3.3	$p < 0.05$
	1 = difficult, 5 = easy		
High School STEM easiness vs difficulty	3.7	3.7	
Middle School STEM easiness vs difficulty	3.7	3.8	
Elementary STEM easiness vs difficulty	3.6	3.8	

Table 13
Intellectual stimulation and ease of curriculum for STEM classes by major

Table 13 shows that STEM majors who are not studying computing indicated that they received more intellectual stimulation throughout their mandatory education than computing majors. The perceived easiness of the STEM coursework showed no statistical difference between majors. When the data was analyzed by gender, for majors in the computing fields, while females perceived the STEM topics to be easier and less intellectually stimulating, there were no statistical differences between males and females.

5. DISCUSSION

A shortage of students and graduates in information sciences (in general in STEM disciplines) is upon us. Compounding the problem is the lack of female students in the computing disciplines. Another factor that compounds the issue is the lack of information in society about information sciences. Students do not "appear" as CISB majors until later on in their college career. Many factors could be contributing to this, but when the general public hears "computing", they think of computer science, and not information systems. It is up to the IS community to help change this perception of computing.

Females seem to discover STEM disciplines earlier in their educational experience (see Table 3) than do males, but do not discover computing disciplines until later in their educational experience (see Table 4). In addition, female students in STEM disciplines are more intellectually stimulated in elementary and middle school, indicating the need to encourage females from a younger age than males. This should be an easy task, as females in elementary and middle school also find the STEM disciplines less difficult than male students.
As females progress through school, they have a greater tendency to follow disciplines that they perform well in. This means that high school teachers and college professors have the task of identifying these students and encouraging them to pursue these disciplines.

Finally, it is up to educators at all levels to recognize talent in students and guide them in an appropriate direction for their studies.

Some limitations of this study include a small n for females, in particular females who are studying computing disciplines (which is illustrative of the issue being addressed), and a lack of breadth in the survey deployment (more students from more schools should be surveyed).

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Editor's Note:

This paper was selected for inclusion in the journal as a EDSIGCon 2015 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 2015.

Appendix A - STEM Survey Instrument

State University Survey on STEM Interest
(STEM = Science, Technology, Engineering and Mathematics)
Your participation in this study will require completion of this questionnaire. This should take approximately 5 minutes of your time. Your participation will be anonymous and you will not be contacted again in the future. This survey asks questions about your interest in STEM disciplines and so constitutes no risk to you in responding. By completing and returning this questionnaire you are giving your consent to participate in my research. Your responses on the questionnaire are anonymous and you should not put any identifying information on it anywhere. You can stop filling out this survey at any time. I will be happy to answer any questions you have about this study. If you have further questions about this project or if you have a research-related problem, you may contact the researcher. If you have any questions about your rights as a research participant you may contact the Director of Sponsored Programs.

Demographic Information	
Gender: □ Male □ Female	Year of Birth: _____________
Degree pursuing: □ Associates □ Bachelors □ Other/Non-degree	
Current Status: □ Freshman □ Sophomore □ Junior □ Senior □ Other	
Your marital status: □ Single □ Married	
Major: □ Mathematics □ Computer Science □ Computer Information Systems □ other (please list your major: _______________________________________)	
Are you employed: □ full time □ part time (number of hours per week ________) □ no	
Do you attend school □ full time □ part time (number of credits __________)	
Did you have computers in your home growing up? □ yes □ no □ part of the time	
Were either of your parents employed in a STEM field? □ yes □ no	
If either of your parents were employed in a STEM discipline, what was their highest education level? Please list: ______________________	

Interest Information					
When did you first discover your interest in STEM disciplines? □ elementary school □ middle school □ high school □ college □ at work					
When did you first discover that you were good at STEM disciplines? □ elementary school □ middle school □ high school □ college □ at work					
When did you first consider a major in a STEM discipline? □ elementary school □ middle school □ high school □ college □ at work					
When you entered college, did you need remediation (non-credit college coursework) in: □ Mathematics? □ English? □ Reading? □ no remediation needed					
School Information					
Please rate the following questions according to the scale: 1 = not intellectually stimulating, 2, 3, 4, 5 = very intellectually stimulating Circle your response					
In high school I found STEM courses:	1	2	3	4	5
In middle school I found STEM courses: :	1	2	3	4	5
In elementary school I found STEM topics: :	1	2	3	4	5
Please rate the following questions according to the scale: 1 = difficult, 2, 3, 4, 5 = easy Circle your response					
In high school I found STEM courses:	1	2	3	4	5
In middle school I found STEM courses: :	1	2	3	4	5

In elementary school I found STEM topics: :	1	2	3	4	5

Influence Information					
Please rate the following influences on your major selection according to the scale: 1 = not important 2, 3, 4, 5 = very important Circle your response					
Personal interest	1	2	3	4	5
Probability of working in the field after graduation	1	2	3	4	5
Salary – starting and long term	1	2	3	4	5
Parents influenced choice of major	1	2	3	4	5
Friends influenced choice of major	1	2	3	4	5
Teacher/counselor influenced choice of major In what grade? _________	1	2	3	4	5
Performance in courses in the major In what grade? _________	1	2	3	4	5
Intellectually stimulating	1	2	3	4	5
Good at computing/science/mathematics	1	2	3	4	5
Other: ____	1	2	3	4	5

Please add any other comments regarding how you ended up as a STEM major at SU.

How an Active Learning Classroom Transformed IT Executive Management

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Abstract

This article describes how our university built a unique classroom environment specifically for active learning. This classroom changed students' experience in the undergraduate executive information technology (IT) management class. Every college graduate should learn to think critically, solve problems, and communicate solutions, but 90% of students are not prepared for white collar jobs. Active learning pedagogy, which involves students directly in their own learning, improves these skills, but active learning exercises are difficult to implement in traditional rank-and-file classrooms. Students are accustomed to passive lectures and they tune out or stare at screens, further frustrating overworked faculty. In this article, we showcase the impacts of creating a modular space to support multiple arrangements and new activities, particularly group discussions. This room included state-of-the-art collaborative tools to support group work and writeable tables to encourage creative expression. Creativity is essential to discovering new solutions to difficult problems. Students reported that this combination of environment plus pedagogic change broke them out of their stupor. It forced them to think more critically and to become involved in class, which increased faculty satisfaction with the course. This article contributes to the literature on how to teach IT management to undergraduates. It also contributes to the sparse literature on how the classroom environment affects student learning, engagement, and critical thinking.

Keywords: active learning, learning environments, critical thinking, IT management, executive leadership, innovative pedagogy

1. INTRODUCTION

Employers expect college graduates will know how to think. College should prepare students to think critically, solve problems, and communicate solutions. Companies consistently rank critical thinking and communication in the top five skills new graduates should know how to do. Furthermore, most raw facts that students memorize are obsolete within a few years after graduation. This problem is even more acute in technology-based fields such as management information systems (MIS). Additionally, 90% of college graduates are unprepared to hold white-collar jobs, further reducing the value of their degrees (Selingo, 2015). Something needs to change, but how?

One important component of a well-rounded MIS education is information technology (IT) management. How can we train students to become IT managers? In this article, we discuss how we built a classroom specifically designed for active learning pedagogy, which enhanced the faculty's ability to teach skills needed in IT management. In active learning, students actively participate in classroom activities as opposed to being passive sponges of faculty wisdom. We changed the nature of learning by changing the learning environment. Students reported being more engaged in class and faculty enjoyed the flexibility to design more interesting sessions.

Executive IT management teaches students how to think strategically about IT resources from a manager's perspective – no easy feat for students with little or no work experience. More perplexing, the real world doesn't have "right" answers. To make good decisions, managers must take stock of available resources, assess options, and meet measurable goals. How do we teach students to do that, without creating clones of our own thinking? We must teach students how to actively think for themselves.

The next sections review the literature about active and place-based learning and describe the course and university settings in which this intervention happened. We then discuss how the IT management course was changed and the impacts on students and faculty. Finally, we describe the future of this research and suggest how other schools could implement this program.

2. LITERATURE REVIEW

Critical thinking is notoriously difficult to teach (Willingham, 2008), particularly in fast-paced, uncertain environments such as IT. Every day, we see thousands of companies solve similar problems in different ways. Did Apple get it right, or Microsoft? IT strategy differs from company to company and sometimes from moment to moment, even within the same company. So how can students with no corporate or IT backgrounds learn IT management?

Transferable critical thinking skills are the key. Skills transference occurs more frequently when learned in context rather than in a vacuum, and students' learning environment can profoundly affect what they take away from a course. Courses with more student-faculty interaction, active student involvement, and "teaching for understanding" increase students' capabilities, whether they are part-time or full-time students (Kember & Leung, 2005). Therefore, the combination of active learning in the right environment should improve students' ability to learn critical strategic thinking, which is a major component of good IT management.

Unfortunately, very little literature talks about how to use active learning to teach IT management. Few studies have measured its effectiveness and outcomes, and none discuss how to build an active learning classroom. For example, Duron, Limbach & Waugh (2006) outline a 5-step framework for critical thinking and active learning. One of the most effective skills teachers need is the ability to question. In other words, students are not spoon-fed answers; in an active learning environment, they must find the answers on their own. In our experience, students unaccustomed to this pedagogy find it frustrating at first, but these skills are vital for students entering an uncertain environment such as IT.

We need to prepare students to ask the right questions and to sift through mountains of information, some of it right, some wrong. Active learning in the right setting can do that. The next section further explains why active learning is vital to teaching IT management.

The Importance of Active Learning

Active learning is any kind of pedagogy that involves the student in his or her own learning, in contrast to more traditional, "passive" forms of teaching such as "sage on the stage" style lectures (Wingfield & Black, 2005). Considering active learning's broad definition, it encompasses various models and theory-based pedagogies such as discussion-based lessons, problem-based learning, role-play, and service learning. Active learning also overlaps with other pedagogies, such as constructivism, cognitive apprenticeship heutagogy and andragogy. Any of these models may potentially fall under active learning's broad umbrella (Bauersfeld, 1995; Blaschke, 2012; Collins, Brown, & Holum, 1991; Wingfield & Black, 2005).

In constructivism, teachers act as facilitators while students co-construct knowledge within the classroom in an attempt to create a level playing field (Bauersfeld, 1995). Active learning overlaps with constructivism, in that students cannot remain passive and construct knowledge at the same time. Cognitive apprenticeship ties into active learning because in cognitive apprenticeship, the teacher and student make their thinking visible as they process new knowledge (Collins, et al., 1991), which actively involves students in the learning process. Similarly, heutagogy (self-determined learning) and andragogy (self-directed learning) are overlapping niches within the broader definition of active learning (Blaschke, 2012).

Active learning is especially important for teaching IT management, because students need to actively learn "to operate in an information rich environment" (Oberman 1991, p. 198). Students entering IT jobs must contend with a rapidly changing environment and potential information overload. IT changes at a faster rate every day. Every new innovation creates a new playing field. IT managers must adapt. For example, in 2009, the advent of Facebook revolutionized marketing and public relations. Between selfie sticks, viral marketing and foodies, the world hasn't been the same ever since.

Active learning seminars are much more effective than traditional ones for "creating interest, learning effectively, preparing for careers, learning how to apply knowledge, and developing independent learning skills" based on a pre- and post-study experimental design (Sivan, et al., 2000, p. 385). To make discussion based lesson plans even more effective, Page and Mukherjee (2005) claim that active learning in the form of negotiation exercises teaches students valuable, higher order critical thinking skills such as analysis, synthesis and evaluation. Certainly, these skills are necessary for effective IT management. Thus, we incorporated these activities into our active learning pedagogy, as discussed in Section 5.

However, it is not enough to add active learning pedagogy to lessons. The learning environment itself must change. The first stage in active learning is disequilibrium, because "the mental discomfort...challenges students to think actively and constructively" (Oberman 1991, p. 198). Place-based learning immerses students in the world around them, which increases context and deepens learning (Gruenewald, 2003; Semken & Freeman, 2008). However, immersive learning environments are limited by the fact that most university classes must remain inside a physical room on campus.

A "community of inquiry" in which students are encouraged to ask questions to learn the answers on their own is vital for critical thinking and deep learning (Lipman, 2003). In fact, it may be the only way it occurs. When students take a deep learning approach, they seek to understand material, which improves recall. With surface learning, students attempt to memorize information without considering what it means or why it's important. Surface learning tends to be forgotten, because it is not connected to anything in memory. An active learning environment should therefore improve critical thinking and deep learning. To explain why we changed the IT management class at this university, the next section describes the context of the IT management course within the larger university setting.

3. THE UNIVERSITY AND IM&S PROGRAM

The University of South Carolina Upstate is a 4-year, regional senior campus linked to a Research One institution in the Southeast United States. The University has approximately 5,700 students and 300 faculty with 4/4 teaching loads, resulting in a low student to faculty ratio. The school's metropolitan mission is to provide high quality baccalaureates who are ready to work. The Information Management & Systems (IM&S) program at the University is uniquely situated in the College of Arts & Sciences. The program is neither Computer Science nor Business, yet it teaches a lot of both.

It also has a vibrant, accredited healthcare information management (HIM) minor. The HIM minor attracts nursing students who don't want direct patient care. (The nursing school is the largest and oldest on campus.) As a result, students in the IM&S program often filter in from other majors where they do not quite "fit." This unique balance between computer science, business, and nursing means that IM&S students are more diverse and sometimes less prepared for strategic thinking. Students don't always know what MIS is or what it does, but they want to work with people and computers.

The local region sorely needs these majors to fill IT management positions, because employers report negative unemployment, with fewer candidates then job openings. Therefore, this course is important for students entering the field. The next section describes the course.

4. EXECUTIVE IT MANAGEMENT

Executive IT management teaches students how to strategically manage IT resources. The course covers the gamut of IT management strategy and issues and challenges facing IT executives including IT alignment, governance, executive leadership, oversight, return on investment analysis, project management, and risk management. Before taking this class, students have learned about relational databases, technical presentation and communication, data warehousing, social informatics, and introductory programming. Project management is often taken concurrently.

The course is required for IM&S majors and students typically take it their senior year. A section is taught every fall and spring and alternating summers. On average, 25 students enroll in the course each semester. In Fall 2014, students were 70% male and 30% female. In Spring 2015, the students were exactly the opposite (70% female and 30% male).

Originally, the course was taught by a retired IT executive who relied on lectures. Graduates felt the information was useful, but that they did not have sufficient opportunities to practice management skills during the course. Students also felt unprepared to make IT management decisions. This faculty member left the University, which created an opportunity for new faculty to revamp the course. The next section discusses how the classroom and the course were changed to support active learning.

5. ACTIVE LEARNING INTERVENTION

In October 2014, the U.S. Department of Education awarded the University a $2.2 million Title III grant to build “active learning spaces” and infrastructure on campus to encourage active learning which should ultimately increase student retention. Student retention is a major university strategic goal. The University applied for this grant because it wanted to initiate new strategies to engage students in their education. As part of the grant, engagement and retention are regularly measured through surveys and focus groups of faculty and students involved in the active learning program.

The University decided to roll out one classroom per building annually, in order to test what works, and maximize outcomes over time. Based on its natural fit with active learning pedagogy, executive IT management was selected as one of eight pilot courses. The first active learning classroom was built in January 2015. This room has innovative, moveable furniture. Almost every piece of furniture in the room can be moved and rearranged to support learning activities, including small to large group work. The tables and chairs are lightweight and/or wheeled. Some tabletops are glass and the room has a dozen personal whiteboards to support brainstorming and creative expression. Very few chairs have chair backs, encouraging students to move around and preventing them from getting “too comfortable.”

The room is equipped with an Epson Bright Link projector on either side of the room. The room was designed around the concept of “no front of the room” and having dual yet opposing projectors facilitates that vision. As a result, the focus shifts to students and student-based learning. See the Appendix for photos of the room.

Environment is a major influence of student involvement in higher education (Astin, 1993). In this course, students learned in a new and constantly changeable environment. Every week, the furniture was rearranged to suit the day’s activity. Students were asked to sit in a new place every week so as to stimulate disequilibrium. Just as active learning prevents student passivity, the environment should not be passive in the learning process either (Whiteside, Brooks, & Walker, 2010).

Along with benefits to creating environments conducive to student learning, Bronfenbrenner (1993) suggests that government programs, university policies, and interactions between faculty and other students impact student behavior (Renn & Arnold, 2003). Therefore, it is neither the pedagogy nor the classroom, but the unique combination of both that creates results. For these reasons, the University intentionally designed spaces conducive to active learning. Faculty received additional training in active learning pedagogy to increase their success in the new room.

Course Redesign

In creating a new kind of course, the first item changed was the textbook. In order to make the course more realistic and maintain student interest, the textbook was changed to an academic novel titled Adventures of an IT Leader by Austin, Nolan and O’Donnell (2009). Published by Harvard Business Review, it tells the story of Jim Barton, a management executive who is unceremoniously thrust into the role of Chief Information Officer (CIO).

Students experience what it’s like to be the CIO through the eyes of a non-IT person as he copes with a hostile CEO, an infrastructure replacement project, and a major data security breach, all while learning how to align the company’s IT strategy with its corporate mission. Barton’s world – like ours – doesn’t have easy answers. Very little is cut and dry.

However, because it's a story, students find it approachable, memorable and useful.

The next major change to the course was to make it heavily discussion-based. It was not designed as a flipped classroom, although students were expected to read the material before coming to class. There were no formal, passive lectures, nor standard PowerPoint slides. Material was delivered through the textbook-novel, six case studies from various sources, and six chapters from an unpublished book on IT debates.

Cases were selected based on a few factors. First, length was important to increase buy-in. The first case reading assigned was short, no more than ten pages, to ease students into the format. Inexperienced students sometimes express dismay if they have to read too many pages in the first assignment (Barnes, Christensen & Hansen, 1994). Second, cases were selected that were closely aligned with topics in the textbook and objectives of the course. Finally, preference was given to cases about well-known companies or technologies that students already knew, to make the case more approachable for students with limited IT work experience.

The course also involved six IT debates. Based on Gill's case method approach, students discussed the merits of the issues (Gill, 2012). Issues included whether privacy still exists given the ubiquity of data collection, whether large-scale ERPs are dying out, and whether IT really makes work more productive since it takes up so much time, for example. To prepare for debates, all students read a prepared chapter of background material. Each debate was assigned to a small group who researched the issue more deeply and presented their findings to the class to discuss in more detail.

Critical thinking means making an informed decision after considering all sides of a situation, or as much information as you have available (Hooks, 2010). IT management involves dealing with uncertainty and weighing risks. Therefore, discussions and activities were designed to get students to see multiple sides of an issue. Students considered "pros and cons" of their decisions in order to weigh options. They were encouraged to go outside the class materials to research issues and to think through the consequences of their decisions. Therefore, after the debates, all students were asked to decide the issue individually. Students reflected on the issues in an online feedback form given at the end of each class. The take-home midterm and final exams were essay-based and designed to test students' critical thinking abilities. Compared to the previous semester, students in the active learning class were better able to articulate their thoughts and communicate the reasons for their decisions – both hallmarks of critical thinking. The next section describes some of the activities students completed in the active learning classroom.

Active Learning Examples

Students created the majority of the meaning and sense making within the course by themselves, with faculty serving as a subject matter expert and sometimes facilitator. Students were encouraged to work together. The day's discussion usually began with small group work to get everyone on the same page. Smaller groups were more effective at getting reticent students to participate, which was particularly important in a predominantly female class.

Students designed the rules for class discussions at the beginning of the semester, and they were encouraged to police themselves. For the most part, students behaved collegially and they supported each other. In one poignant example, one student bravely came to class after three of his friends had died in one week. He was obviously upset. He was excused to leave, but he chose to stay. The class politely asked if there was anything they could do to help. A few students went so far as to hug him in sympathy, and then he was politely let to absorb the discussions going on around him. Thankfully, most days were much less emotional.

After small group work, the whole class worked together. Although students led the discussions and explored the issues themselves, they still needed guidance to focus their efforts. One particularly effective exercise were the problem solving slides. A set of four to six slides were displayed on one or both of the Epson whiteboards. Students did not see the slides before class. The slides contained open ended problems. The class designated someone to write the answers on the slides to solve the problems. Problems typically brought together material from multiple sources including those students had not seen before. For example, to discuss how to allocate IT budget resources, students categorized a company's IT systems into a grid for Competes versus Qualifiers (Austin, et al., 2009). In another example, students compared the advantages and problems associated with outsourcing, and one of the slides gave students a chart showing industry trends, which they could then (or not) incorporate into their discussion on the topic. These slides were later uploaded to the course learning management system for later study. Example are given in the Appendix.

Students could also write on the tables to make group decisions. In discussing case studies, students were challenged to list facts, assumptions, analysis and decisions as a way of categorizing knowledge. Most chose a SWOT analysis (strengths, weaknesses, opportunities, and threats). By writing down ideas collaboratively, students were forced to discuss their ideas with the group. Students could also use the tables to doodle and draw out ideas. Writing while thinking improves recall and creativity (Brown, 2014). These activities improved communication in small and large group settings, as shown in student feedback and learning outcomes, described in the next section.

6. STUDENT LEARNING OUTCOMES

Assessing and grading students' work in an active, participation-based course is difficult. In this course, students were assessed based on how well they prepared for class, their willingness and enthusiasm for the day's activities, and their self-reflection of those activities. Preparation was graded based on the quality of the student's contribution to the day's discussion. Were they aware of the day's lesson topic? Did they bring notes to class? Did they bring questions? Were they moving the discussion along or did they sit quietly, staring at their phone? Did their end of class reflection mention the day's topic? Did they leave class with any burning questions?

Students' perceptions of their learning are almost as important as their performance. Students reported that the classroom environment affected their learning. Students stated that the classroom arrangement encouraged them to get to know their fellow students, to come out of their shells, to network with classmates, and to better prepare for class discussions. The fact that their peers might judge their performance (as opposed to just the teacher) altered how they felt about the class.

Students were asked for feedback at the end of the semester in the form of online surveys and in-person focus groups. The survey data for this course was collected with other courses, so we cannot report it here. However, student feedback from the focus groups could be separated out. It was overall positive.

Compared to a traditional classroom, students felt the room was beneficial for discussion. They preferred this room for discussion over a traditional classroom. For example students reported that "In this type of classroom, it was easier to figure out who was talking instead of having to look behind you. You actually heard other peoples' ideas." As a result, "I felt more involved and [like] I mattered more… in more traditional classrooms, you don't get to talk unless you raise your hand."

Another student said that "the furniture gave me a relaxed feeling where I was able to feel comfortable to talk more." "It allowed for more communication and to allow students who usually would not communicate too easily. The furniture in the class placed us (the students) in a position to interact with one another and bounce thoughts and ideas off each other." On the other hand, "Some people were resistant to change…you're used to that one seat you sit in all semester. From a teacher standpoint, I can see why it was good because students sat next to someone new." Students got to know their fellow classmates better than they would in a traditional classroom.

As far as what they learned in the course, students stated that it "helped in how to make difficult decisions and handle those situations in a diplomatic manner." Further, that "learning how to critically think about situations helps me in my career. I enjoyed the group activities that we later shared to the group. It helped me to understand some of the material that I did not fully get. The notes from our class helped me understand material in some other courses a little better because we discussed it." In other words, students identified that they were learning to think critically and connected it with their careers. Students noted how the room worked in tandem with the discussions to actively involve them in their own learning.

7. FACULTY REFLECTION

From the faculty's perspective, this course would be difficult to facilitate for anyone inured to traditional lectures. It required giving up control of the class space to students. It entailed additional preparation before class to design how to run the space. It also required a high tolerance for ambiguity, empathy and emotional intelligence, to know when to press a matter and when to let it go. These skills are needed for any discussion-based course, but the active learning classroom cast a spotlight on these issues and brought them to the forefront. In addition to designing the discussion, we also had to think about the space itself. We had to account for the furniture and the physical space. For example, with students working in small groups around low tables, at least one student would have her back turned. The dynamic changed because the teacher was no longer the sole focus. Teaching in this environment sometimes felt like spinning plates on spindles. In order to succeed, students had to be prepared for a different dynamic.

Preparing Students for Active Learning
Students were forewarned ahead of time what to expect, and how they might benefit. This mode of learning may not work for all courses in the MIS curriculum, particularly those with hard and fast "right" and "wrong" material. However, IT management strategy is hard to learn without seeing it in action. Therefore, for IT management, it helped students to practice these skills.

For faculty considering active learning interventions, we offer some advice. First, plan to move around a lot. Try to think outside the box. Designing interactive activities for each day's lesson is rewarding, creative and fun. Don't be surprised if some activities flop. They will. It doesn't mean you've failed; you've learned something. Perhaps it needed a scaffold assignment first. Perhaps it was just the wrong group of students. What works with a group of students in the morning section may not work in the afternoon and vice versa (Brookfield, et al., 2012). The same thing happens in industry, and we should prepare students to try new things.

No Right Answers
Even late in the semester, when students should have been completely comfortable with the active learning environment and the discussion-based format, they would look to the professor when they talked. Although students understood that they controlled the learning space, they were still ingrained to the old pedagogy. They didn't completely trust their control over the space. Students in general are very sensitive to faculty dominance and/or reticence in a classroom. Faculty hold a lot of power, because they control students' grades. It is hard to overcome years of conditioning in one semester.

One method to alleviate this problem was to turn students' questions back on them. Especially if students asked, "is that right?" for validation, the answer was, "You tell me." In this way, students were forced to consider the facts. More importantly, it enforced the idea that they control their own learning. If students persisted, they were encouraged to look it up or have a friend look it up on their smart device to find an answer, or to ask the class at large. If the question spoke to faculty expertise as a member of the discussion, only then would students get a direct answer.

Students who are used to being fed answers find this practice somewhat frustrating at first, but over time, they learn to appreciate it. In a sense, it's freeing. They come to realize that they know more than they think they do, and that they are allowed to decide the answers. They aren't required to think like the professor – just to think. To better prepare students for this learning environment, it's essential to explain the rules from the outset. Explain how student participation will be graded and how students will benefit. Relate the material directly to topics that students know.

8. CONCLUSIONS

Theoretically, based on how people learn, an active learning environment should improve student outcomes. However, evidence of this link is sparse. Wingfield & Black (2005) found no link between course design and student grades, satisfaction, or perception. The only perceptible difference that students reported was in the course's usefulness in their future careers (p. 123). In this case, we changed the room and the pedagogy, and students reported they noticed the difference. Their critical thinking improved. More importantly, students and faculty enjoyed the course.

While it would be infeasible to expect schools to build dedicated active learning spaces overnight, it is still possible to incorporate active learning into traditional rank-and-file desk arrangements. By allowing and even encouraging students to rearrange the room to suit their needs, we can simulate active learning pedagogy. If we refuse to give students every answer while teaching them to find their own answers, we will create the next generation of critical thinkers, which is exactly what college is supposed to do. As one student wrote so eloquently, "Open your mind to new possibilities. Days of the old boring traditional classroom are over."

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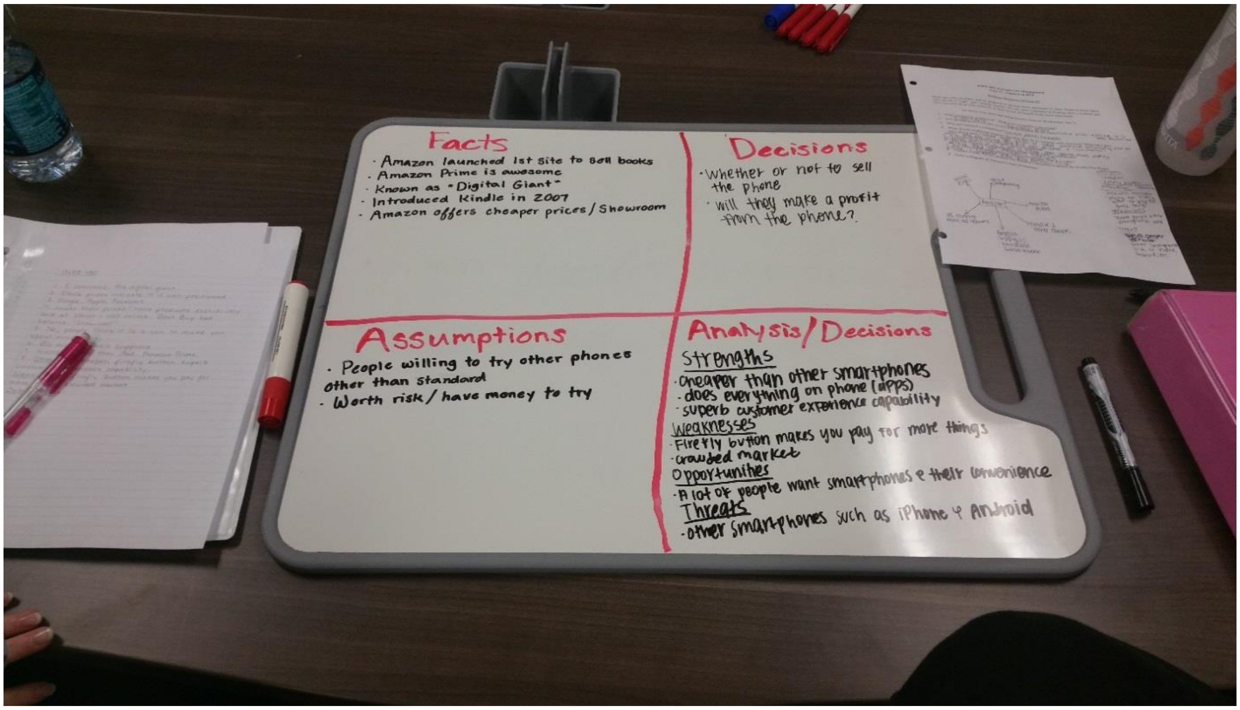
Appendix

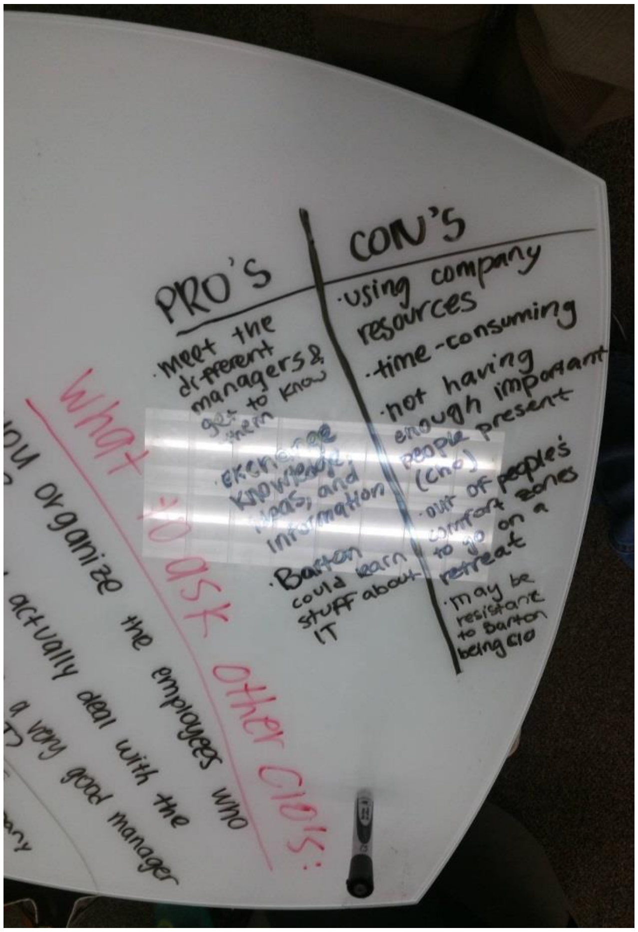
Course Schedule

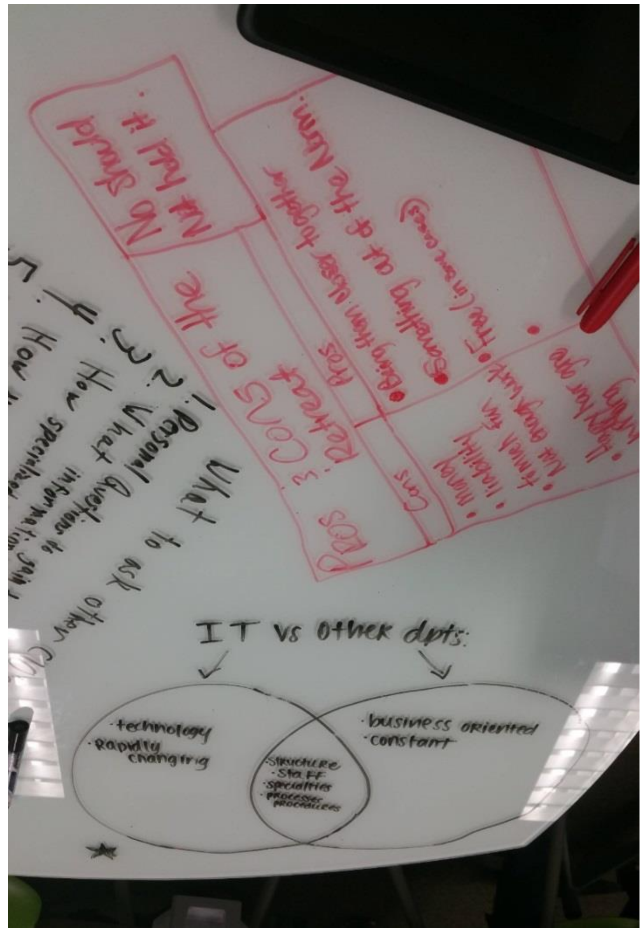
Week	Topics Covered	Readings
1	Introduction to course, create discussion rules	Austin Ch 1 and Case 1
2	Role of the CIO in the organization vs other CXOs	Austin Ch 2-3
3	IT spending and budgets, importance of IT strategy	Austin Ch 4-5 and Case 2
4	IT and competitive advantage	Debate 1
5	IT project management	Austin Ch 6-7
6	Return on investment and role of the board of directors	Austin Ch 8-9 and Case 3
7	Enterprise resource planning, privacy issues	Debate 2
8	Ethics and risk management	Austin Ch 10-11 and Debate 3
9	Policies on emerging technologies such as social media	Austin Ch 12-13 and Case 4
10	Effects of big data on the organization	Debate 4
11	Vendors, human resources, and offshoring	Austin Ch 14-15 and Debate 5
12	Standards versus customization, security vs. risk management, entrepreneurship	Austin Ch 16-17 and Case 5
13	Open source and intellectual property	Debate 6 and Case 6
14	Reflection and focus groups	None

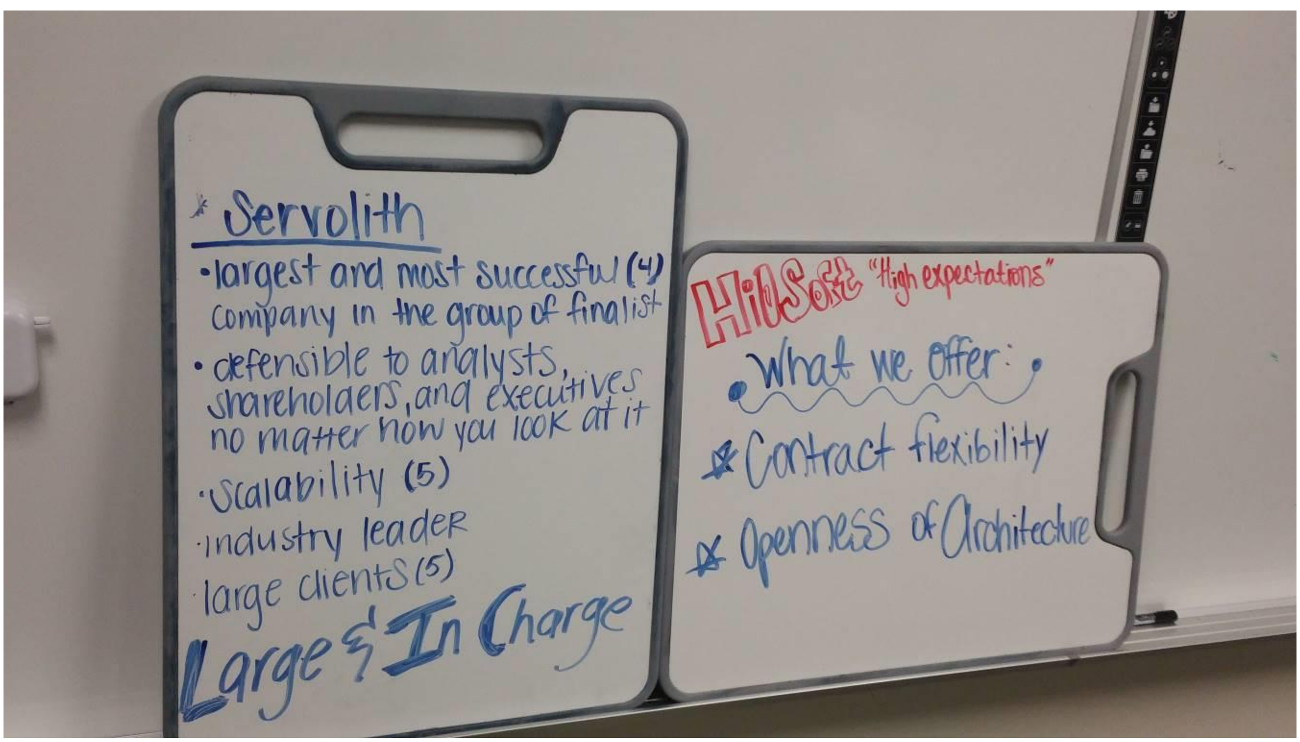
Examples of student work



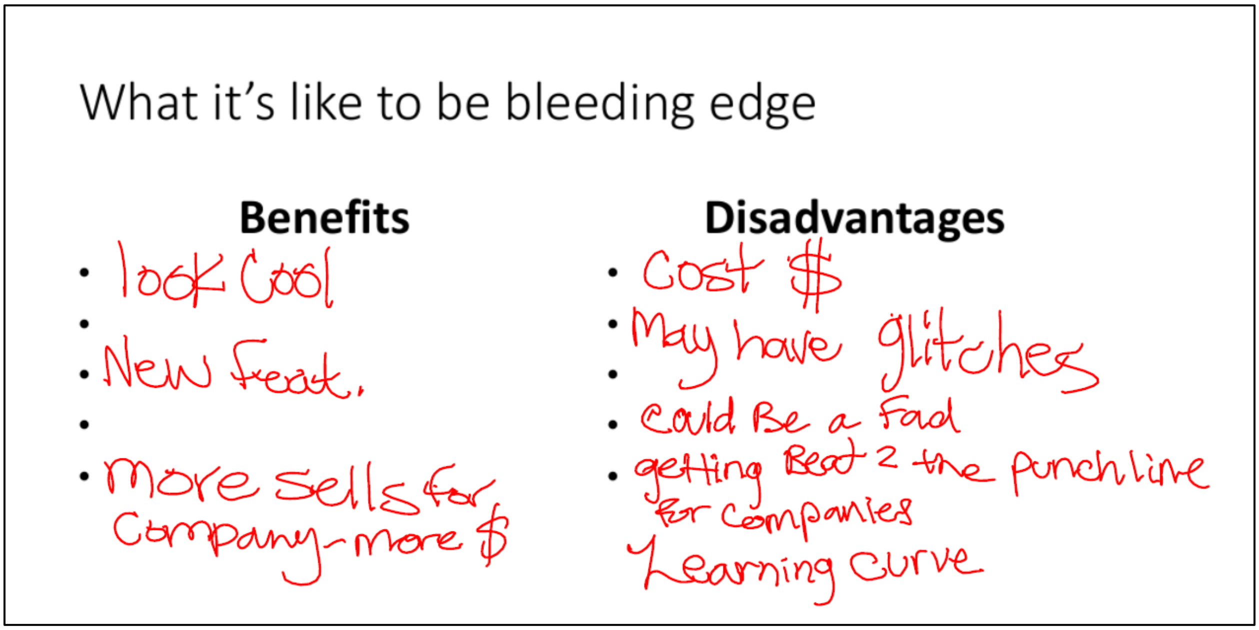
Examples of student work (continued)

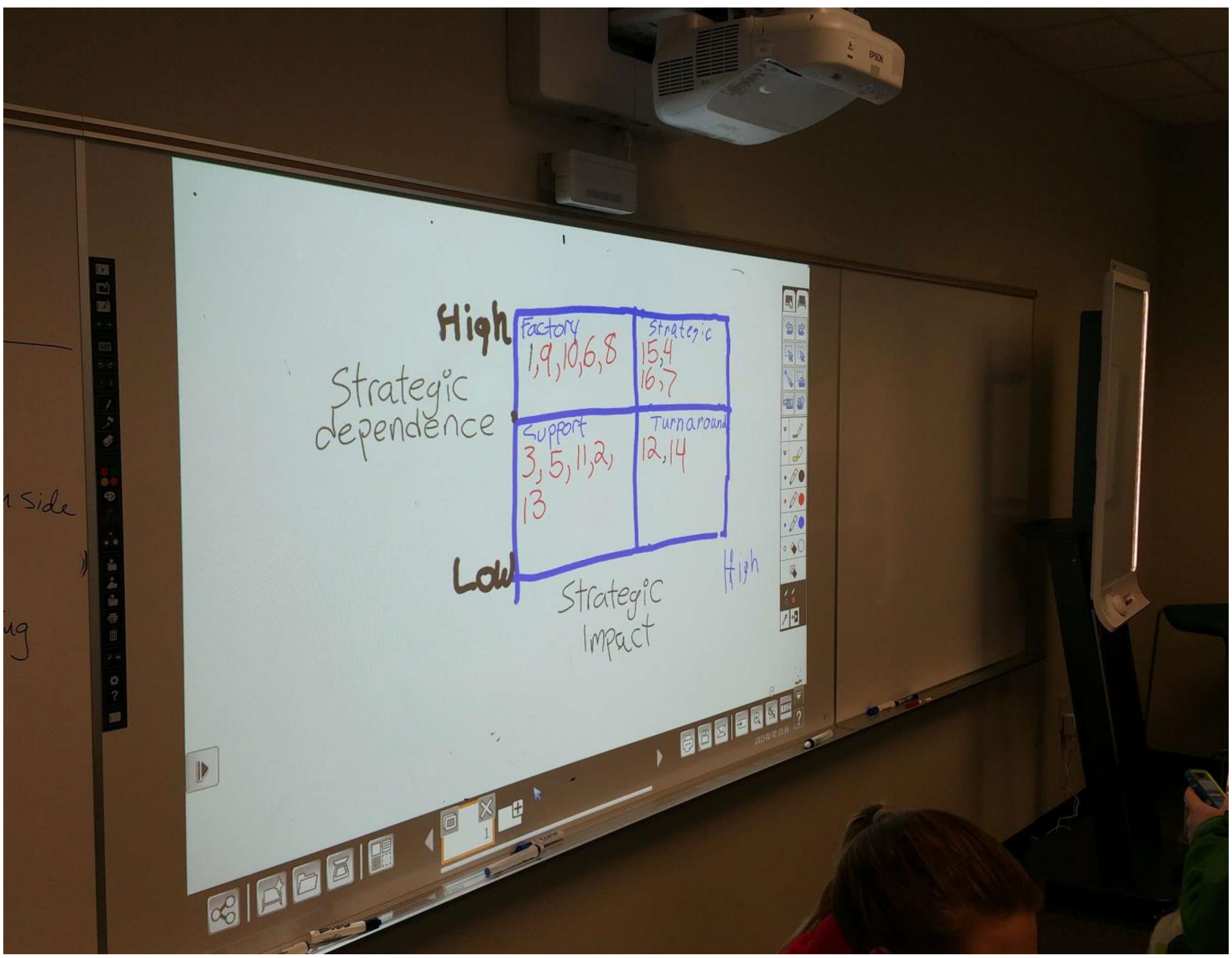




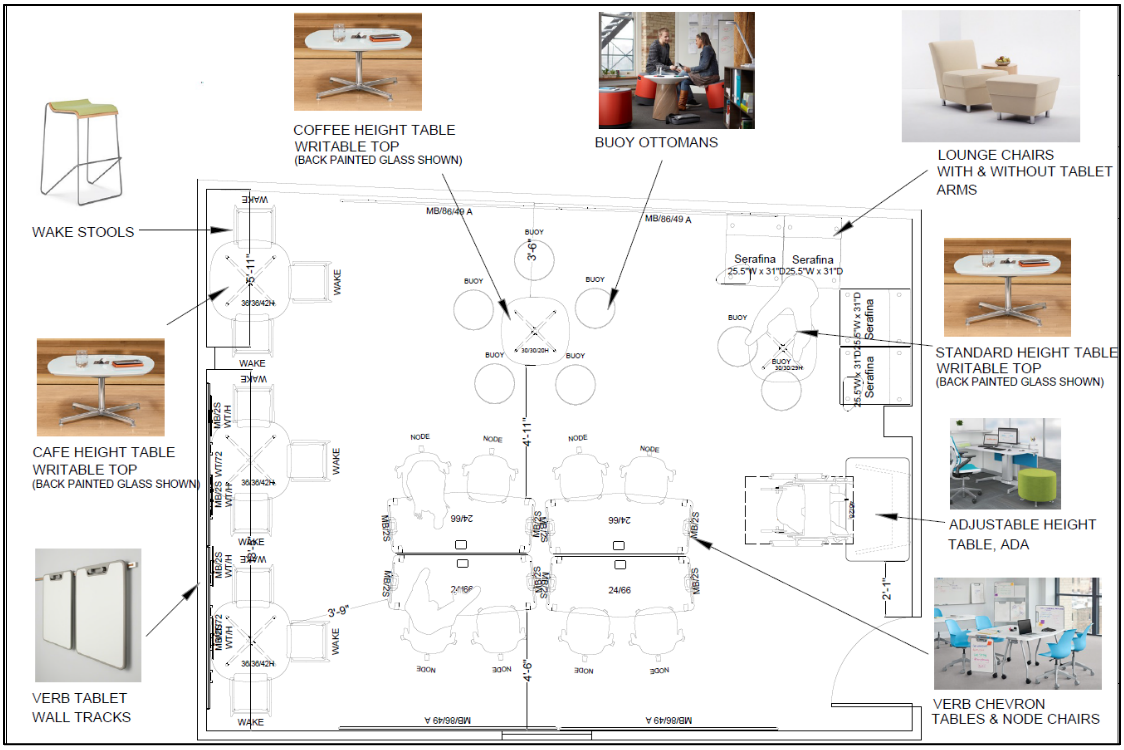


Examples of student work (continued)





Active Learning Classroom



ACTIVE LEARNING CLASSROOM

"Reprinted with permission from Young Office, who prepared these diagrams for USC Upstate's use and dissemination in designing and building its first active learning classroom."

Acclimating Students to Technology in the First-Year College Experience

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Abstract

The start of the college experience is often hectic as students discover their new surroundings on campus. Students must carry out several high-tech tasks on their laptops and mobile devices in order to be successful participants in the digital culture that permeates their institution of higher learning. This paper describes the implementation of mandatory JumpStart sessions, held during the first week of the semester outside of class time, for first year students enrolled in a required Technology Concepts course. The goal of these peer-led sessions is to set up student laptops and devices to function within the university's computing infrastructure, to install needed software for their technology concepts course, to introduce students to computing resources on campus, and to create a social learning environment where students engage with each other. In doing so, students form a community of practice which serves them well as they acclimate to their new surroundings.

Keywords: technology literacy, introductory technology course, tech savvy, mobile computing, freshman experience

1. INTRODUCTION

Incoming college students arrive on college campuses with differing levels of digital literacy, and suddenly find themselves with the need to discover and acclimate to the new technology devices and infrastructure that surround them. They must set up email on their laptops and devices, install malware and virus detection software, navigate their university's intranet and learning management system (LMS) to access course documents and files, and install additional software on their laptops for use in courses in which they are enrolled during the coming semester.

As higher education continues to depend on the use of technology and the web to deliver courses and exams, manage grades, place students in work-study assignments, register for courses, and access online library resources, the need for students to have a properly configured laptop and mobile device becomes essential.

This paper describes the development and implementation of JumpStart sessions designed to help freshman students at a business university configure their laptops and mobile devices, install necessary software to prepare for their required technology concepts course, and help them acclimate to the university's computing and online resources. In the process, students participate in a social learning experience, meeting peers and tutors, and engaging with social media.

2. TECHNOLOGY AND THE FIRST-YEAR COLLEGE EXPERIENCE

Despite the technology savviness of today's digital natives (Prensky, 2001), the level of technology skills that students have when arriving on campus varies. (Kaminski, Seel, & Cullen, 2003), (Ratliff, 2009), (Winke & Goertler, 2008), (Feldmann & Feldmann, 2000). Kaminski (Kaminski, Seel, & Cullen, 2003) states that institutions have found "a fundamental 'digital divide' in computer-based skills that students bring to post-secondary education.

Winke and Goertler (2008) studied the abilities of 911 post-secondary students at a state university, 98% of whom owned or had access to a laptop or desktop computer. Their results found "a personal versus academic/professional computer literacy divide" among students. Many easily could send email, browse the Internet, play videos, and download files, but were not familiar with more advanced tasks such as interacting with multimedia, and maintaining websites. (Winke & Goertler, 2008, p. 494)

Stone, Hoffman, Madigan, and Vance (2006) examined how first-year students at universities in Pennsylvania and Connecticut learned their technology skills. They found that "a lack of basic ICT (information and communication technology) skills may render an incoming freshman unable to perform the fundamental tasks required at the university level." (Stone, Hoffman, Madigan, & Vance, 2006, p. 118)

Collaborative learning, where students learn by working together in small groups to solve problems, has been shown to be beneficial for students learning technology. "In order for students to become competent users of the technology they need to be able to integrate the technology into daily … activities." (Miertschin & Willis, 2004, p. 152) Learning from peers has been shown to be effective in developing a community of learners. (Tinto, 2000), (Frydenberg, 2013) "In a tutoring lab setting, student tutors bring with them the authentic experience of having themselves learned the material that they are trying to explain, an awareness of the difficult concepts, and an understanding of what aided their own learning." (Frydenberg, 2013, p. 52) Students working together form learning groups that promote engagement with the topic. "Students in a learning community tend to form their own support groups; learning community students become more actively involved, and students' stories always highlight the powerful messages about the value of collaborative learning." (Tinto, 2000, p. 1)

Given the disparity of technology skills among incoming college students, and the effectiveness in learning when students engage with both technology and each other, the authors set up "JumpStart" sessions during their first week of classes in order to ease the transition and meet these goals. These questions guided this study:

- How could small group, peer-led "jump start" sessions help students adapt to the technology needs of their freshman experience?
- Would small group sessions enable students to accomplish the tasks necessary to set up their laptops and mobile devices for use in their first year IT course?
- How could such a session include a social component that would engage students to use connect both in person and online with campus resources and peers?

3. DESIGN OF JUMPSTART SESSIONS

The authors developed JumpStart sessions to acclimate first year introductory technology students enrolled in IT 101 (Introduction to Information Technology and Computing Concepts), an introductory IT course required of all first year students at Bentley University, a business university in Massachusetts. IT 101 teaches digital literacy skills and covers information technology topics, including making use of laptops, productivity and application software, the World Wide Web, computer components and mobile devices, developing web pages with HTML, operating systems, the Internet, image and video formats, and wireless networking. The course is required of the approximately 900 students in the freshman class, 55% of whom enroll in the course in the fall, and 45% of whom enroll in the spring. The fall semester had 22 sections with an average of 27 students per class.

Bentley University has a mobile computing program, which distributes laptop computers to students as part of their technology fee. For decades, there was only one choice for a laptop model: a machine running the Windows operating system. As laptop form factors and the popularity of multiple operating systems has evolved, the 2014-2015 year was the first where students could choose between a full-size laptop or ultrabook running Windows, or a MacBook Air running MacOS. The Windows machines were equipped with a base image including Office 2013, FTP software, and university controlled antivirus software. The standard Mac image included Office 2011 for Mac, FTP software, and the university controlled antivirus package.

Students needed to download and install additional spyware/malware detection and security software, configure their email, set up their electronic textbooks and course materials, and download additional applications in order to be able to participate fully in their IT 101 and other courses with a functioning computer.

The JumpStart Sessions relied on paid student tutors from the Computer Information Systems Learning and Technology Sandbox (CIS Sandbox), the university's social learning space for exploring technology, to facilitate each session.

Session Goals
Goals for the JumpStart sessions include:

- Introduce students to their group members so students can begin to make friends
- Introduce students the CIS Sandbox, its tutors, services, and activities
- Install HTML editor
- Configure e-books and online resource materials for use in IT 101
- Make sure Java and pop-up blockers are installed correctly
- Set up university email on mobile devices
- Teach safe downloading techniques
- Teach basic laptop maintenance

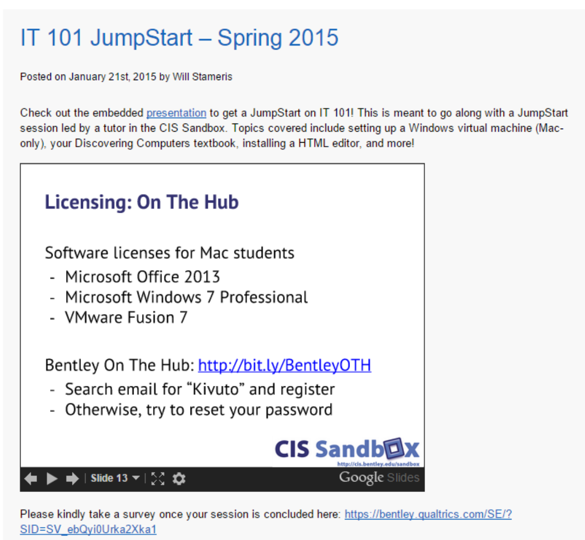

Figure 1. Blog post about the JumpStart Sessions

Students running Mac computers needed to obtain licenses from On The Hub, Microsoft's online licensing site for educational use, then install VMware Fusion 7, setup Windows 7, and install Office 2013. The installation process for these and other software applications is then the same for Mac and Windows users.

A post on the CIS Sandbox blog, as shown in Figure 1, contains the slide presentation for the tutors to access easily, and for the students to refer to later. The slides contain step-by-step instructions for installing and configuring the necessary software titles as well as information about computing resources on campus.

Implementation

JumpStart sessions were scheduled for the first 8 days of the semester (starting on the second day of classes). Instructors announced them during the first class meeting, and students signed up electronically using a common Google spreadsheet, as shown in Figure 2. The Google spreadsheet centralizes the sign-up process and allows multiple people to edit the same document at the same time.

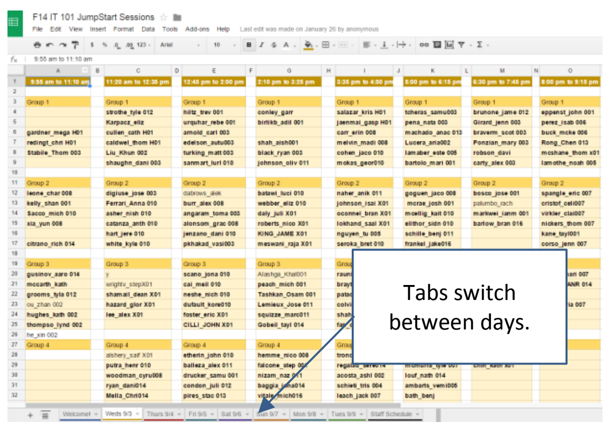

Figure 2. Spreadsheet to sign up for a JumpStart session.

As shown in Figure 2, tabs at the bottom of the sheet jump to sessions offered on a particular day; each day is color coded for easy navigation. Depending on the day, time, and availability of tutors, as many as four sessions were scheduled concomitantly, coinciding with a 75-minute class period. Students signed up for one JumpStart session at a convenient or available time when they did not have classes.

Sessions met in the CIS Sandbox, the university's social learning space for technology education. Six students and one tutor sat around one large table with their laptops, and followed a presentation displayed on a large monitor at the end of the table, as shown in the photo in Figure

3, that one student Tweeted during their session.

Figure 3. Tweeting a group photo after the JumpStart session.

One tutor facilitated each small-group session, which could accommodate as many as six students. With up to four concurrent sessions over 8 course blocks on weekdays, approximately 180 students per weekday, and fewer on weekends, participated in JumpStart sessions. All 600 students enrolled in IT 101 during the fall semester were able to participate in a session within during the first week of classes. Holding these sessions in the CIS Sandbox also introduced the students to the tutoring and other services of the lab before they would need them.

Students signed up with their university email names rather than their full names, as these were all always fewer than 13 characters and served as a way to identify the students uniquely and easily. They appended their section name (001, 002, etc.) when signing up to facilitate filtering all students from a given section who attended. Tutors formatted the names of the students who participated in their sessions in bold as a way to take attendance. At the end of a day, one tutor had the task of preparing a report showing the students who were no-shows during the day.

Appendix I shows the agenda for a JumpStart session. The reader is invited to visit http://cis.bentley.edu/sandbox and search for JumpStart to find additional JumpStart session materials.

4. SURVEY RESULTS AND ANALYSIS

After their JumpStart sessions, students were asked to complete a very short survey about their experience. 224 students chose to complete the survey.

Mac vs. Windows Machines

The number of students with machines running Windows was almost twice the number of students using Mac (149 to 75 respectively). This suggests that almost 66% of freshman students selected using a Windows laptop rather than a Mac. The standard configuration was an HP laptop; an extra fee was charged to students who selected a Windows ultrabook (Lenovo Carbon) or the Mac laptops. This undoubtedly influenced the number of students who selected a Mac laptop.

Because students with Macs needed to install different software than the students with Windows laptops, students with Macs needed to sign up for a Mac-only session. With approximately 100 students using Macs each semester, 18 sessions over the six days, or three per day, were designated as Mac Only. This turned out to be a wise choice, as everyone at the table was following the same instructions and procedures.

Session Duration

The time allocated for each session was 75 minutes. 75 minutes was plenty for an introduction followed by five to eight software installs on student machines. Survey results indicate that 77% of students completed the session in 45 - 60 minutes, with almost 50% of total students reporting that they completed their sessions in less than 45 minutes.

Session Evaluation

Close to 50% students found this session extremely helpful for their coursework and 64% students said they would recommend this to their peers.

Said one student, "The session was very helpful! I was able to install the software I needed for the class, with guidance. Also, we had the opportunity to ask questions."

The sessions also enabled students to meet the tutors in the CIS Sandbox learning lab, before they would need to return there to ask them for help later in the semester.

5. LESSONS LEARNED

Several lessons learned will guide the planning and delivery of future JumpStart sessions.

Social, Informal Learning
JumpStart sessions are a good opportunity for social, informal learning from peers. They begin with introductions, so students can meet their classmates and peers. By meeting tutors early in the semester before they have questions on homework, students can feel comfortable going to the CIS Sandbox lab later in the semester when they might need help from tutors. Students know they are welcome.

Social Media
Many students were less than enthusiastic about posting a group selfie to the CIS Sandbox Facebook page or Twitter to record their experience at the JumpStart sessions. Some groups posted Tweets about their participation. This was intended to be a required part of the session content in order to introduce students to the social media feeds of the CIS Sandbox, and to ensure that students knew how to post on social media. Students were also encouraged to follow the CIS Sandbox social media feeds to receive updates throughout the semester.

Session Duration
Although many groups finished the required tasks within 75 minutes, there is no reason to shorten the time allocated. Interviews with tutors and suggested that some may have omitted some of the tasks that were not related to software installs (such as posting about the session on social media). The amount of material to be covered by the JumpStart sessions increases each semester, so the 75 minute format will continue to be used.

Downloads
Software takes a long time to download from On The Hub, especially when students try to access and download the software to their machines over a wireless connection. To avoid the burden of each student having to download all of these files, flash drives containing the required images and files for VMware Fusion 7 installer, Windows 7 image, and Office 2013 installer were provided to each group. Installers for Windows applications, such as Expression Web and an open source graphics editing package were also provided on the flash drives.

Students used the licensing system at On The Hub to obtain their license codes for the Microsoft software, but did not need to download the software from the On The Hub server. This also proved to be a useful teaching opportunity, as many students were not familiar with installing files from ISO files. One flash drive per group of six students seemed to be sufficient.

Attendance
It is important to have accurate attendance records in order to notify faculty which students did not attend their sessions. Resources need to be allocated to making sure it is kept correctly. While tutors were instructed to take attendance by formatting the student's name on the sign-up spreadsheet in bold, some names were accidentally reformatted. In future semesters, faculty may provide the names of students in their classes for tutors to "check off" in a shared spreadsheet different from the sign-up sheet, to which all students have access.

6. CONCLUSIONS

Setting up software required for use in IT 101 as part of the JumpStart sessions relieves the instructors of spending class time on a time-consuming task. Completing the installs in groups of 6 students with one tutor and gives students a much better and personalized experience than doing it in a class of 27. Because tutors often facilitate several JumpStart sessions, they are prepared to assist students with issues that may arise during the installation process.

Delivering JumpStart sessions to 900 incoming students during the opening days of the fall and spring semesters validates contemporary research findings suggesting that first-year college students have varying degrees of knowledge about their laptops and the software on them. Although students were given information about their laptops and campus computing resources at freshman orientation, it was helpful to review this information again in small groups.

For future sessions, it would be interesting for tutors to know beforehand, where incoming students fall on the scale of knowledge about the technologies addressed in the JumpStart program. This information would be helpful for students to join in student/tutor groups with similar experience levels. Because students sign up for these sessions during their first class period, such classification may have to be done by self-selection. It would be interesting to see if students with similar or different experience levels create more effective groups.

The first week for any incoming student is a time for acclimating to the college experience. Reviewing campus computing resources and guiding students through the process of setting up their technology accounts, installing and configuring software for their computers and mobile devices, keeping their laptops safe, offers students both social and academic benefits as they find their way in their new surroundings.

7. ACKNOWLEDGEMENTS

The authors acknowledge Viraj Ayachit and Jerry Chen, graduate students and tutors who created the survey instrument used to gather feedback from the Jumpstart session participants.

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Appendix 1. JumpStart Session Content Outline

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1. Introductions
    a. Who's around the table?
    b. Where are you from?
    c. Which section of IT 101 are you in?
2. Intro to CIS Sandbox
    a. Technology available
    b. Tutoring Services
    c. Review sessions and other events
    d. Connecting via social media, blog
3. Configuring Machines
    a. Set up Wi-Fi if not already working
    b. Installing software (Macs – VMWare Fusion, Windows, Office)
        i. Requires licensing through Microsoft "On the Hub",
        ii. Walk through students through the process of setting up and installing windows and VMware
    c. Installing Email, e-textbook, HTML editor, graphics editing programs, others
    d. Configure tutorial software
4. Maintenance
    a. Teach students how to get out of some of the common laptop issues (software not responding, popup blockers, etc.)
    b. Encourage students to make use of the software tools downloaded during their JumpStart session
    c. Remind students of on-campus resources available
5. Configuring Devices
    a. Set up Wi-Fi and email on smartphones and tablets if not done yet
6. University computing environment
    a. Configure email
    b. Access learning management system (Blackboard)
    c. University intranet (campus jobs, schedules, etc.)
7. Engagement
    a. Encourage students to take selfies and post to Twitter or CIS Sandbox Facebook page. This engages students, shows social media, and provides an opportunity to develop digital literacy skills.

E-Learning and Medical Residents, a Qualitative Perspective

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Abstract

Medical education helps ensure doctors acquire skills and knowledge needed to care for patients. However, resident duty hour restrictions have impacted the time residents have available for medical education, leaving resident educators searching for alternate options for effective medical education. Classroom situated e-learning, a blended learning delivery method, was created to find an effective option for medical education. Qualitative phenomenological research was used to understand residents' perceptions of the effectiveness of, and interactions in, classroom situated e-learning and traditional lectures. In-depth interviews were used for data collection. Analysis of the data revealed all participants found classroom situated e- learning effective, and had a preference for interaction that included discussion with the educator and other learners. Recommendations for future research include a replication of this exploratory study with residents in other residency programs, and quantitative research comparing the learning outcomes of classroom situated e-learning with traditional lecture based learning.

Keywords: E-learning, E-education, Medical education, Online learning, Distance Learning, Resident Education.

1. INTRODUCTION

Medical education is an integral component of the medical system for ensuring that doctors acquire and maintain skills and knowledge essential for patient care. Residency programs generally provide residents with increased hands-on experience with patients. In 2003, the Accreditation Council for Graduate Medical Education (ACGME) instituted a mandatory reduction in resident duty hours with the intent to improve overall patient safety (Lin, Beck, & Garbutt, 2006). Resident education is considered a part of duty hours. Therefore, the reduction has resulted in a reduction of resident education (Tempelhof, Garman, Langman, &

Adams, 2009). Residents reported that restricted duty hours have led to less time for education (Mathis, Diers, Hornung, Ho, & Rouan, 2006) and missed medical education opportunities due to a focus on service delivery to patients (Vidyarthi, Katz, Wall, Wachter, & Auerbach, 2006).

To resolve this dilemma innovative options are needed to help residents find time for the education needed to become skilled doctors. While lecture is the most common mode of delivery (Robertson, Yun & Murray, 2009), time constraints require the use of other modes of learning. Blended learning, which combines face-to-face interaction with e-learning, is being explored as an alternative modality for medical education. Potential benefits of this approach have been shown to include flexibility (Crouch, 2009), improved test scores (Lewin, Singh, Bateman, and Glover, 2009), and significant cost savings (Sung, Kwon, & Ryu, 2008).

This study investigates an option for effective delivery of medical education that combines e-learning with face-to-face interaction, reflecting the limited amount of time necessitates all education for residents is effective. The use of e-learning takes advantage of technology and the ability to access learning anytime and anyplace. However, it lacks face-to-face discussion, which has been considered critical for student thinking and reflection. There is a need to find, and use, innovative educational options that will meet the learning needs of residents and the educational goals of residency program directors (Templhof et al., 2009). In addition, there is a need to understand residents' perceptions of effective medical education and innovative learning methods in order to build e-learning opportunities to provide quality educational opportunities.

2. LITERATURE REVIEW

Resident medical education is a mandatory component of an accredited residency program, yet mandated hours, full and demanding schedules, and responsibilities make it challenging for residents to find time to participate fully in formal medical education (Templhof et al., 2009). Moreover, continuous physician medical education is critical to maintain and improve healthcare for all patients (Mazmanian, 2010). However, limited time and a continual increase in, and changing of, content in the field of medicine make medical education more challenging than ever (Accreditation Council for Graduate Medical Education, 2007).

Residency program directors must ensure that their programs offer "effective educational experiences for residents that lead to measureable achievement of educational outcomes in the ACGME competencies" (Accreditation Council for Graduate Medical Education, 2007). The core competencies established by the ACGME are: "patient care, medical knowledge, interpersonal and communication skills, professionalism, practice-based learning and improvement, and systems based practice" (Accreditation Council for Graduate Medical Education, 2011, section 4).

A survey of residency program directors in 2011 revealed that more than half of the respondents believed that duty hour restrictions would negatively impact residents' achievement on at least five of the six ACGME core competencies (Antiel et al., 2011). In 2011 ACGME reduced the number of resident work hours which in one institution resulted in a decrease in the number of patients treated by residents and the number of conferences offered, however, no change in test scores was evident (Vucicevis et. al., 2014). Program directors must determine how to effectively deliver resident education within the context of their own programs (Holmboe et al., 2005). E-learning could be a solution to the learning dilemma.

E-Learning

E-learning is a form of distance education, and distance education is over 100 years old when one considers correspondence courses (Means, Yoyama, Murphy, Bakia, & Jones, 2009). Today, distance learning has broadened into a wider variety of options, including e-learning, which has become the quickest growing type of learning in education (Mahle, 2007). E-learning is one of many phrases used to describe a learning experience that employs some type of computer based technology to deliver education or profession development (Remtulla, 2007).

E-learning can be used in a variety of ways, by a variety of learners, and for a variety of reasons. It can be used for synchronous learning, requiring the e-learners and educators to participate in learning experiences at the same time, even though they are in different locations (Means et al., 2009). Khirwadkar (2009) indicated that technology could engage learners in meaningful dialogue around a topic, can provide problem-based learning, or can be used to solve, or work on real life problems. Learners can experience e-learning as it attempts to mimic the traditional classroom experience, like a lecture based class, or it can create an experience that is completely different from traditional classroom encounters such as electronic games, simulations, problem-based learning, or multifaceted group projects (Means, 2009)

E-Learning and Medical Education
Medical education has been delivered in multiple ways, with a variety of results. While medicine continues to evolve, medical education still primarily relies on passive lecture-based experiences (Graffam, 2007). The use of web based learning for medical education can be traced back to 1992 (Westmoreland, Counnsell, Tu, Wu, & Litzelman, 2010). E-learning for medical education can be used in many ways, resulting in a variety of possible advantages including: easy access to case-based learning, self-paced learning, connecting learning in the clinic with learning outside of the clinic (Stern, 2008), flexibility, adaptability of content for different learners or groups, and easily updatable content (Webber, 2007).

Technology allows for easier creation of, and access to, patient-based learning, which is considered a hallmark of medical education (Smith, Cookson, McKendree, & Harden 2007). Patient-based learning refers to the use of patient cases as an educational tool, much like scenario based learning. Additionally, e-learning in medical education can remove barriers related to location and time. Residents assigned to rotations in off-site locations may not be able to attend lectures at their learning institutions, or hospital (Gray & Tobin, 2010). E-learning provides a broad variety of ways to present content and innovative options for delivering education (Bove, 2008). Researchers have found that residents are comfortable using e-learning methods of education (Westmoreland, Counsell, Tu, Wu & Litzelman, 2010).

Technology has been used in a variety of ways to deliver medical education. Text, images, and sound can be delivered electronically. This eliminates the need to access expensive machines to view certain test results like x-rays, echocardiograms, and other test results. Sounds from stethoscopes, and ventricular assist devices can be turned into audio files and made available to residents to analyze. Simulation offers a way for learners to try new skills in a safe environment (Takayesu, Nadel, Bhatia, & Walls 2010). Content available on smart phones, or through computers located in common areas near patient rooms, can provide valuable just-in-time tools when caring for patients (Bove, 2008).

Along with these benefits come some potential problems associated with e-learning Solitary e-learning can be an isolating experience for learners, and discussion supports students' critical thinking and reflection (Cook & McDonald, 2008). Cook (2006, p. 59) found potential disadvantages could include "social isolation, de-individualized instruction, high development costs, technical problems, and poor instructional design."

Blended Learning in Medical Education
The use of blended learning for medical education has similar variations in the definition and usage of the term. One example of blended learning included a combination of face-to-face lectures and e-learning modules to teach doctoral students in pharmacology (Crouch, 2009). Another blended learning project combined online modules, face-to-face discussions, and video presentations, to teach general practitioners (Bekkers et al., 2010). A third type of blended learning, for new nurses, was made up of face-to-face classroom sessions followed by a series of e-mailed questions, delivered over time, to the learners. The nurses e-mailed their responses to the questions they received. Then the nurses were sent instructional feedback on their responses (Sung et al., 2008).

Medical students in a blended learning program had better exam scores than their peers, who took the same course in a face-to-face lecture format. The blended learning course combined the use of e-learning modules, online communication, and weekly communication with a preceptor (Lewin et al., 2009). General practitioners who participated in a blended learning program on antibiotic resistance reported increased awareness and confidence when making decisions about prescribing antibiotics for patients. They also reported a decrease in the amount of antibiotics they prescribed after the blended learning program (Bekkers et al., 2010).

Organizational staffs have realized benefits from offering blended learning as a medical education option. The initial cost for creating the e-learning component of blended learning can be high, but can ultimately result in a cost savings over face-to-face classes. This is because blended learning allows for continued use of electronic learning components that once created, can be used repeatedly (Sung et al., 2008). Blended learning has been reported to be less demanding on faculty time, because educators are not required to be the sole disseminator of the course content (Crouch, 2009).

Learners in medical education have also reported benefits from blended learning, beyond their gain in knowledge. Learners enjoyed the flexibility that blended learning could offer (Crouch, 2009). Doctors, in a blended learning program for continuing education in clinical care, appreciated the blended learning approach (Shaw, Long, Chopra, & Kerfoot, 2011). Medical students, in a blended learning program, enjoyed the learning experience, and reported that they were able to apply the information they learned directly to the clinical setting (Lewin et al., 2009).

Blended Learning For This Study

The form of blended learning for this study is classroom situated e-learning, a form created specifically for use with residents at a pediatric hospital in Ohio. This mode of synchronous learning puts a small group of residents and a facilitator in the same room. The content is contained in the e-learning module, which is displayed on a screen located at the front of the room. The facilitator leads the residents through the e-learning module, where residents are encouraged to solve problems, share ideas, and ask questions, as they move through the case and the tasks being presented. The module is also designed to simulate the decisions, test results, and order of decisions that residents must make when seeing patients.

New innovations in medical education are needed to produce excellent doctors, and residency programs are in search of innovative options for delivering effective medical education (Robertson, Yun, & Murray, 2009). Classroom situated e-learning has the potential to meet those needs. However, research must be conducted to determine if the learners believe it is an effective form of medical education.

3. RESEARCH METHOD

This study addressed the need to find an effective mode of medical education that would make the most efficient use of medical residents' limited time. Restrictions in residency hours have impacted the time residents have for medical education (Accreditation Council for Graduate Medical Education, 2011). Residents also experience a highly demanding workload. Both factors limit the time residents have for participating in medical education (Baker, Klein, Samaan & Lewis, 2010). In addition, there is a need to find and use innovative educational options that will meet the learning goals of residents and residency program educators (Tempelhof et al., 2009).

The purpose of this qualitative study was to examine residents' perceptions of the effectiveness of blended learning and the effectiveness of traditional face-to-face lectures. In-depth interviews were used for collecting data. The sample size was nine residents at a pediatric hospital. Given the value of education during residency (Charap, 2004), the high demand on residents' time, and their limited time for education (Baker et al., 2010), alternatives to traditional face-to-face education is needed. Blended learning has the ability to combine face-to-face interaction with e-learning and could be an effective alternative to traditional lecture education.

Research Methods and Design

This study was guided by the following research questions:

Question 1: How do residents perceive the effectiveness of classroom situated e-learning and traditional lecture based learning?

Question 2: How do residents perceive the interaction between the student and the content, the facilitator or instructor, and other students in classroom situated e-learning and traditional lectured based learning?

A qualitative research method was used for this study because it provided the ability to gain a deeper understanding of the phenomenon from the perspective of the participants (Moustakas, 1994), which was the intended goal of the research. This is an interpretive research approach, used to understand how something works, as opposed to trying to fix something that does not work (Schram, 2006). The interpretive approach fit with the intention of the research, to understand the effectiveness of classroom situated e-learning for medical education with residents from the learners' perspectives. A phenomenological perspective was used to understand how people make meaning of an experience or phenomenon (Patton, 2002). The aim of phenomenology is to understand what an experience means for those who have lived it (Moustakas, 1994). A small sample size is typical of qualitative research (Rudestam & Newton, 2007) and is based on the specific goals of qualitative research, in comparison to the larger sample sizes needed for quantitative research. Qualitative research usually relies on gathering in-depth data from small samples (Patton, 2002).

Sixteen residents participated in at least one e-learning session and of the sixteen, nine pediatric residents agreed to participate in the study. A total of ten interviews were initially conducted with the first interview being a pilot. An interview protocol was created and reviewed by three individuals to establish face validity: a classroom facilitator and medical fellow; a classroom facilitator who was a physician, and a university professor who was a medical anthropologist specializing in qualitative research. As a result of these reviews the interview protocol was revised and piloted with one resident. A transcript of the interview was reviewed and further revisions of the protocol resulted in an instrument that would ensure that the research goals could be addressed.

Each of the nine residents was interviewed for a length of time that varied from 33 minutes to one hour. The average length of the interviews was 43 minutes. During the interviews residents were provided with the definitions of *effective medical education* and *interaction in medical education* being used in this research. For the purpose of the research effective medical education was defined as education that increases residents' knowledge in at least one of the ACGME's six core competencies; patient care, medical knowledge, interpersonal and communication skills, professionalism, practice based learning, and systems based practice Interaction in medical education was defined as interaction between the resident and the content, the resident and the facilitator or educator, and the resident and other residents or learners.

4. RESULTS

Research Question 1
How do residents perceive the effectiveness of classroom situated e-learning and traditional lecture based learning? This question had two elements: participants' perceptions of the effectiveness of classroom situated e-learning; and participants' perceptions of the effectiveness of traditional lectures.

Analysis of the questions resulted in a total of six themes, which were delineated based on the two elements. A combination of direct quotes and paraphrased statements were used to support each theme. These themes are summarized in Table 1.

Question Elements	Theme
Perceptions of classroom-situated e-learning effectiveness	1. Problem-based or case based learning 2. Access to an expert 3. Interactive or active learning 4. Small-group learning
Perceptions of the effectiveness of Traditional Lectures	5. Practical or applicable content 6. An engaging educator

Table 1: Thematic Results of Research Question 1

Comfort and familiarity was one of the reasons given for residents' preference for lecture based learning. However, only three of the participants in this research made mention of lectures as a form of education with which they have comfort and experience. According to Participant 7, "I think they're fine …it's what I'm used to so … I learn well with them obviously or else I probably would not have gotten this far." None of those participants, however, said it was their preferred way of learning, and two of the participants mentioned their belief that there were better ways for them to learn. Participant 5 described a level of comfort with traditional lectures: "Definitely I think in medical school it was more lecture format, and I think that's just the way my brain worked at that time, so I was used to it." However, Participant 5 went on to describe a change in how he currently prefers to learn:

"Now it's more on the fly, I think it's more time, and plus I won't be listening … if it's not applying directly to my care and my scope of practice."

Research Question 2
How do residents perceive the interaction (between the student and the content, the facilitator or instructor, and other students) in classroom situated e-learning and traditional lectured based learning?

This question has two elements: participants' perceptions of the interactions in classroom-situated e-learning; and participants' perceptions of the interactions in traditional lectures. In addition, each element was divided into the three types of interaction, between the learner and the content, the learner and the educator, and the learner and other learners.

Analysis of the residents' responses to this question resulted in a total of seven themes, which are delineated based on the two elements of the question, and the three types of interaction. A combination of direct quotes and paraphrased statements were used to support each theme. The themes are summarized in Table 2.

Type of Interaction	Method of Learning	
	Classroom E-Learning	**Traditional Lectures**
Content	1. Discussion 2. Through the computer	
Educator	3. Providing practical or real world content 4. Asking questions of the educator 5. Feedback from the educator	7. Asking questions of the educator
Learner	6. Discussion	

Table 2: Thematic Results of Research Question 2

Discussion

This research explored participants' perceptions of their lived experiences in classroom situated e-learning and traditional lectures. The research specifically looked at their perceptions of the effectiveness of the two forms of education, and the interactions they experienced in both forms of education. All of the participants had experienced both traditional lectures and classroom situated e-learning prior to participating in the research. The research was conducted using a qualitative, phenomenological approach.

Effectiveness was defined as an increase in knowledge in at least one of the ACGME six core competencies. The competencies are: "patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, and systems-based practice" (Antiel et al., 2011, p. 185).

Resident achievement of all six competencies is a requirement for resident education programs (Accreditation Council for Graduate Medical Education, 2007). The first research question was used to understand participants' perceptions of the effectiveness of classroom situated e-learning and traditional lectures. All nine participants reported increased knowledge in at least two core competencies as a result of participating in classroom situated e-learning. Six participants reported an increase in knowledge in at least one core competency, as a result of participating in an effective traditional lecture.

The first research question was divided into (a) effectiveness of classroom-situated e-learning and (b) effectiveness of traditional lectures. Analysis of the data revealed four themes regarding effective aspects of classroom situated e-learning: (1) problem-based or case-based learning, (2) access to an expert, (3) interactive or active learning, and (4) small-group learning. Data analysis revealed two themes concerning participants perceived effective aspects of traditional lectures: (5) practical or applicable content, (6) and an engaging lecturer. Participants self-reported positive outcomes, and preference for classroom situated e-learning, adds a new dimension to the possible effective educational options available for use and for research in resident education.

These findings support the need for research that explores new ways to provide resident education (Tempelhof et al., 2009), and the use of blended learning for resident education (Lewin et al., 2009).

The second question was used to learn participants' perceptions about their interactions in classroom situated e-learning and traditional lectures. Interaction in education was based on Moore's (1989) description of three types of interaction; with the content, with the educator, and with other learners. The second research question was divided into (a) classroom situated e-learning, and (b) traditional lectures, which were each further divided by the three types of interaction. When describing classroom situated e-learning, the two themes revealed by data analysis, for interaction type 1 (interaction with the content) were (1) discussion and (2) through the computer. The three themes named for interaction type 2 (interaction with the educator) were: (3) providing practical or real world information, (4) asking questions of the educator, and (5) feedback from the educator. The one theme named for interaction type 3 (interaction with other learners) was (6) discussion. There was no theme for interaction type 1 (interaction with the content) during traditional lectures. The one theme for interaction type 2 (interaction with the educator) was (7) asking questions of the educator, and there was no theme named for interaction type 3 (interaction with other learners).

Evaluation of the findings revealed the participants preference for education that is based on adult learning theory. All nine participants found classroom situated e-learning, based on adult learning theory, to be effective. Six of the nine participants were able to name an effective traditional lecture, which are based on pedagogy (Stratman et al., 2008). Four of the six themes addressing residents' perception of the effectiveness of classroom situated e-learning and traditional lectures can be correlated with at least one assumption of the andragogical model, Knowles' model of adult learning theory (Knowles et al., 2005).

When asked the most important form of interaction, for their own learning, six participants chose interaction with the content, two chose interaction with the educator, and one chose interaction with other learners. This matches Moore's (1989) description of the importance of the three types of interaction. The data analysis revealed seven themes for interaction in classroom situated e-learning and traditional lectures. However, when looking across the three types of interaction and the two types of learning formats, discussion stood out as a preferred form of interaction. In addition, no themes emerged for interaction with the content for traditional lectures, although learners indicated they believed that type of interaction to be most important for their learning. In addition, not theme was indicated for discussion in traditional lectures, which was the resident's preferred method for interaction.

5. IMPLICATIONS AND CONCLUSIONS

This research used qualitative, phenomenological design, to answer two research questions. The questions addressed residents' perceptions of the effectiveness and interaction in classroom situated e-learning and traditional lectures. Analysis of the data collected from this research revealed 11 themes regarding participants' perceptions of the educational experiences.

Participants found blended learning, in the form of classroom situated e-learning, to be effective and a positive learning experience. Participants reported that traditional lectures have the possibility to be effective, but four participants reported they are not the best way for them to learn, and three participants were unable to provide an example of an effective lecture. They reported that interaction with the content was the most important form of interaction for their learning. However, they had the most agreement regarding interaction with other learners, and said discussion with other learners had a positive effect on their medical education. They also valued conversation and question asking in all three types of interaction.

There were limitations to this research. The first being the use of qualitative research design, which resulted in a small sample size. In addition, participation in the research was voluntary, and those who chose not to participate could have differing perceptions than the residents who chose to participate. Also, the timing of the interviews, at the end and beginning of the academic year, could have affected the participants' perceptions of the educational experiences.

Resident program directors and educators could use the data from this research to further inform their decisions regarding the educational opportunities they provide their residents, and the creation of new educational experiences. There are practical applications that could be considered for residency programs based on the results of this research. The applications for consideration are the value of incorporating blended learning into resident education; the value of incorporating opportunities for resident discussion and conversation, and asking of questions; and the desire to lessen the use of traditional lectures as a form of medical education in residency.

This research added new information to the existing body of knowledge regarding options for effective resident education. However, it also supports continued research in this area. Quantitative and qualitative research in the use of blended learning, in the form of classroom situated e-learning, and other blended learning options, is needed to increase the understanding of the potential benefit of blended learning for medical education. Additional research could also address the potential benefits of interaction between learners, in the form of discussion, and conversation and question asking in medical education.

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Editor's Note:

This paper was selected for inclusion in the journal as a EDSIGCon 2015 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 2015.

APPENDIX

Interview Guide
Research Questions

Q1. How do residents perceive the effectiveness of classroom situated e-learning and traditional lecture based learning?

Q2. How do residents perceive the interaction (between the student and the content, the facilitator or instructor, and other students) in classroom situated e-learning and traditional lectured based learning?

Definitions

We are defining effective medical education as education that increases residents' knowledge in at least one of the ACGME's six core competencies. (Patient Care, Medical Knowledge, Interpersonal and Communication Skills, Professionalism, Practice Based Learning, Systems Based Practice)
We are defining interaction in medical education as interaction between the resident and the content, the resident and the facilitator or educator, and between the resident and other residents or learners

Questions

1. Describe a learning experience you have had as a resident that has been effective for you, and increased your knowledge in at least one of the ACGME's six core competencies.
   a. What made the experience effective?
   b. Was there a feeling or "aha moment" that you had during the learning experience and if so describe it?
   c. When did you know it was effective (during or after the experience)?
   d. In which ACGME core competencies was your knowledge increased through the experience?
2. Describe the interactions you had with the content during that experience and any role those interactions played in the effectiveness of the learning experience.
   a. Thinking about the content
   b. Processing the content
   c. Applying the content
3. Describe the interactions you had with the educator during that experience and any role those interactions played in the effectiveness of the learning experience.
   a. How the content was organized and presented
   b. Discussion you had with the educator
   c. Evaluation or feedback provided by the educator
   d. Motivation and interest in the topic you gained from the educator
4. Describe interactions you had with the other learners during the experience and any role those interactions played in the effectiveness of the learning experience.
   a. Discussion with other learners
   b. Presentation or sharing of information by other learners
   c. Motivation or support provided by other learners
5. Thinking about all of your experiences as a learner, what kinds of learning activities work best for you and why?
   a. Describe specific examples of those learning activities and why/how they worked
   b. What made those experiences effective?
   c. How did you know they worked for you?
   d. What was the setting for the experience and did that have an impact?
   e. What was the content of the experience and did that have an impact?
   f. What types of interactions were in those experiences and how did they impact your learning (between you and the content, educator, other learners)?

6. Describe a lecture you have attended as a resident that was effective, and increased your knowledge in at least one of the ACGME's six core competencies.
    a. What was the core competency/s and how was your knowledge increased?
    b. What made the lecture effective (lecturer, content, presentation method…)?
    c. Was there a feeling or "aha moment" you had during the lecture and if so describe it
7. What interactions did you experience with the content during the lecture?
    a. Describe the interactions
    b. How did the interactions impact your learning?
    c. How did they impact your satisfaction with the lecture?
8. What interactions did you experience with the instructor during the lecture?
    a. Describe the interactions
    b. How did the interactions impact your learning?
    c. How did they impact your satisfaction with the lecture?
9. What interactions did you experience with other learners during the lecture?
    a. Describe the interactions
    b. How did the interactions impact your learning?
    c. How did they impact your satisfaction with the lecture? Describe a lecture that was ineffective and did not increase your knowledge in at least one of the ACGME's six core competencies.
    d. What made it ineffective (lecturer, content, presentation method, distractions)?
    e. What did you do to deal with the situation (walk out, do something else, muscle through it)?
    f. What could have made it better?
10. What interactions did you experience with the content during the lecture?
    a. Describe the interactions
    b. How did the interactions impact your learning?
    c. How did they impact your satisfaction with the lecture?
11. What interactions did you experience with the instructor during the lecture?
    a. Describe the interactions
    b. How did the interactions impact your learning?
    c. How did they impact your satisfaction with the lecture?
12. What interactions did you experience with other learners during the lecture?
    a. Describe the interactions
    b. How did the interactions impact your learning?
    c. How did they impact your satisfaction with the lecture?

Now we are going to talk about the rheumatology noon conferences on JIA and JDM, which we are calling classroom-situated e-learning.

13. Did the rheumatology noon conferences have any components that where effective or increased your knowledge in at least one of the ACGME's six core competencies? (If yes)
    a. What was the core competency/s and how was your knowledge increased?
    b. What made it effective (facilitator, content, format, interactivity)?
    c. Was there a feeling or "aha moment" and if so describe it
14. Were there moments during the rheumatology classroom situated e-learning sessions that were ineffective and if so what could be done to increase the effectiveness for you?
    a. What made it ineffective?
    b. How did you deal with the situation (what did you do during those times)?
    c. What would make it more effective?
15. What interactions did you experience with the content during the rheumatology noon conferences?
    a. Describe the interactions
    b. How did the interactions impact your learning?
    c. How did they impact your satisfaction with the conference?
16. What interactions did you experience with the instructor during the rheumatology noon conferences?
    a. Describe the interactions
    b. How did the interactions impact your learning?

   c. How did they impact your satisfaction with the conference?

17. What interactions did you experience with other learners during the rheumatology noon conferences?
    a. Describe the interactions
    b. How did the interactions impact your learning?
    c. How did they impact your satisfaction with the conference?

18. How do you feel overall about lectures as an effective form of education? How do you feel overall about classroom situated e-learning (the rheumatology noon conferences) as an effective form of education?

19. How do you feel overall about the importance of the three types of interaction for your learning?

A Technical Infrastructure to Integrate Dynamics AX ERP and CRM into University Curriculum

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Abstract

Enterprise Resource Planning and Customer Relationship Management are becoming important topics at the university level, and are increasingly receiving course-level attention in the curriculum. In fact, the Information Systems Body of Knowledge specifically identifies Enterprise Architecture as an Information Systems-specific knowledge area. The revised Information Systems Curriculum Guide from 2010, sponsored by the Association of Information Systems and the Association of Computing Machinery, suggest Enterprise Architecture as a required course with Enterprise Systems and Business Process Management as suggested electives. Implementing the aforementioned courses into the curriculum poses challenges such as providing necessary resources, overcoming institutional constraints, and the lack of hardware architecture for advanced systems such as Microsoft Dynamics AX. This work addresses three critical issues. First, we provide a suggested technical architecture built upon the Windows Server family and Dynamics AX which may be used to implement ERP and CRM, based on Dynamics AX, into the classroom. Second, we demonstrate connectivity between an installation of Dynamics AX 2012 R3 and CRM 2011 in the cloud using the Microsoft Connector for Dynamics. Finally, we suggest a sample scenario and case for implementing ERP and CRM concepts into the university curriculum.

Keywords: ERP, CRM, Dynamics, AX, Architecture, Infrastructure, Curriculum

1. Introduction

The ongoing revolution in technology continues to remake university and college curricula, particularly in colleges and schools of business. Enterprise Resource Planning (ERP) is becoming an increasingly critical topic in Information Systems curricula as employer demand for knowledgeable and qualified employees rises. The 2013 Information Systems Job Index, from the Association for Information Systems (AIS) and the Fox School of Business at Temple University, states that systems analyst is the most common profession for information systems majors (Mandviwalla, Harold, Pavlou, & Petrucci, 2013). According to the U.S. Department of Labor's Bureau of Labor Statistics (bls.gov, 2012), systems analysts work on programming, infrastructure, installation, and testing among other tasks. An organization's ERP system is likely its largest computer system because ERP impacts all facets of business from accounting and finance to manufacturing, HR, management, operations, purchasing, etc. Based on this, the need for ERP in the curriculum is evident.

IS curriculum guides have changed repeatedly over the years, responding to the changing needs and environment of industry. In 2005, the Association for Computing Machinery (ACM) created the Information Technology Volume for Computing Curricula (Curricula, 2005) which listed Enterprise Systems as an optional course in the Systems Integration and Architecture Track. In 2010, Association of Information Systems (AIS) and the Association for Computing Machinery (ACM) posted the IS 2010 curriculum guidelines (Topi et al., 2010). Enterprise Architecture advanced to a core IS course. Enterprise Systems along with Business Process Management became sample elective courses. Enterprise Architecture is designed with student learning objectives such as frameworks for infrastructure management, IT investment, as well as data and information architecture. One topic covered in Enterprise Systems is legacy system integration. Integrating legacy, or mainframe systems, with more modern ERP systems has become standard operating procedure in many organizations.

SAP has places itself at the forefront of ERP in the university curriculum via the SAP University Alliance where SAP charges a yearly fee. For this fee, the university is provided with training and curriculum resources. Besides training and curriculum, SAP hosts the ERP system from SAP University Competence Centers around the US and the world. SAP can be seen in the curriculum and literature via (Antonucci & Zur Muehlen, 2000; Becerra-Fernandez, Murphy, & Simon, 2000; Johnson, Lorents, Morgan, & Ozmun, 2004) as well as a Communications of the Association of Information Systems report (Bradford, Vijayaraman, & Chandra, 2003).

The Enterprise Systems course is directly related to ERP with learning objectives covering topics such as implementation, key concepts from functional areas, evaluation of enterprise software providers, etc. An additional objective is integrating functional systems into a single enterprise-wide information system. ERP is an enterprise-wide information system. The business process management course demonstrates the demand for information systems students who understand and can manage the processes in a business firm. In this track, we see ERP appearing in required courses and interwoven into electives thereby becoming an integral aspect of information systems curriculum.

According to Forbes (Forbes, 2013) top ERP vendors include Microsoft, SAP, Oracle, Infor, and Sage. Microsoft provides the Dynamics product line, including Dynamics AX for Enterprise Resource Planning and CRM for customer relationship management. While SAP is the current market leader, Dynamics products have been making gains in their respective domains (ERP and CRM). One of the powers of the Dynamics product suites are their familiarity to the user. The look and feel of the Dynamics AX client resembles other Microsoft products, facilitating the task of learning basic navigation. In addition to its ease of navigation, Dynamics AX also offers the advantage of ready customizability. With vendors such as SAP, employees must be trained in a proprietary language, ABAP. In contrast, Dynamics AX can be accessed with the standard Visual Studio tools with which most developers are familiar. Visual Studio is also taught in many technical, community college, and university environments. Microsoft also reports that implementation time for Dynamics is much shorter than its competitors; therefore, adopters save money and time on the implementation process as ERP implementations may take years to complete.

2. Related Work

Dynamics AX courses are in the beginning stages, supported by a new Microsoft Dynamics Academic Alliance (DynAA) to promote Dynamics products in higher education. It is no secret that SAP has been active with colleges and universities for many years. Microsoft is now seeking to strengthen its relationships with students and faculty at higher education institutions around the globe. One example is a student certificate program in which a student will earns a certificate in Dynamics after taking courses that have a combined 100 hours of Dynamics instruction.

ERP growth in industry now requires more staff to understand and implement ERP concepts and systems. However there is an ongoing shortage of Dynamics-proficient staff globally (Badagandi, Upadhyaya, & Patil, 2013). Dynamics AX instruction has been added at institutions such as Duquesne University in Pittsburgh, PA. In this course, AX concepts are introduced and applied to Enterprise Systems concepts such as Project Management, Change Management, and security (Nightingale, 2014). Courses have also been presented based on Microsoft Dynamics GP, a small to mid-size ERP system, where crucial ERP concepts are integrated with GP. Topics are based on the GP modules and include modules on HR, Manufacturing, and Sales (Kim & Kim, 2014).

3. Technical Architecture

Universities are reluctant to permit faculty to run servers and services on production networks. For example, a university's Active Directory Infrastructure (domain, users, sites, etc.) are highly guarded for security and reliability. University Information Technology departments are reluctant to grant faculty access for experimental installations. Additionally, university level IT departments do not have the knowledge or skillsets required for Dynamics AX implementations. This leaves faculty in a position of performing installation and administrative tasks in order to implement Dynamics into their courses. Unfortunately, administrative tasks such as these are rarely valued in the university tenure and promotion process. In addition, mastering the technical implementation details as well as the functionality of the Dynamics software require vastly different skillsets. In order to bypass these hurdles, SAP uses competency centers which provide infrastructure, software, administration, and support (SAP, 2014). Production ERP services are available via the Internet and faculty are shielded from the technical complexities of offering such a solution in the classroom. The technical architecture presented here is designed to serve as a template for faculty to implement Dynamics outside of university constraints with the exception of access to the physical and logical TCPIP network in a manageable scenario.

The basis for the technical architecture is the Microsoft Windows 2012 Server family. The installation presented was based on Windows Server 2012 R2. For AX to function, there are many critical backbone services that are required. First, Windows Server 2012 must be installed. DNS is required for Active Directory and Microsoft SQL Server is required for Dynamics AX. Upon installing the Windows 2012 Server, DNS, or domain name service, must be added and configured. DNS is a service that performs name resolution by mapping computer names to IP address and vice versa. DNS is required for name resolution to function within the Dynamics environment. Active Director is an LDAP (lightweight directory access protocol) compliant directory service for managing accounts and groups such as user accounts, computer accounts, and security groups. Active Directory (AD) must be installed and configured and may be completed through the Server Manager Dashboard by the Add Roles of Features option or by running DCPROMO. MS Dynamics AX requires MS SQL server to be installed as a prerequisite. SQL Server 2014 is deployed in the technical architecture depicted in this work. *Figure 1* illustrates Server Manger with the required services installed.

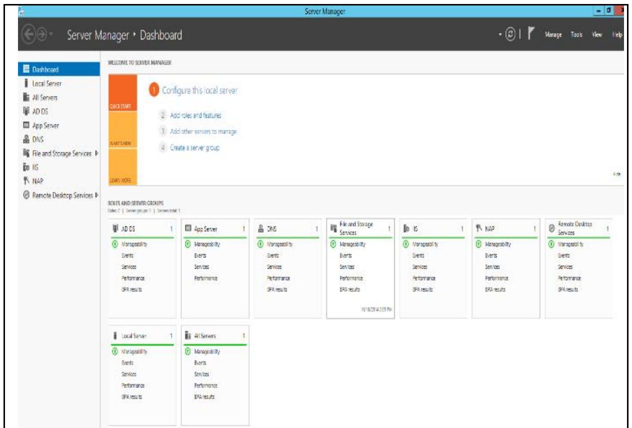


Figure 1 – Windows Services to Support Dynamics in the University Environment

University restrictions on faculty access to the hardware resources necessary for a dedicated CRM/ERP installation is a fairly common phenomenon. At the same time, having support staff who possess the skillset and/or resources necessary to install, configure, and maintain a Dynamics architecture is far from common. Budgets in academics institutions continue to shrink; therefore, it is unlikely for any extended training to be funded; therefore, faculty must support their courses through their own expertise and by seeking training through unconventional sources such as self-training. Members of the Microsoft Academic Alliance have access to customer source and a wealth of training materials for faculty and students in the form of online self-paced training as well as classroom materials for learning and teaching Microsoft Dynamics. Finally, there are restrictions on Dynamics AX where the client must be located on the same Active Directory Domain as the server or a two-way transitive trust must be configured.

Figure 2 depicts a technical architecture for deploying MS Dynamics AX into the university classroom. The model is designed to bypass the production university environment with the exception of access to the IP network. First, it is recommended to build the Dynamics AX environment on top of a virtual infrastructure. In the scenario presented, VMware ESXi 5.5 is employed to support the virtual infrastructure and hosted onsite and supported by faculty and IT support.

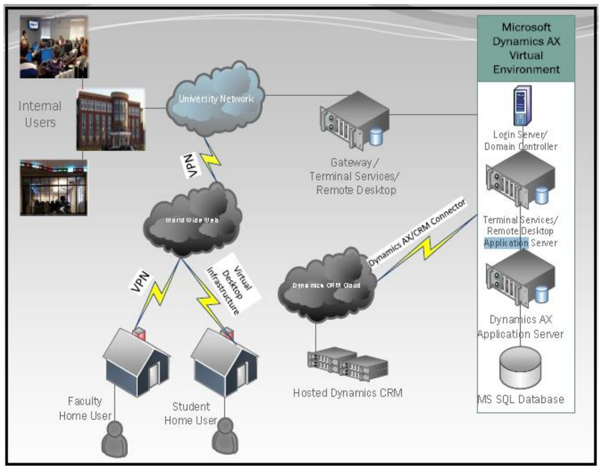


Figure 2 – Technical Architecture for Dynamics AX Deployment in a University

While this is not required, it facilitates many required tasks of any production environment. For example, the capability to quickly create a snapshot, or picture of the current state, facilitates backup. Besides facilitating backup, the snapshot can be made at the beginning of a course and rolled back to the initial state at the conclusion of the course. Additionally, the snapshot may be taken prior to a configuration change to make recovery of a fatal error much easier. VMware provides academic licensing at reduced costs. A virtual infrastructure reduces the downtime in the event of a hardware failure as a virtual server can be moved to another physical server without rebuilding the Dynamics AX environment.

Once the Dynamics Environment is installed and configured with DNS, Active Directory, MS SQL Server, Microsoft Dynamics, etc. and the AX software is tested and data loaded from the sample Contoso data, the next step is installation and configuration of Remote Desktop Services, or RDS, formerly known as Terminal Services. This is completed by opening server manager, adding roles, and then adding the Remote Desktop Services role. Once RDS role is installed and configured, licenses must be added to permit clients to connect. Licensing is available via academic licenses, the Dynamics Academic Alliance, or thorough the University's volume licensing program. Finally, the Dynamics AX client can be added as a Remote App program. The Remote App publishing is completed via selecting the server collection from the Server Manager, Remote Desktop Services, Collections, selecting the Collection configured during RDS installation and configuration, under Remote App Programs selecting the Tasks dropdown and clicking Publish Remote App Programs. This launches the Publish Remote App wizard when can be used to publish Dynamics AX as a remote application in Windows Server 2012.

At this point, VMware is hosting an image with your configuration (dual processor, 32gb RAM, 1+ TB HDD recommended) which is running Windows Server 2012 with infrastructure services (DNS, AD), SQL Server, and Dynamics AX, Remote Desktop Services, and the Dynamics AX client configured as a remote application. Next, configuration of the classrooms and laboratories to access the Dynamics AX client must be performed. University laboratories typically fall under the domain of technology support services and are reimaged every semester or every year making advanced configuration problematic. Additionally, university computers will be members of the production university AD domain and, as previously mentioned, the AX clients and servers must reside on the same AD domain. The Remote App configuration under Remote Desktop Services serves to remedy the aforementioned issues. The only configuration required of the university lab and classroom computers is locating a single text file on the computers or on a shared drive. A sample text file, with an .rdp file extension, is presented as *Figure 3.* Certain aspects of the file will differ such as remote application name and IP address for example. The basic steps for setting up the infrastructure for Dynamics AX are:

1. VMWare to Host Windows Server 2012 Installations
2. Windows Server 2012 Core Services Must be Installed and Configured (AD, DNS, etc.) in either a single or multi-server scenario
3. MS SQL Server Installed and Configured to support Dynamics AX
4. Remote Desktop Services Installed and Configured
5. Remote Desktop Services Licensing must be Installed
6. Dynamics AX Installed and Configured
7. Remote Desktop Services Configured to host Dynamics AX as an Application
8. RDP File Created and copied to lab workstations or VDI

```
redirectclipboard:i:1
redirectposdevices:i:0
redirectprinters:i:1
redirectcomports:i:1
redirectsmartcards:i:1
devicestoredirect:s:*
drivestoredirect:s:*
redirectdrives:i:1
session bpp:i:32
prompt for credentials on client:i:1
span monitors:i:1
use multimon:i:1
remoteapplicationmode:i:1
server port:i:3389
allow font smoothing:i:1
promptcredentialonce:i:1
authentication level:i:2
gatewayusagemethod:i:2
gatewayprofileusagemethod:i:0
gatewaycredentialssource:i:0
full address:s:192.168.1.1
alternate shell:s:||Ax32
remoteapplicationprogram:s:||Ax32
gatewayhostname:s:
remoteapplicationname:s:Microsoft Dynamics AX 2012
remoteapplicationcmdline:s:
```

Figure 3 – A Sample RDP File

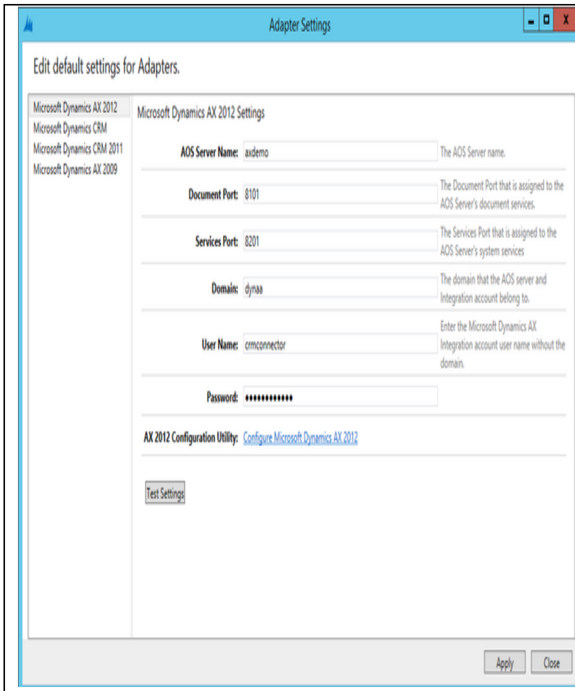


Figure 4 – Connector for Microsoft Dynamics Adapter Configuration

4. Dynamics AX ERP and CRM Integration

Integrating Dynamics AX ERP and CRM can be achieved via the Connector for Microsoft Dynamics. In the example scenario, the aforementioned Dynamics AX environment is integrated with CRM Online. The Connector for Microsoft Dynamics is customizable depending on an organization's needs. The first step is to install the connector software and all requirements for the connector software. The Connector for Microsoft Dynamics can be downloaded from the Customer Source website by MSDYNAA members.

Once the software is installed, each system much be added in the adapter settings configuration. The possible configurations can be seen as *Figure 4.* In the scenario presented in this work, the configurations to configure are Microsoft Dynamics AX 2012 and Microsoft Dynamics CRM 2011. Configuration requires a user account to act as the connector. This use is configured in Active Directory and in Dynamics AX. This account will be used to transfer data between AX and CRM and must have appropriate access. The AOS server name, document, and services port must be setup. In the example provided, everything is based on default settings.

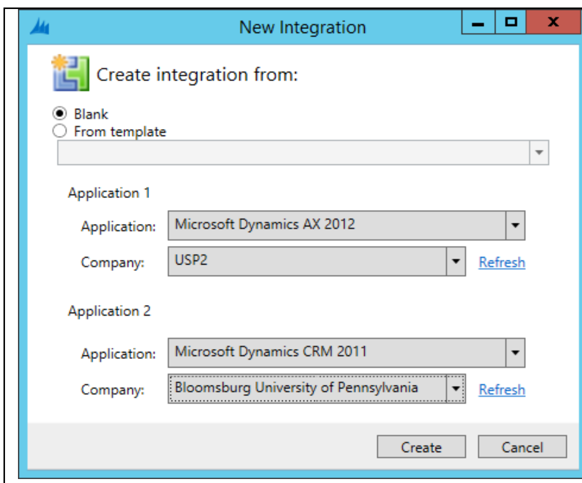


Figure 5 – New Integration Creation

Following installation and configuration of the Connector for Microsoft Dynamics, a new integration must be created. In the list box of the New Integration form, the applications configured in the previous step will be listed. Choose AX to CRM 2011. This integration is bi-directional meaning a second integration is not required for CRM to AX. Once the integration has been created it is necessary to determine which mappings are required for integration. The example presented activates all maps. The maps can be configured to run at any interval required. The interval should be set based on the amount of changes occurring between the systems. For example, if students need to see synchronized materials immediately, set the schedule for every minute. *Figure 5* details the new integration creation screen and *Figure 6* details the mapping configuration screen from the Connector for Microsoft Dynamics.

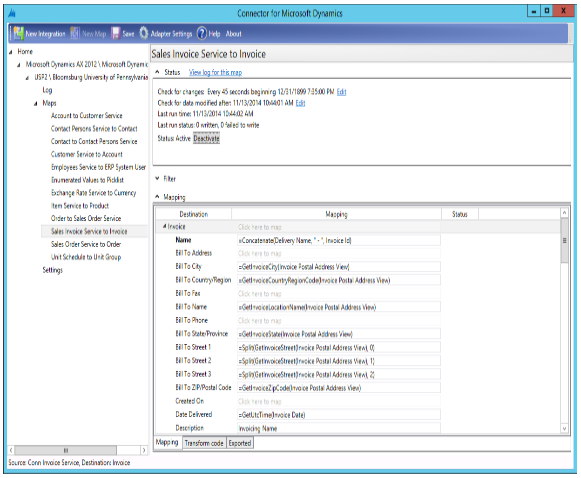


Figure 6 – Connector Mapping Configuration

5. Course Integration

One of the benefits of setting up and configuring the Connector for Microsoft Dynamics is the ability to integrate courses on ERP and CRM concepts. A key educational benefit of an integrated approach is that it replicates the real-world ERP/CRM environment. Experiential learning offers benefits such as increased understanding of the task covered in the experiential learning activity (C. Munoz & Huser, 2008; L. S. Munoz, 2010). Integration may be accomplished by offering multiple courses or by incorporating both subjects in a single course. One possibility is to have students co-registered in both courses where concepts can be interwoven between classes. This facilitates a reinforcement learning approach (Silvetti & Verguts, 2012) or a variation on the models based on the "introduce, reinforce, apply, assess" model. In order to implement integration, key or pivotal concepts can be employed between the courses. *Figure 7* shows the opening screen for Microsoft Dynamics AX 2012 R3 and *Figure 8* shows CRM Online. One such pivotal point to integrate the courses is on the sales order. If all mappings are enabled on the Connector for Microsoft Dynamics, then products from AX will populate into CRM and Sales Orders will transfer between the systems. This permits instructors to enter a sales order in one course and examine it in the other. For example, CRM may cover pre-sales activates leading up to creating a sales order. The sales order will be automatically transferred to Dynamics AX, where students in the AX 2012 course can move the sales order to production, finished goods, and finally billing the customer. This permits the instructor and students of either course (or both courses) to illustrate and investigate the relationships between sales and marketing efforts and materials procurement, logistics, and production. A sales order in this context represents a record of a promise by a seller to deliver to a buyer. Exposure to AX functionality will enable actors from the sales and marketing perspective to understand how quickly and easily the promises embodied in the sales order can be kept; exposure to CRM functionality will enable actors from the supply chain and logistics perspective to understand what will be required to fulfill the promises sales and marketing actors make on the firm's behalf.

Depending on the specifics of a given curriculum, students in the co-registered sections can reap the benefits of multiple framing: the opportunity to analyze, evaluate, and solve a problem from multiple perspectives (Colby, Ehrlich, Sullivan, & Dolle, 2011). In addition, an integrated course structure of the kind described herein facilitates the adoption of either team-based learning (Fink, Michaelsen, & Knight, 2004; Michaelsen & Sweet, 2011), problem-based learning (Allen, Donham, & Bernhardt, 2011), or collaborative learning (Alavi, 1994). Each of these methods involves students in "heads-on, hands-on" (Allen et al., 2011) problem-solving activities. Numerous studies have shown superior learning outcomes such as performance on courses assessments in fields such as physics (Hake, 1998) medicine (Albanese & Mitchell, 1993), and marketing (C. Munoz & Huser, 2008).

However, in order to yield the desired educational benefit, the experience must "work," making the technical infrastructure and implementation critical to the success of the effort. If the technology does not work as intended, the problems encountered may interfere with student learning. Although attribution theory (Folkes, 1988; Weiner, 1985) suggests that dissatisfaction with a negative experience may be reduced if the negative experience is evaluated by the customer as being outside the control of the provider, in this context the faculty member(s) are likely to be the focus of blame for failure (faculty often hold students responsible for being sure they can use the learning management system, for example, and are likely to be held to a comparable standard by students).

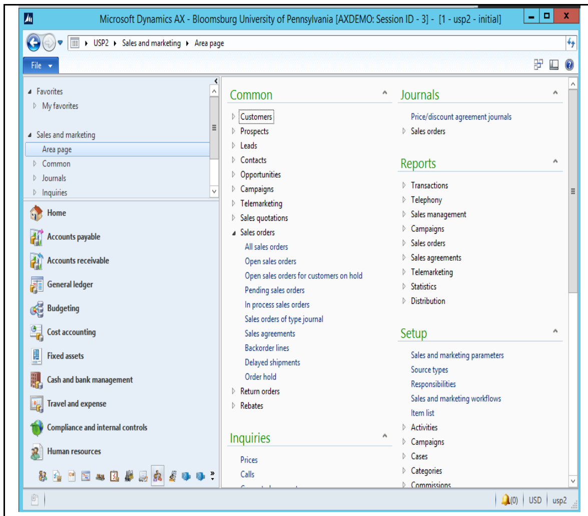


Figure 7 – Dynamics AX

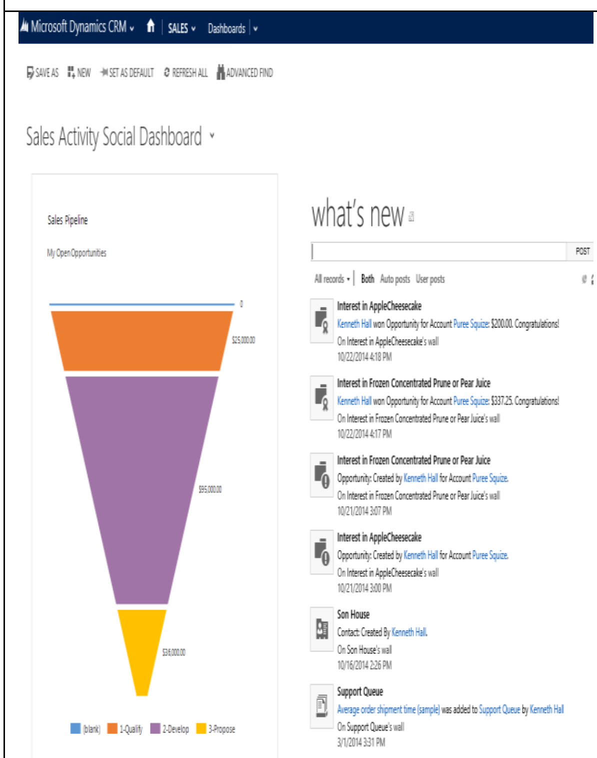


Figure 8 – Dynamics CRM in the Cloud

Figure 9 shows a sales order as a pivotal point for course integration between Dynamics AX 2012 and CRM 2011. Sales orders are required for the ERP environment as sales orders are an important concept. The sales order can be used to take students from ordering raw materials, storing the raw materials in a warehouse, paying a vendor invoice, through manufacturing, finished goods warehouse and inventory, through shipping to the customer. The same sales order may be employed in the CRM course for pre-sales activities, customer contact, demand forecasting, etc. *Figure 10* shows all sales orders in Dynamics AX 2012 R3. Orders shown in this screen are both native to AX 2012 and transferred orders from CRM 2011. Orders that begin with ORD are orders that have transferred automatically by the Connector software.

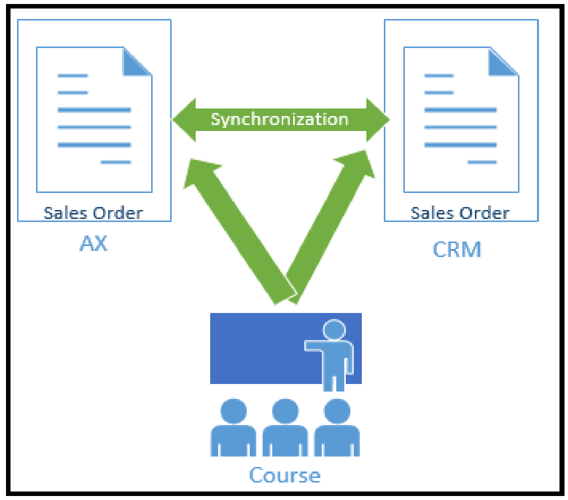
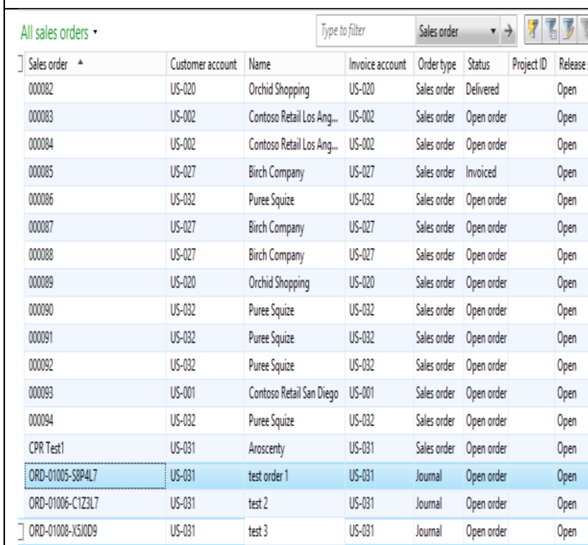


Figure 9 – Course Integration of ERP and CRM with Sales Order Course Pivot



All sales orders

Sales order	Customer account	Name	Invoice account	Order type	Status	Project ID	Release s
000082	US-020	Orchid Shopping	US-020	Sales order	Delivered		Open
000083	US-002	Contoso Retail Los Ang...	US-002	Sales order	Open order		Open
000084	US-002	Contoso Retail Los Ang...	US-002	Sales order	Open order		Open
000085	US-027	Birch Company	US-027	Sales order	Invoiced		Open
000086	US-032	Puree Squize	US-032	Sales order	Open order		Open
000087	US-027	Birch Company	US-027	Sales order	Open order		Open
000088	US-027	Birch Company	US-027	Sales order	Open order		Open
000089	US-020	Orchid Shopping	US-020	Sales order	Open order		Open
000090	US-032	Puree Squize	US-032	Sales order	Open order		Open
000091	US-032	Puree Squize	US-032	Sales order	Open order		Open
000092	US-032	Puree Squize	US-032	Sales order	Open order		Open
000093	US-001	Contoso Retail San Diego	US-001	Sales order	Open order		Open
000094	US-032	Puree Squize	US-032	Sales order	Open order		Open
CPR Test1	US-031	Aroscenty	US-031	Sales order	Open order		Open
ORD-01005-S8P4L7	US-031	test order 1	US-031	Journal	Open order		Open
ORD-01006-C1Z3L7	US-031	test 2	US-031	Journal	Open order		Open
ORD-01008-X5J0D9	US-031	test 3	US-031	Journal	Open order		Open

Figure 10 – Sales Orders from Dynamics AX

Figure 11 shows a specific sales order in Dynamics AX 2012. *Figure 12* shows the same order in CRM 2011. This order was generated within the CRM 2011 environment. The order was transferred to the AX environment via the

Connector for Microsoft Dynamics. During the transfer process, all required validation checks are performed. For example, the product on the sales order must be listed in the system as must the customer. Once the sales order arrives in the AX 2012 system, the order may be processed just as a sales order native to the AX 2012 system. The same is true for transferring from AX 2012 to CRM 2011.

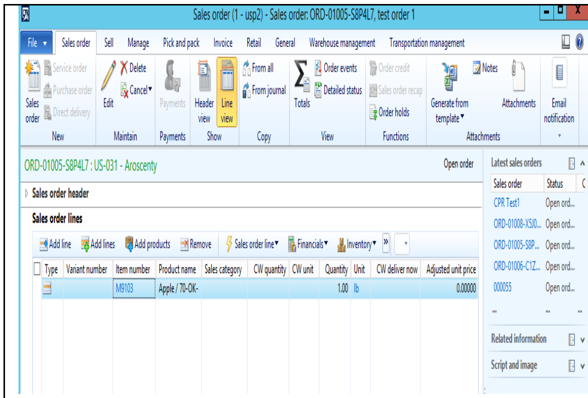


Figure 11 – Sales Order ORD-1005-S8P4L7 in Dynamics AX

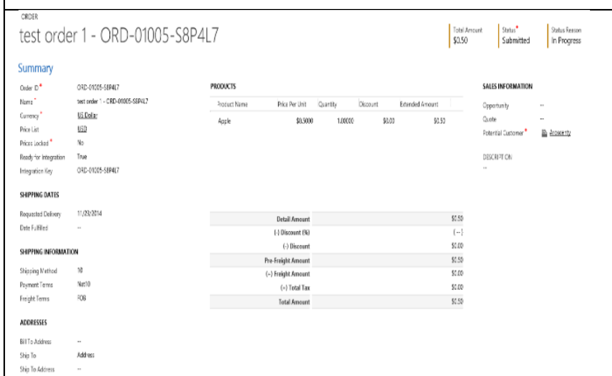


Figure 12 – Sales Order ORD-1005-S8P4L7 in Dynamics CRM

6. Conclusions

A multiple-perspective view of the interrelationships between sales and marketing activities on the one hand and supply chain and logistics activities on the other enable students to adopt a holistic view of the firm and its role in satisfying customer needs, wants, and demands. Here we have demonstrated a means by which instructors can use Dynamics AX and Dynamics CRM with the Microsoft Connector from Dynamics AX to enable students to develop a holistic perspective of supply chain and CRM issues in the face of otherwise-daunting resource constraints. This approach fits well with current trends in university instruction and is intended to meet the needs of students and employers as well as educational institutions.

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Appendix of Images

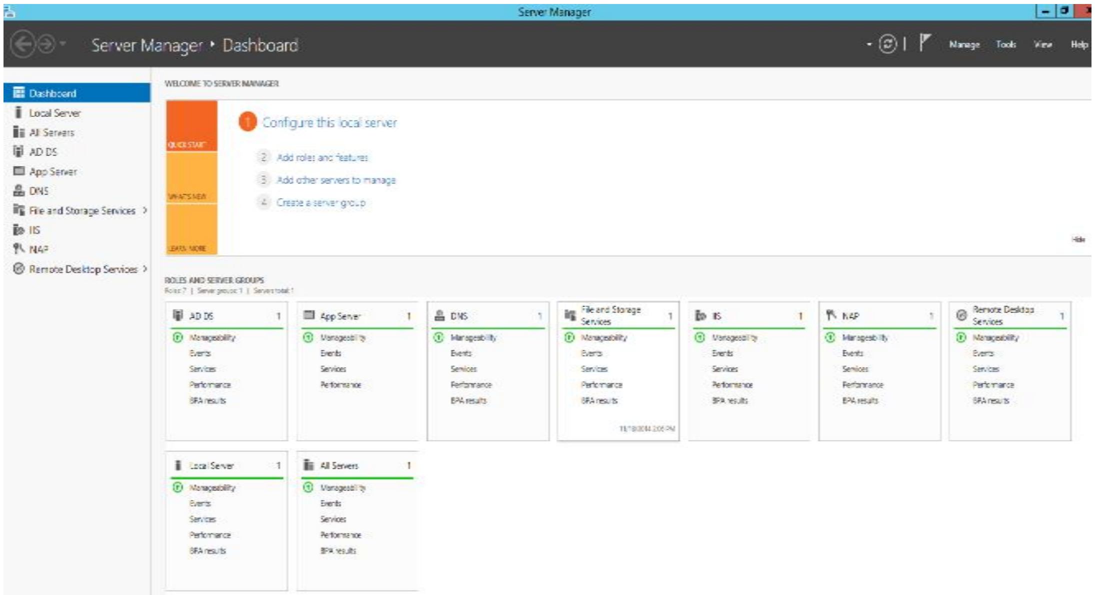


Figure 1 – Windows Services to Support Dynamics in the University Environment

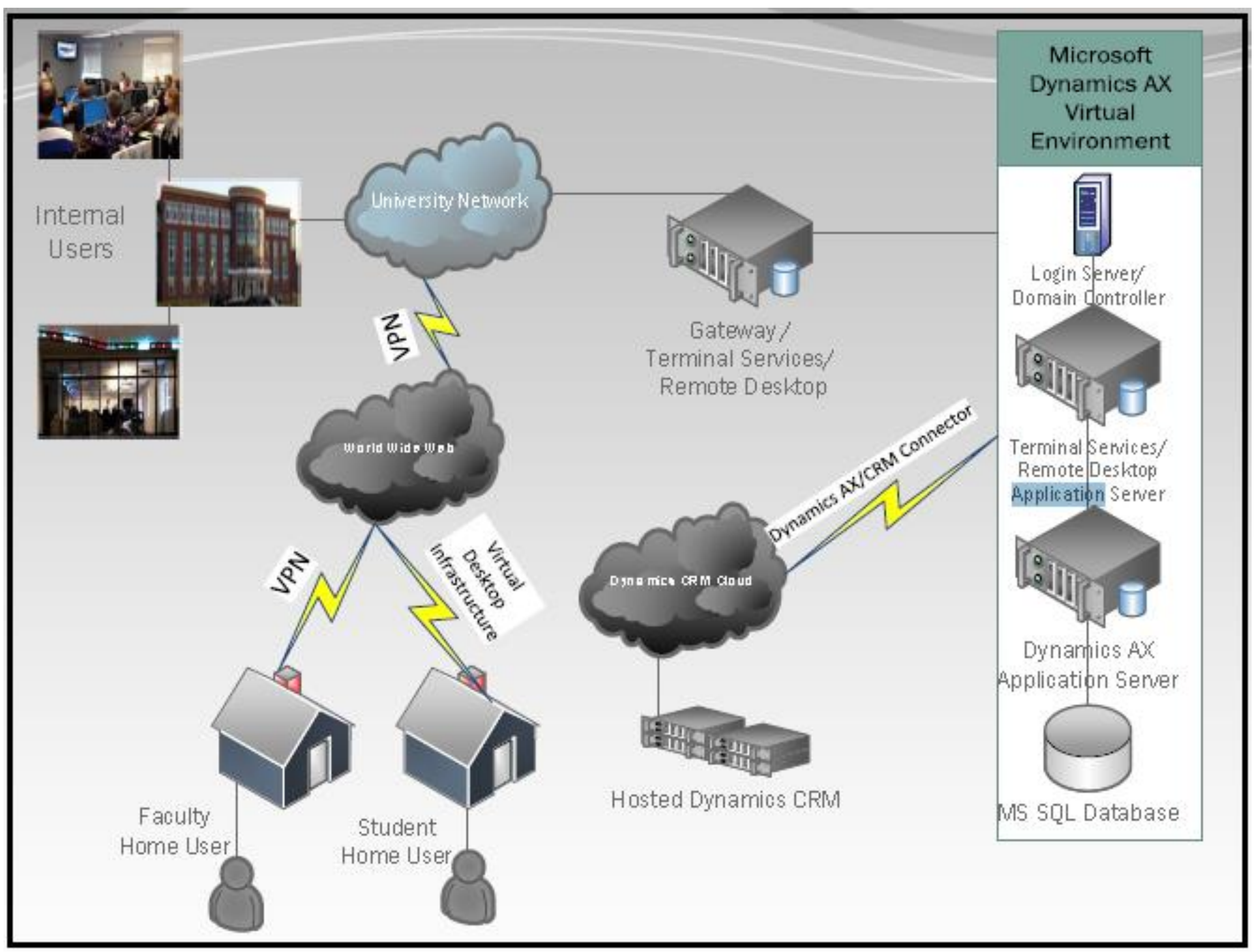


Figure 2 – Technical Architecture for Dynamics AX Deployment in a University

```
redirectclipboard:i:1
redirectposdevices:i:0
redirectprinters:i:1
redirectcomports:i:1
redirectsmartcards:i:1
devicestoredirect:s:*
drivestoredirect:s:*
redirectdrives:i:1
session bpp:i:32
prompt for credentials on client:i:1
span monitors:i:1
use multimon:i:1
remoteapplicationmode:i:1
server port:i:3389
allow font smoothing:i:1
promptcredentialonce:i:1
authentication level:i:2
gatewayusagemethod:i:2
gatewayprofileusagemethod:i:0
gatewaycredentialssource:i:0
full address:s:192.168.1.1
alternate shell:s:||Ax32
remoteapplicationprogram:s:||Ax32
gatewayhostname:s:
remoteapplicationname:s:Microsoft Dynamics AX 2012
remoteapplicationcmdline:s:
```

Figure 3 – A Sample RDP File

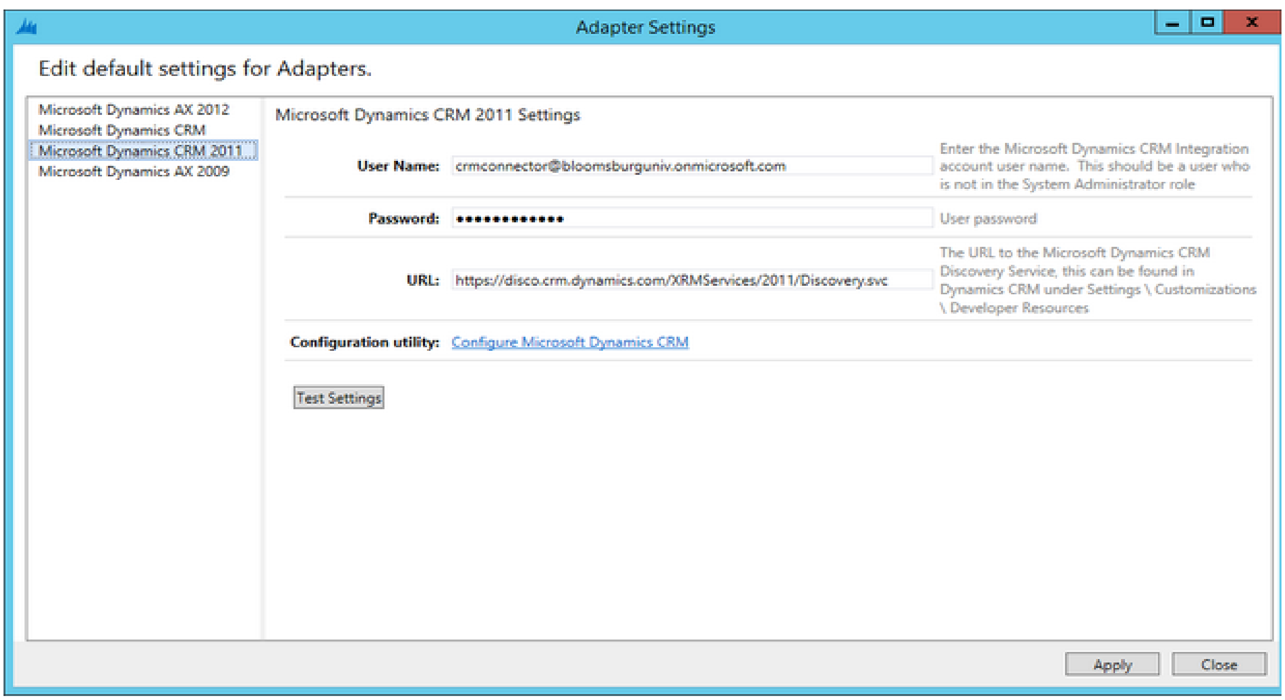


Figure 4 – Connector for Microsoft Dynamics Adapter Configuration

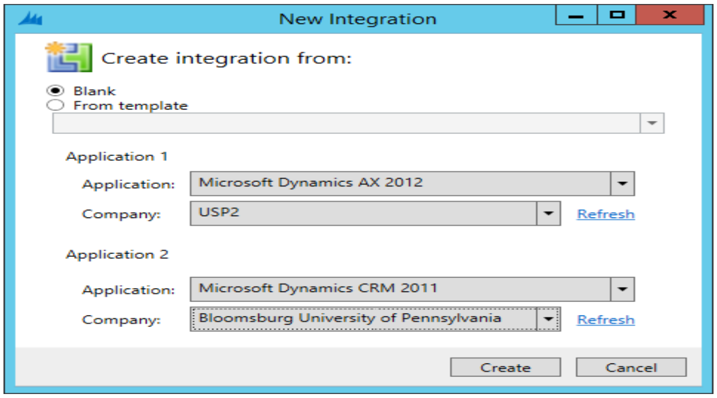


Figure 5 – New Integration Creation

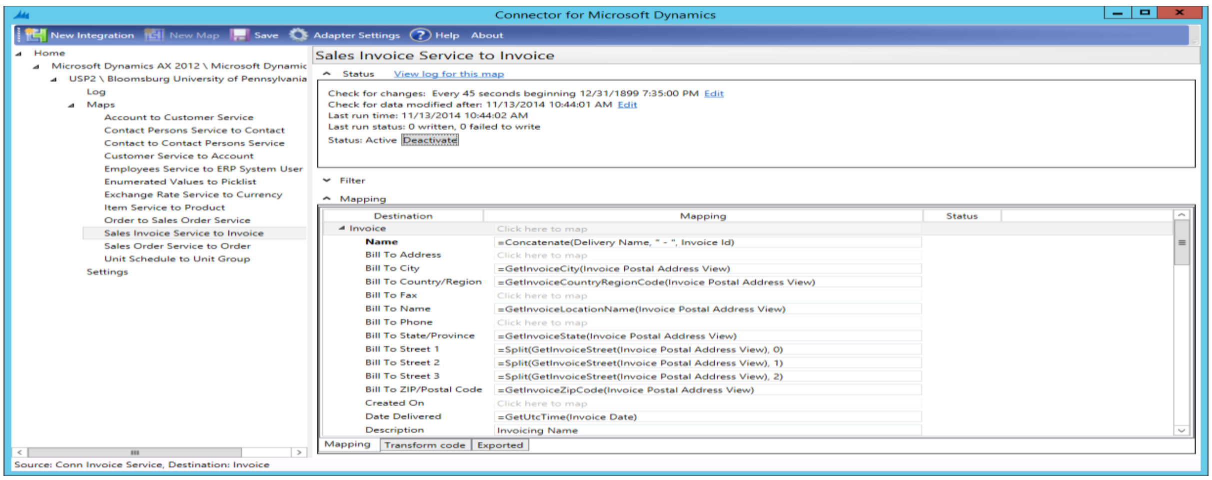


Figure 6 – Connector Mapping Configuration

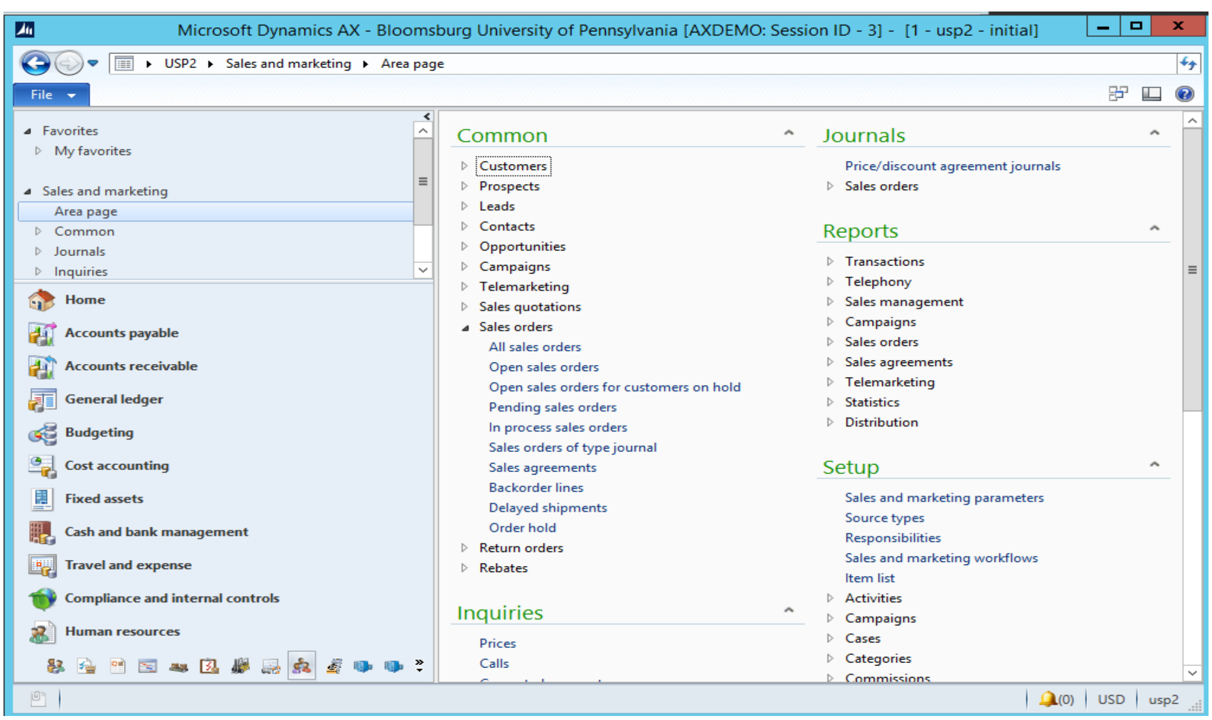


Figure 7 – Dynamics AX

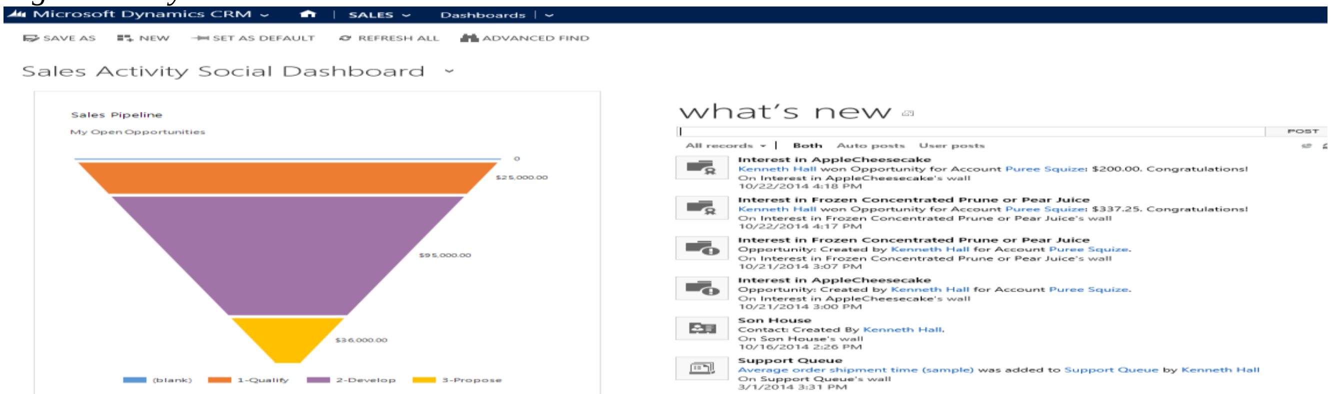


Figure 8 – Dynamics CRM in the Cloud

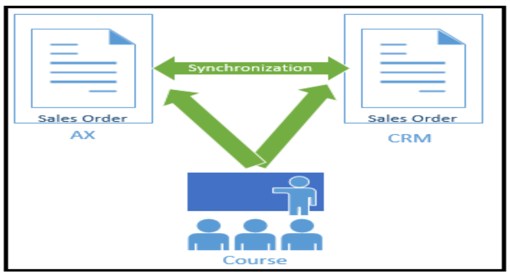
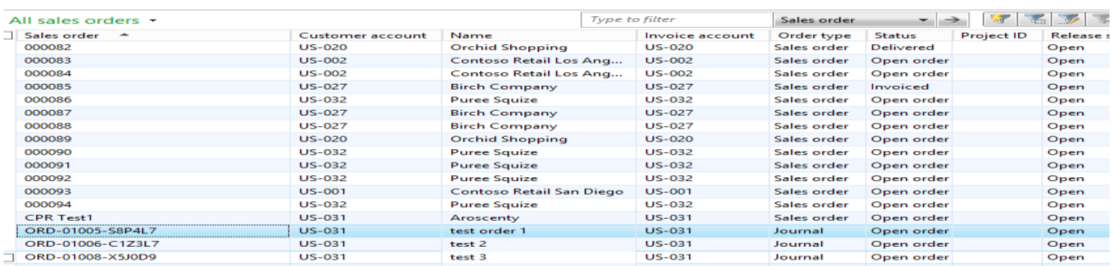


Figure 9 – Course Integration of ERP and CRM with Sales Order Course Pivot



All sales orders

Sales order	Customer account	Name	Invoice account	Order type	Status	Project ID	Release s
000082	US-020	Orchid Shopping	US-020	Sales order	Delivered		Open
000083	US-002	Contoso Retail Los Ang...	US-002	Sales order	Open order		Open
000084	US-002	Contoso Retail Los Ang...	US-002	Sales order	Open order		Open
000085	US-027	Birch Company	US-027	Sales order	Invoiced		Open
000086	US-032	Puree Squize	US-032	Sales order	Open order		Open
000087	US-027	Birch Company	US-027	Sales order	Open order		Open
000088	US-027	Birch Company	US-027	Sales order	Open order		Open
000089	US-020	Orchid Shopping	US-020	Sales order	Open order		Open
000090	US-032	Puree Squize	US-032	Sales order	Open order		Open
000091	US-032	Puree Squize	US-032	Sales order	Open order		Open
000092	US-032	Puree Squize	US-032	Sales order	Open order		Open
000093	US-001	Contoso Retail San Diego	US-001	Sales order	Open order		Open
000094	US-032	Puree Squize	US-032	Sales order	Open order		Open
CPR Test1	US-031	Aroscenty	US-031	Sales order	Open order		Open
ORD-01005-S8P4L7	US-031	test order 1	US-031	Journal	Open order		Open
ORD-01006-C1Z3L7	US-031	test 2	US-031	Journal	Open order		Open
ORD-01008-X5J0D9	US-031	test 3	US-031	Journal	Open order		Open

Figure 10 – Sales Orders from Dynamics AX

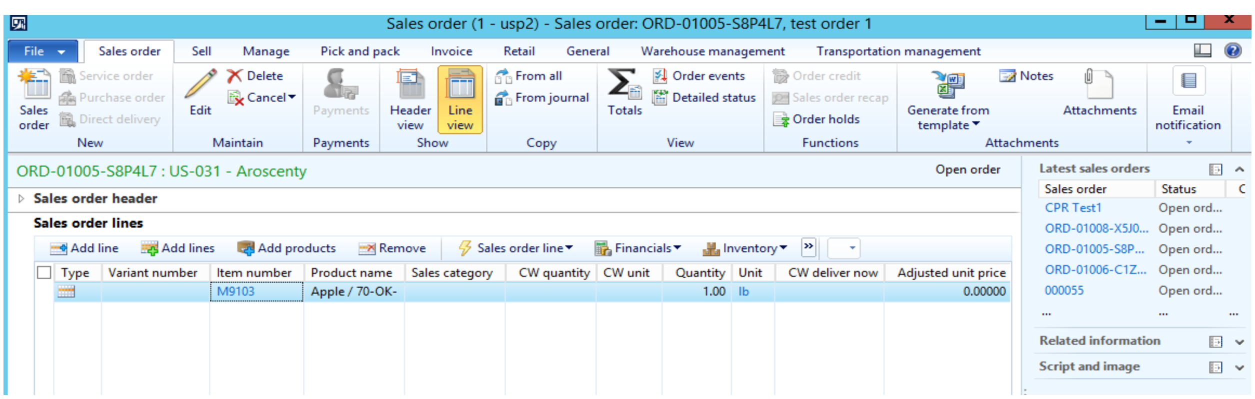


Figure 11 – Sales Order ORD-1005-S8P4L7 in Dynamics AX

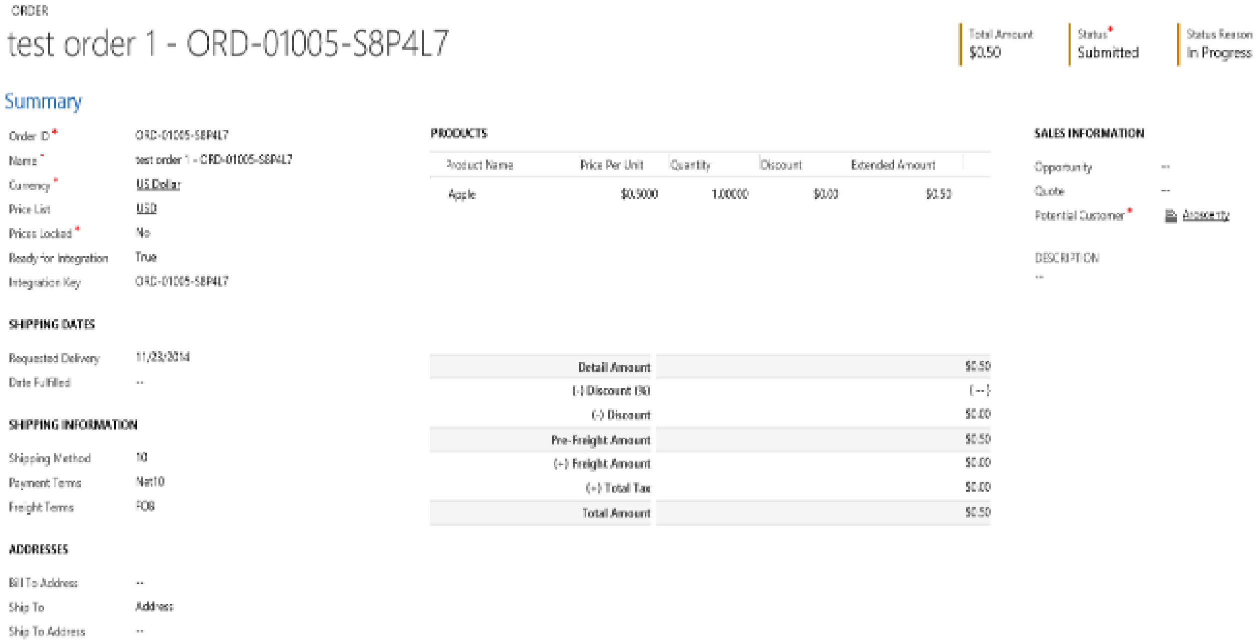


Figure 12 – Sales Order ORD-1005-S8P4L7 in Dynamics CRM

The Development of an Educational Cloud for IS Curriculum through a Student-Run Data Center

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Abstract

The industry-wide emphasis on cloud computing has created a new focus in Information Systems (IS) education. As the demand for graduates with adequate knowledge and skills in cloud computing is on the rise, IS educators are facing a challenge to integrate cloud technology into their curricula. Although public cloud tools and services are available for many students today, education institutes can build a private, educational cloud to facilitate more practical, interactive and hands-on learning. This paper presents a proposal of building a student-run data center through an industry partnership between Cal Poly Pomona and leading cloud technology firms such as Microsoft, Avanade, Chef, and Juniper. The data center will create a private cloud to engage faculty and students in a highly accessible, experimental cloud environment, where through real-world experience faculty can teach and students can learn the design, configuration, deployment, management, and use of cloud solutions. This polytechnic approach in cloud curriculum integration will also allow the IS department to be simulated as a modern enterprise with a goal to virtualize its IT provisioning, where students can gain a broader, more enterprise-centric view of modern computing.

Keywords: IS Curriculum, Data Center, Cloud Computing

1. BACKGROUND

Cal Poly Pomona is one of two polytechnic universities in the public California State University system, the largest university system in the United States. The university motto is "Learn by Doing," and experiential and project-based learning is an important characteristic of a Cal Poly education. The CIS Department is part of the College of Business, and its undergraduates earn a Bachelor of Science degree in Business with an emphasis in Computer Information Systems.

A leading-edge curriculum that makes CIS graduates attractive to the IT industry is part of the culture and tradition of CIS at Cal Poly Pomona. During the late 1970s and early 1980s, CIS faculty members advocated the separation of business programming from computer science (Athey, 1979; Athey and Wagner, 1979, 1980) and were early leaders in the development of a model curriculum that emphasized business applications, known as the Cal Poly/DPMA Model Curriculum (Mitchell and Westfall, 1981). Other major achievements in IS curriculum development include: early adopter of object-oriented technology in mid 1990s, full curriculum development in Web technology, e-commerce, and Service-Oriented Architecture in late 1990s, and again early adopter of mobile applications development in 2013.

The CIS undergraduate curriculum is highly structured, with a strong common core and advanced career tracks. The CIS faculty first developed career tracks in 1980. They revise tracks regularly, based on changes in the IT industry and the availability of new faculty to teach courses in different areas. Currently, the department offers two career tracks: *Application Development* and *Information Assurance*. Security is a growing area, in which CIS is a leader, evidenced by its designation in 2006 and 2014 as a Center of Academic Excellence from both the National Security Agency and the Department of Homeland Security. Thanks to the continuous curriculum development, the faculty and student body of the CIS department today possess strong expertise in the areas of networking, security, and application development.

In 2014, the College of Business Administration received a $500,000 endowment gift from Avanade, a joint venture between Accenture and Microsoft, to support the legacy of Mitch C. Hill who was Avanade's former CEO and a distinguished Cal Poly Pomona graduate. The gift provided seed money to establish the Mitchell C. Hill Center for Applied Business Information Technology in Winter 2015, with a mission to provide a focal point and leadership role in applied business information technology through polytechnic education, applied research, and industry partnership. As its first initiative, the Center entrusts the CIS department to construct a student-run data center to engage students with modern cloud computing through creating, managing, and providing cloud services to enhance learning and research.

This paper is organized as follows. Section 2 discusses the definition, solutions and deployment models of cloud computing as well as information on the current demand for cloud data centers. Section 3 reports a summary of related literature in the area of cloud computing for higher education and IS curriculum. Section 4 describes the proposed data center, and Section 5 illustrates how cloud solutions can be integrated into the IS curriculum. Finally, Section 6 presents the conclusions.

2. CLOUD COMPUTING

The concept of cloud computing was first introduced in the 1960s (Marston, 2011) and has resurfaced in such forms as Application Management Services (AMS) and Application Service Providers (ASP) in the dot-com era. The basic idea of cloud computing is that the computing is "in the cloud," where the "cloud" is taken from the symbol in network diagrams that represents the Internet.

There seems to be little agreement in the definition of cloud computing between scholars, analysts, and IT experts, because they either approach it from different angles (Kovacevic et al., 2012) or the standards for connecting the computer systems and the software are not fully defined at the present time (Beal, 2015). Nonetheless, this paper uses the definition provided by the National Institute of Standards and Technology (NIST) as it has been cited often in the literature:

> "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."

The NIST's definition identifies five essential characteristics for the model of cloud computing: on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service. The manifestation of these characteristics in practice has also coined terms like "computing as a utility" and "computing as a service". Because of its significant impact on IT, cloud computing has been credited as a "genuine information technology revolution" (Morrison, 2011), a "potentially game-changing technology" (Kontzer, 2009), a "new computing paradigm" (Jararweh et. al, 2012), and the "fifth major paradigm shift in computing" following mainframe computing, personal computing, client-server computing, and web computing (Conn & Reichgelt, 2013). IT experts expect cloud computing to become the "dominant IT service delivery model" by the end of the decade (Jararweh et. al, 2012).
According to NIST's definition (NIST, 2011), cloud computing mainly offers three cloud solutions: *Software as a Service* (*SaaS*),

Platform as a Service (*PaaS*), and *Infrastructure as a Service* (*IaaS*). *SaaS* provides users with access to applications in the cloud such as email (e.g., GMail), text editors (e.g., Google Docs), or online storage (e.g., Dropbox). In a *PaaS* model, a cloud provider delivers a container environment with hardware and software tools to run the user's application components. For instance, application developers can deploy their own .NET Web applications onto Windows Azure cloud instances. With *IaaS*, cloud solution providers such as Amazon's Elastic Compute Cloud supplies infrastructure resources, usually in terms of virtual machines, upon which consumers can deploy and run arbitrary software including operating systems and applications. In broader terms, cloud solutions can be further categorized to include *Application as a Service*, *Database as a Service*, *Information as a Service*, *Infrastructure as a Service*, *Integration as a Service*, *Management as a Service*, *Process as a Service*, *Security as a Service*, *Storage as a Service* and *Testing as a Service* (Linthicum, 2010).

NIST lists four cloud deployment models. The *Private cloud* is built to be exclusively used by a single organization or a business unit. The *Community cloud* is provisioned for the exclusive use by a specific community of consumers from organizations that have shared needs or concerns. The use of the *Public cloud* is open to the general public. Finally, the *Hybrid cloud* is a composition of two or more distinct cloud infrastructures (private, community, or public). Each model yields distinct characteristics including varying pros and cons. Deployment decisions are determined by considering various influencing factors such as the requirements of an organization, type of organization and the scale of the organization (Kalpana & Laharika, 2013).

The essence of the cloud is that it makes computing resources always available from anywhere through a data center. A data center is the cloud hub where all the cloud services are designed, configured, deployed, secured, and provided. A data center is generally organized in rows of ''racks" where each rack contains modular assets such as servers, switches, storage ''bricks", or specialized appliances. Hardware or platform virtualization, the creation of a virtual machine to act like a real computer with an operating system, is the most common technology being employed by today's data centers to reduce costs, increase agility and enhance security.

Managing a large number of cloud services is an enormous task. The most recent technology in data center operations is the implementation of Software Defined Networking (SDN) (Sher-DeCusatis & DeCusatis, 2014). SDN commonly refers to a set of technologies that separate the network control and management functions from the data transmission functions. Rather than pre-configuring network devices to make hop-by-hop decisions on traffic routing, SDN provides Application Programming Interfaces (APIs) to automate network management currently performed by low level, manual commands. The ability to program network infrastructure APIs is rapidly emerging as a key differentiating skill for network architects and administrators, and will soon become a requirement for most employers (Sher-DeCusatis & DeCusatis, 2014).

Driven by the recent proliferation of cloud computing, data centers are experiencing rapid growth in both scale and complexity (Zhang et. al, 2011). According to a prominent market survey, (Research & Market, 2015) the global market for datacenter construction is expected to register an annual compound growth rate of 21 percent through 2018.

3. CLOUD COMPUTING FOR HIGHER EDUCATION AND IS CURRICULUM

The rapid migration toward cloud computing has also prompted higher education to consider adopting cloud technology to lower the cost of technology implementation and increase access to technology infrastructure. The potential academic benefits and efficiencies of cloud computing in higher education has been recognized by many universities (Marinela & Andreescu, 2011). In Gartner's 2012 CIO survey (Lowendahl, 2012), the 143 higher education respondents ranked cloud second after mobile among their technology priorities. The survey also indicates that the opportunities and challenges in leveraging cloud technology cannot be ignored by higher education. In fact, a recent national survey of computing and IT in US higher education (Green, 2014) has shown that the proportion of campuses reporting a strategic plan for cloud computing rose to 29 percent in fall 2014, up from 27 percent last year, 24 percent in 2012, 21 percent in 2011, and 9 percent in 2009.

While university administrations have interests in cloud computing in terms of efficiency, effectiveness and cost savings, higher education institutes also have an academic side goal of learning and knowledge production. As the demand for graduates with knowledge and skills in cloud computing is on the rise, IS educators have an urgent duty to help students respond to this rapidly evolving trend.

For IS programs, the challenge is to decide on how to design curriculum that teaches cloud technology and incorporates appropriate cloud-based technologies into their pedagogy. The literature shows that various approaches have been taken to integrate cloud computing into IS curricula.

Cloud computing can be integrated into a whole IS program or curriculum. For instance, Lawler and Joseph (2012) discuss how cloud technology can be integrated into a Technology Entrepreneurship program. In the program, students can learn skills for leveraging cloud computing practices in the context of an enterprise strategy. Chen et. al (2012) integrate cloud computing components into seven third/fourth-year undergraduate level information systems, computer science, and general science courses that are related to large-scale data processing and analysis. In an attempt to improve the existing IS Model Curriculum (e.g., IS Model Curriculum 2009), Lawler (2010) defines a more comprehensive and structured program by which computer science and information systems students can learn needed skills in cloud computing strategy and technology in four years.

Cloud computing as a core subject can also be created as a single course. There are a number of this type of courses being offered to teach the fundamentals and principles of cloud computing (e.g., Border, 2013; Chen et. al, 2012; Maraschini et. al, 2013; Lawler, 2011). Common knowledge units such as cloud technologies (e.g., firewalls, addressing and sub-netting, storage architectures, virtualization, service-oriented architectures, autonomic and utility computing, etc.), cloud services and provisioning, cloud design and deployment, and cloud management and governance are being taught in these courses.

With cloud technology, students' learning is no longer confined within the classroom. Learning environments could be improved by allowing students to access learning resources anywhere and anytime from clouds infrastructures. Therefore, cloud technology can be used as a tool to improve pedagogy and enhance student learning in individual IS courses. For instance, several IS courses (Chen et. al, 2012) use open-source computing tools such as Hadoop, Mahout, and Hive to enhance student learning environments. Realizing the fact that the advent of cloud computing has made modern data management technologies differ from the traditional ones, Grossniklaus and Maier (2012) taught cloud-based, scalable data stores such as NoSQL and VoltDB in their data management course. Instead of investing in more expensive computer labs and classrooms, Mrdalj (2011) proposes an attractive alternative for Business Intelligence courses that uses cloud technology to implement a rather cost-effective, rapid and dynamic environment. Finally, rather than having students use customary methodologies, such as the Unified Process, Agile, or others, Roggio (2011) proposes a new approach to teaching a two-course sequence capstone course in software development. The approach divides student teams into those who help in setting up the cloud infrastructure, platform, and applications support and those who use the cloud to develop applications.

There are two distinct perspectives on the cloud, either you are a user of a cloud or you are the developer or provider of cloud services to others. Thus, IS educators must not only educate students to be competent users of clouds but also train them to be capable cloud builders or service developers. There has been confusion among IS educators that cloud services available for education refer to only those provided by the public clouds (ISaila, 2014). In fact, educational, private clouds can be built to interconnect faculty and students with applications, platforms, content, and data in support of curriculum need (Conn & Reichgelt, 2013; Mathew, 2012).

For small and medium-sized organizations such as common education institutes, private clouds are prohibitively expensive (Harms & Yamartino, 2010). Until recently, it was not cost effective to provide students with access to real world examples of IT infrastructure (Sher-DeCusatis & DeCusatis, 2014). Fortunately, this problem can be addressed through industry and academic partnerships. This paper presents a proposal for building a student-run data center through an industry partnership between Cal Poly Pomona and leading cloud technology firms such as Microsoft, Avanade, Chef, and Juniper. The data center will create a private cloud to engage faculty and students in a highly accessible and experimental cloud environment where they can practically teach and learn the design, configuration, deployment, management, and use of cloud solutions.

4. THE DATA CENTER

The data center includes computing, networking and storage systems that are typical for use in cloud data centers. The design of the data center included participation from students, faculty and industry partners to ensure the facility was designed with student and curricular needs in mind while also representing industry best practice.

The room that houses the data center is approximately 15′ x 20′ and has a data-center grade air conditioning unit mounted in the ceiling. There is no backup air conditioning aside from the building-wide unit that only runs when the building is open and the ceiling-mounted room unit so a failure of the in-room air conditioning system will require the shutdown of computers within the facility. There is also no generator backup for the facility so a loss of power will mean that UPSs in the room will simply offer computers ample time to shut down gracefully. As a result of the size, air conditioning, and power constraints of the facility, the data center will run only curricular and research workloads. Projects in the data center that grow to needing large-scale deployment or robust uptime and availability will need to migrate to public cloud infrastructures.

The data center is being built in phases and when complete will include 128 RUs of space for servers in addition to 112 RUs of space allocated to storage, power backup, cable management etc. While Cal Poly Pomona is currently on the quarter system it is in the midst of a transition to semesters. As a result, the data center is divided into four quadrants with three quadrants being in use at any given time and the fourth quadrant being under construction.

In the first two years one quadrant will be built each semester and added to the production pool. By year three, servers in the first quadrant will be removed and reconditioned or replaced. The following semester the second quadrant would be rebuilt and so on. This process will ensure that a section of the data center is being built every semester which means that every student will participate in the construction of the data center. The continual reconstruction process will also provide ongoing upgrades and improvements that will keep the center aligned with industry best practices and with the evolving curricular and research needs of the university.

Data center hardware will be homogenous within each quadrant but heterogeneous across quadrants. The blend of architectures allows efficiencies of homogenous systems while also allowing the flexibility and scalability of heterogeneous systems. This will also offer the ability to pursue new design methods each semester while maintaining operational integrity for existing systems.

Students will study operating systems and networking in the second year of the program and will participate in data center construction during that year. In years three and four students operating the infrastructure will compete for data center administration positions including data center management, change management, systems and network administration, software development etc.

In addition to operating and maintaining systems within the data center, students will also research and implement best practices such as the optimization of energy consumption, flexible and scalable operations, virtualization, security and more. Through consultation with faculty and campus IT administration, students will continually refine the data center to meet goals pertaining to efficiency and effectiveness of operations

The design and operations of the data center will also be adaptable to research and curricular demands. The ability to modify the data center to facilitate curriculum and research will offer Cal Poly Pomona a unique ability to pursue projects and opportunities that would not otherwise be possible.

The goal of the data center is to allow users to acquire and provision resources with no direct interaction between student administrators and the computing systems within the facility. Instead, Chef Cloud management software will be used to fulfill user demands in real time. Student administrators will then tend to the care and feeding of the cloud platform while automated provisioning processes will tend to the fulfillment of user demands. Juniper Networks provided SDN-capable network hardware allowing both systems and networks to be automatically provisioned on demand.

Cybersecurity will be a key focus of the data center from operational, curricular and research perspectives. Faculty will use and teach best practices of organizations such as the Cloud Security Alliance (CSA). Access to the data center will initially be limited to the campus community. Operations staff will have access to the data center itself and direct fiber connects the data center to a student development lab offering unabated 10 Gbps IPv4 and IPv6 network access for developers. Additional access will make use of VPN tools to ensure that authentication, authorization and accounting controls are in place. As security controls are enhanced and matured, data center administrators will work with faculty and IT staff to open access to the entire campus community and eventually the Internet.

5. THE CLOUD SOLUTIONS AND THE CURRICULUM

The mission of the data center is to educate students not only to be competent users of clouds but also capable cloud builders and service developers. This can be achieved by simulating the CIS department as a modern enterprise with a goal to virtualize its IT environment. In this environment the student-run data center, with faculty supervision, can operate as the IT division of the enterprise through which a private cloud and its cloud solutions can be created and provided for curriculum needs. Through this cloud-enabled curriculum, faculty and students can be cloud users, cloud solution developers and cloud infrastructure developers. Through this highly accessible and experimental cloud environment, faculty and students can practically teach and learn the design, configuration, deployment, management, and use of cloud solutions. Table 1 shows that three "workforces" from the two career tracks of faculty and student body can be formed to create, provide, and manage the three major cloud solutions:

The *IaaS* is an on-demand cloud solution that provides an elastic approach to allocating compute and storage resources, generally in support of virtual appliances or machines. With this approach, CIS students can be allocated general purpose and specialized virtual machines for use in their coursework. IaaS provides the greatest strength to the Security and Networking Workforces who require reliable virtual machines to carry out simulations and projects related to their focus. In Azure, the IaaS role is implemented via the Virtual Machine Cloud resource provider that runs on top of a physical Hyper-V cluster managed by System Center 2012 Virtual Machine Manager. Due to the modularity of Azure, this cluster of physical Hyper-V servers can be horizontally expanded based on current resource needs and future growth.

Table 1. Workforces for Cloud Solutions

Solution	Application Workforce	Security Workforce	Networking Workforce
IaaS		x	x
Paas	x	x	x
Saas	x	x	

The *PaaS* is the cloud solution that provides the application development support. Isolated IIS, .NET Framework, Microsoft SQL and MySQL resources can be exposed to users of the cloud to develop web application projects requiring web and database services. Administrators are able to allocate these resources on-demand and can specifically define what is available given a particular project's requirements. This provides great assistance to the data center by offering a development environment more akin to that found in an enterprise rather than on personal hardware.

The *SaaS* cloud solution allows student access to web-based services that supply uniform functionality which caters more towards the managerial aspects of the CIS major. For example, Microsoft CRM is a web application designed to assist business interaction with customers by building quotes and managing relationships. This application does not require development skills on behalf of the user so is unlikely to be a part of the Azure Pack offering.

The next step is to identify the best possible cloud solutions for the curriculum. Table 2 illustrates the mapping between popular Microsoft Azure solutions and the existing CIS core and elective courses. The table suggests which Azure cloud solutions can be implemented for which course. For example, Microsoft's RemoteApp is a solution in Azure that allows users to use applications on any Android, iOS, Mac OS X, and Windows device. These applications are run on a Windows server through the Azure cloud via Microsoft's Remote Desktop Services. RemoteApp is an important and powerful tool that students can use in their CIS classes. By deploying any software needed onto RemoteApp, students can access and use required software on nearly any device, without needing to install anything other than the RemoteApp client. Since students do not have to install the applications themselves on their local device, there should be no instances of hardware and software compatibility issues.

Table 2. Cloud Solutions for CIS Courses

CIS Course	Cloud Solution
CIS 231 - Fundamentals of CIS	5, 10
CIS 234 - Object-Oriented Java	5
CIS 304 - Intermediate Java Programming	5
CIS 305 - Database Design Development	5, 6
CIS 307 - Business Telecommunications	5, 9, 8
CIS 310 - Management Information Systems	7
CIS 311 - Interactive Web Dev.	5, 10
CIS 315 - Intro to Sys. Analysis and Design	5, 6, 10
CIS 388 - Client/Server App. Dev.	5, 6, 10
CIS 345 - Data Modeling	1, 2, 5, 6, 7
CIS 347 - Telecommunication Networks	5, 9
CIS 415 - Adv. Object Oriented Systems	1, 5
CIS 417 - Broadband & Multimedia Networks	5, 9
CIS 421 - Multimedia Application Dev.	1, 2, 3, 7,10
CIS 424 - Advanced Java Programming	5, 6
CIS 427 - Mobile Comm. and Networks	4, 5, 9
CIS 433 - IS Auditing	1, 7, 10
CIS 451 - E-commerce App. Dev.	5, 6, 7, 10
CIS 466 - Systems Development Project	5, 6, 7, 10
CIS 467 - Network Security	5, 8, 9
CIS 471 - Internet Security	5, 7, 9
CIS 481 - Computer Forensics	5, 10
CIS 491 - Secure Web Dev.	5, 10
CIS 499 – Mobile App Dev.	5, 4, 10

* Analytics(1), CDN(2), Cloud API(3), Mobile Services (4), RemoteApp (5), SQL Database (6), Storage (7), VM (8), Virtual Networking (9), Websites (10)

The following three use cases further explain how an individual course can request and use Azure cloud solutions:

Use Case 1: CIS 305 Database Design and Development

CIS 305, Database Design and Development, is one of the core courses where students learn data modeling and normalization, relational database design and development, CASE tools, and SQL. Since this course is taught by multiple instructors, the course coordinator will request a SaaS cloud solution to let students model data and conduct database projects. The data center will setup a virtual machine as a PaaS for the SQL Database cloud solution to be integrated into the course.

Upon logging into a Windows 7 Professional virtual machine the student would notice Erwin Data Modeler pre-installed. The Erwin Data Modeler is used on Azure to provide a powerful way for students to visualize and manage data from multiple sources on-premise or in the cloud. Historically, students have had to install a version of Microsoft SQL Server on their own machine. With Azure, each student is then able to carry out their projects from an accessible location with adequate hardware resources. Because configuration of the database is addressed by the provisioning process and hardware resources are allocated based on best practices for database services, many technical problems experienced by students today become a non-issue. Students would be able to provide their instructors with connection information that would give the instructor access to grade their live database, thus eliminating the need to export and submit database files.

Use Case 2: CIS 451 E-commerce Application Development

CIS 451, E-commerce Application Development, is one of the elective courses in the Application Development career track. This course is designed to provide students with an overview of e-commerce computing and an analysis of the architectures, technologies, practices, and trends of e-commerce systems from both technical and managerial perspectives. In this class, each student is required to create three e-commerce applications: an online store, an API-based payment processing module, and an XML Web service application.

Since this course covers application development, the instructor will request a SaaS cloud solution to let students develop and store e-commerce applications and data in the Azure cloud. The data center will then configure and create a virtual machine as a PaaS and then complete the installation of a Visual Studio 2015 instance as a SaaS. With the use of Visual Studio in the cloud, students are no longer tied to using only their personal computer but are able to program their assignments from any computer at any location. Another way for students to access Visual Studio in the cloud is to use RemoteApp, which allows any Windows application to be run on any Android, iOS, Mac OS X, or Windows device remotely through the RemoteApp client. In addition, projects and other relevant data and files can be shared, accessed, and modified through Microsoft OneDrive.

Through Azure's web-based cloud solution, students will be able to work on a "live" website hosted on the cloud. Students and professors can view updated changes in real time. The Storage cloud solution will also allow the students to store their website templates and professors to store relevant teaching materials and sample code. For applications that require database management, a cloud-based SQL database can be provided by the SQL Database cloud solution.

Use Case 3: CIS 466 Systems Development Project

CIS 466, Systems Development Project, is the capstone course, where student teams are formed to take on real-world IS projects. There are various types of projects that cover areas such as business plans, website development, e-commerce applications development, mobile applications development, network configuration and management, information assurance and audit, computer forensics, and so on.

Depending on the project types, the course instructors can request Saas, Paas, and/or IaaS cloud solutions from the data center. For example, a mobile application project can use the Mobile Service to allow a student team to rapidly build cross-platform and native apps for iOS, Android, Windows or Mac, store app data in the cloud or on-premises, authenticate users, send push notifications, as well as add the custom backend logic in C# or Node.js. For a networking project, the Virtual Machines or Virtual Networks can be provisioned using PaaS and then provided to deploy and manage Windows and Linux Virtual Machines including VM Templates, scaling and Virtual Networking options.

6. CONCLUSIONS

Cloud computing is a rapidly growing area and training students to be well-versed with this technology when they graduate is urgent. There are many approaches to integrating cloud computing into IS curriculum. This paper describes an innovative way for the curriculum integration to be implemented with minimum budget overhead through partnering with industry donors. The data center, with the highly accessible and experimental cloud, will allow faculty and students to learn cloud technology in a simulated enterprise environment where IT provisioning is virtualized.

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Developing Capable Undergraduate Students: A Focus on Problem-Based Learning and Assessment

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Abstract

In today's society, education institutions must strive to develop graduates that are capable of facing the challenges they seek, and who are adaptable to the changes they will encounter post-graduation. Inherently, both institutions and educators must contain and exhibit these same attributes. Developing learners with high-level capabilities requires well developed and implemented curriculum that remains adaptable and relevant. Problem-based learning is a pedagogical choice that is appealing in this endeavor as it has a long history and holds promise for contemporary needs. However, it is complex and can be difficult to implement with confidence and efficacy. This paper looks at the issues surrounding modern learning, including a synopsis on learning theory from Bloom's taxonomy, to objectivism and constructivism, to learning assessment and assurance of learning. Problem-based learning is discussed with the intent to simplify its complexity and facilitate its application. Illustrative examples from the authors' experience are discussed.

Keywords: Learning theory, Pedagogy, Problem Based Learning, Assessment

1. INTRODUCTION

The modern competitive environment increasingly requires individuals and organizations to evolve and improve to remain successful. This is especially true for educators who are challenged with not only maintaining their own relevancy and capability, but who must develop the same in students, too.

The truly strategic instructional choices are ones that support student learning and development, aligning what is best for students with the long-term interests of the institution. In other words, the institutions and programs that serve students well and which allow them to succeed post-graduation in the challenges they choose, are the institutions that will win and best serve society. Faculty members, being the ones who design and deliver the courses and programs offered, are crucial to their students' and institutions' success.

This is not the first time education institutions have faced disruption. Freedman (n.d.) speculates whether higher education has the capability to truly adapt to future evolutions in pedagogy and medium, and suggests that although it "has been challenged in the past and survived," what "forms will prevail now?, [a]nd will the students keep attending?" (p. 6). Given history and the pace of current change, remaining agile and adaptive is as relevant for learners as it is for educators and institutions. Bransford, Sherwood, Vye. & Reiser (1986) note that learning is a confluence of learner-centered, knowledge-centered, and assessment-centered activity within a learning community. Modern learning communities will have to be responsive in approach, structure, and technology like never before. Dull (n.d.) reinforces these claims, noting "[a]daptive learning technology, as a new pedagogy, suggests we think about learning theory converging with adaptive learning" (para. 7), thereby getting to "a type of self-mapped learning experience while using assessment to measure and adjust direction" (para. 7). This is indeed a tall order to deliver and assure given the complexity of learning theories.

Problem-based learning (PBL) is a pedagogical choice that matches well with these modern needs. Having first appeared in the literature in the late 1960s, PBL is not a new theory or approach, and is generally attributed to medical school education at McMaster's University (e.g., Albanese and Mitchell, 1993). Over the years, PBL has evolved considerably to represent a plethora of techniques and approaches. As such, it provides utility and value for instructors who include it in their teaching repertoire. However, it can be intimidating to undertake and implement. Instructors must be versed on learning theories, make many implementation choices, and then implement PBL skillfully to be successful.

While PBL is a promising approach, assessing and assuring learning is integral to any pedagogical implementation. Assessment and assurance of learning (AOL, should ideally improve insight into decisions and efficacy and, if possible, be integrated into the learning structure itself with students involved throughout. This manuscript considers issues associated with contemporary teaching, concentrating on understanding how learning theories, the pedagogical choice to use PBL, and the concern with assessment and AOL can be managed for success. Some examples from the authors' experience are discussed.

Learning as both a theory and a practice has meandered its way from tried and tested Socratic methods through hermeneutic constructs, andragogy, objectivism, constructivism, social constructivism, etc. to the method focused on in this paper: Problem-based learning.

The musings of academic philosophers and educators such as Thorndike, Skinner, Dewey, Bruner, Ausubel, Bloom & Krathwohl, Vygotsky, Mezirow, Kolb, Knowles, etc. to identify a few, bring society to a point where learning needs to transcend just knowing, and give serious consideration to the resultant competency of a student, i.e. what it is they can do with their knowledge, as opposed to just what they know beyond completing their program of study. The authors advocate that knowing alone is not competence, but the ability to do and explain to others how to do, is. Seely Brown (2008), exemplifies the authors' position: "I think we are really going to see much more learning by doing" (p. 61).

The remainder of this paper is structured as follows: A short review of Bloom's taxonomy of learning will be provided, then, an expansion of learning theories and their importance to contemporary concerns is presented. This expansion includes learning theories such as objectivism and constructivism. It is important to keep in mind that achieving authentic student learning and capability development is a prime concern, and so assessment and assurance of learning (AOL) is discussed next. Then, an overview of PBL approaches and concepts is initiated. There are many issues and choices concerning PBL implementation and this discussion will seek to expand upon a selection of pertinent items while providing a starting point for further explorations. Finally, application examples from the authors' experience and opportunity will be discussed.

2. LITERATURE REVIEW

Bloom's Taxonomy

Bloom's taxonomy of learning (Anderson and Krathwohl, 2001; Bloom & Krathwohl, 1956) describes learning according to a hierarchy of lower and higher order concerns. The lower levels consist of remembering and understanding, while analyzing, evaluating, and creating are categorized as higher-order learning.

Higher Order Learning Concerns	**Creating Evaluating Analyzing**
Lower Order Learning Concerns	**Understanding Remembering**

Figure 1. Bloom's Taxonomy of Learning

Each level of the hierarchy has an appropriate place and value in the learning process, and indeed will be present with varying emphasis in each course. For example; in introductory courses, where learning important vocabulary and foundational concepts are an emphasis, lower order concerns such as remembering and understanding might be of prime focus. For follow-on or advanced courses, the higher order concerns are often the central interest.

From both a learning and strategic perspective, though, instructors should be seeking ways to integrate the higher-level concerns into their courses and to coordinate the learning levels across curriculum and course sequencing. If this is done well, it leads not only to meaningful and interconnected learning from course to course, but it also ensures the program as a whole is integral to achieving the deep learning that is so highly valued.

To illustrate, consider a statistics course that is a prerequisite for follow-on courses like operations management, and which has a prerequisite itself in a computer applications course. By coordinating the use of technology like spreadsheets across these courses, this sequence can become tightly integrated: Not because a course catalog description denotes the prerequisite, but because learning and student development is truly integrated across the courses and curriculum. This would seem like basic curriculum mapping, and it is, but given surveys of alumni and employers alike concerning how well graduates are prepared for and engaged in their careers, many education programs would be well-served to do this better, and more seamlessly across curricula. Similarly, this integration allows instructors to design their courses differently so, as in the example above, the operations management course can move quickly to higher order concerns of evaluation and analysis, where students can learn how to develop solutions for concerns beyond operations management.

Even though Bloom's taxonomy has been around for nearly 60 years, it has particular relevance to contemporary higher education in its relation to learning theory, and in how it guides instructors and institutions in where and how they choose to compete to add value to the learning process. Furthermore, this should be done in concert with the realities of what current graduates need for success in their careers, and in recognition of the modern competitive landscape in higher education.

Objectivist Learning Theory

One of the fundamental learning theories to consider in developing courses and curriculum is objectivism. Under the objectivist learning theory, the instructor is seen as responsible for student learning, as knowledge is considered independent of and external to the learner himself or herself.

Much of the recent education literature asserts that the orthodox objectivist approach is not effective in many situations. Objectivism, so it is asserted in the literature, is a system where the teacher (the 'sage on the stage') drones out small, predigested dollops of information, where assessment exercises may have no real connection to how the student will apply their skills upon graduation, and where students are implicitly encouraged to adopt a shallow approach to learning (Biggs, 1999; Ramsden, 1991). Thus, in the objectivist paradigm, students may typically observe a lecture by the instructor or other expert and then be expected to retain and recall it on demand.

Objectivism has a role to play in most learning situations, even upper division courses, but its primary function is likely concentrated in introductory and lower division courses. It is not insignificant to note that objectivist approaches provide opportunities for course delivery efficiency.

For example; in the introductory statistics course, some material could be made available for students in a flipped classroom approach, where significant components are recorded once and watched by students outside of the classroom. This flipped approach is often useful for basic, foundational concepts as it is consistent with learning theory and it can be accomplished in a cost-effective manner, as the recordings can be reused and repurposed as desired. This frees instructors to concentrate efforts on meeting the higher-order—and often more instructor-intensive and challenging—learning concerns.

Alternatively, consider a computer modelling/applications development course that teaches students intermediate Excel spreadsheet and Access database skills. This course utilizes the Microsoft Official Academic Courseware (MOAC) that is aligned with the Microsoft Office Specialist (MOS) exams, which students can take at semester's end. The instructor records the Excel or Access lesson while working through that lesson with the students. The students are then at their leisure to revisit the recorded lesson at any time while attempting to complete the associated Knowledge, Competency, Proficiency, and Mastery Assessments at the end of each lesson. Further, students record themselves completing these assessments and the resultant recordings are uploaded to the LMS (BlackBoard) for supplementary review and feedback by the instructor, and as a learning tool for other students preparing for the MOS exams. In addition to this, students in the course are then challenged to apply these skills to solve business-related problems, extending the course from the objectivist paradigm to the realm of constructivism.

Constructivist Learning Theory

"In education research, proponents of constructivism argue that their learner-centred theory is superior to the teacher-centred orthodoxy of objectivism, and that a paradigm shift is underway" (Lister & Leaney, 2003 p. 429).

In constructivist learning theory, the student, rather than the instructor, is considered the central driver of the learning process. Constructivism challenges students to connect what they are learning in a specific course or lesson to new, relevant issues or situations. Through this process, they "construct" their own knowledge of how what they are learning can be applied to solve problems that are personally important, and do so in an active and experiential manner (Chickering & Gamson, 1991; Kolb & Kolb, 2005; Knowles, 1988).

Under constructivism, instructors become less like experts who merely espouse or transfer their knowledge, and more like facilitators who create a learning environment which encourages students to contemplate how what they are learning applies to their lives and the world at large. Indeed, this links nicely with adaptive, self-adjusting learning espoused by Dull (n.d.). Inherently, a constructivist approach to teaching requires instructors to design courses and experiences to achieve the higher-level learning concerns of analyzing, evaluating, and creating.

Consider under constructivism how the fundamental use of recordings might change. In the constructivist framework, instead of instructor-created videos that are broadcast to students, the students themselves could be challenged to create course videos as a way to demonstrate how what they are learning applies to their personal concerns and interests. Students can even be challenged to do the videos well enough so that their creations can be incorporated into the course, where their peers and future students can learn from their explanations. Furthermore, instead of simply an instructor-based evaluation, student peers could provide feedback to each other. In this way, all students are engaged throughout the learning process, from content generation to evaluation in a high-level, constructivist manner. With such a design, students should know their learning is important not only to themselves, but to other students and the course itself, as well. And, as will be elaborated on in the next section, student output and effort can serve as a means to assess and assure learning has taken place.

The value of constructivism has long been recognized, even before the phrase was coined. In his seminal work, Democracy in Education (1916), Dewey opines that if instructors "give the pupils something to do, not something to learn; and the doing is of such a nature as to demand thinking, or the intentional noting of connections; learning naturally results" (Dewey, 1916, p. 181). This certainly seems prescient as it is not only relevant, but central to modern, adaptive learning systems, as well.

In summary, then, constructivist learning is important not only because it concentrates or reaches the higher levels of Bloom's taxonomy, but also because it allows students to engage in meaningful learning experiences that they can tailor to their needs and values. When integrated with modern technology and approaches like video recordings, student learning can be captured for assurance of learning purposes where students know that their creative efforts both benefit themselves and support other students too. With proper design choices then, the learning structure enhances the meaningfulness of educational experience, which is associated with career success (Belkin, 2014), as it facilitates student involvement and encourages them to think deeply about the material and why it is meaningful to them.

Assessment and Assurance of Learning

Picciano (2002) claims the evidence and measure of a student's performance can be determined in many ways: "[s]uccessful completion of a course, course withdrawals, grades, added knowledge, and skill building …, depending upon the content of the course and the nature of the students" (p. 22). Ellis & Goodyear (2010) claim that "[l]earning activity is the key: what the learner does is what makes a difference to the learning outcomes" (p. 118).

At a fundamental level, one measure of learning effectiveness for higher education is that graduating students should be able to know and do discernably more in their particular fields of study than when they started as freshmen. Educators strive to create learning environments which allow students to be both academically and pragmatically competent: For students to have dual competency—evidenced in both their knowing and in their doing—and then be able to teach someone else what they have learned, so that they know and can do, too. In their foreword to "Quality on the line-Benchmarks for success in Internet-based distance education," Bob Chase (President, Blackboard Inc.) and Matthew Pittinsky (Chairman of the National Education Association), claimed: "We believe the distance from student to teacher must be measured in results—quality learning—achieved by our students (in Phipps and Merisotis, 2000 p. vii).

Accrediting bodies play an important role in assuring quality. The fundamental principles underpinning the assurance of learning criteria at the authors' institution are the two standards set by the Association to Advance Collegiate Schools of Business [AACSB]: (1) accountability and (2) continuous improvement (AACSB Assurance of Learning Standards: An Interpretation, 2013). "Learning goals should reflect broad educational expectations for each degree program, regardless of major. They also reflect the major intellectual and behavioral competencies a program intends to instill in its students due to the total educational experience across a given program" (AACSB Assurance of Learning Standards: An Interpretation, 2013, p. 6).

The purposeful and systematic instructional design employed in both of the authors' traditional and online courses has endeavored to include both elements of assurance and assessment that hold true to both of the above-mentioned AACSB principles. From an accountability point of view, learning objectives are established and measured in a manner that assesses a student's ability to know and then to do.

As educators, the authors strive to continuously improve the courses offered at their home campus, and put forth that the students and alumni are the proximate arbitrators of whether these efforts held value for them or not. However, the ongoing efficacy and competence of graduates from the authors' institution will invariably be measured by persons beyond the campus environment, i.e. employers, civic leaders, community organizations, advanced degree programs, and the like. Effective improvement efforts that do not align with the implicit needs of these external stakeholders will be for naught, and keeping this in the forefront of the authors' minds hastens their urgency to keep pace with the dynamic environment students will soon enter.

Learning will always be determined by the student, but the measure of their learning and resultant competency will be made by factors beyond their control. It is crucial that as much control as is possible, i.e. the assurance and assessment of learning, is embedded in every course offered.

Problem-Based Learning (PBL)

Problem-based learning (PBL) has been the subject of hundreds of research articles. As Albanese and Mitchell (1993) note, PBL originates with McMaster University in the late 1960s and is now practiced throughout the world in many different forms. While PBL initially was focused on medical education using pure discovery learning, it has been applied to dozens of different problem disciplines with a wide array of implementation approaches and techniques. In addition to Albanese and Mitchell (1993), interested readers may see Savery (2006) for PBL reviews and definitions.

While the flexibility of PBL enhances its potential usefulness and applicability, this also adds complexity that might impair implementation effectiveness as instructors can become overwhelmed. Because of the complexity in PBL implementations, some researchers have attempted meta-analyses and meta-synthesis to reduce and understand it better. Strobel and van Barneveld (2009) review 150 previous studies in eight previous meta-analyses to look at student and faculty satisfaction, knowledge retention, skill performance, and performance when mixed-knowledge and skills are required. For the practicing educator, the basic take-away from this meta-synthesis is that traditional lecture is appropriate for conveying basic information to students. However, for higher-order and longer-term knowledge acquisition and application, PBL is more effective.

While the PBL literature is skewed towards medical education, Walker and Leary (2009) perform a meta-analysis of 82 previous studies across disciplines. They look to understand PBL efficacy on authentic, real-world, and ill-structured problems that might not have a single right answer, and where instructors acting as facilitators or tutors in the learning process might be effective. The authors look at PBL in disciplines such as teacher education, social science, business, science, and engineering, amongst others. They consider assessment levels, problem types, and implementation methods for which PBL might be effective. Walker and Leary (2009) conclude that PBL students did at least as well as lecture-based counterparts, and impact was actually stronger for disciplines *outside* of medical education, indicating PBL has wide appeal. More specifically, Walker and Leary (2009) note that PBL is particularly useful on semi-unstructured problems where instructors increase and decrease learning support—known as scaffolding—appropriately, which is consistent with and extends the ideas of Strobel and van Barneveld (2009).

Hung (2011) notes that the research into PBL is not universally positive in conclusion and that part of the problem might be the sheer breadth of approaches and factors which make PBL difficult to study. Mayer (2004), for example, notes pure discovery learning, as utilized in some problem-based learning implementations, may not be effective and may even hinder learning, hence some guidance in the learning process is useful. Many factors can impact effectiveness including student attitude and readiness, matching curriculum and PBL design, resource, and workload problems.

In addition, Hung (2011) stresses the need for appropriate assessment methods to measure PBL outcomes, choosing the appropriate PBL approach, teaching about the PBL philosophy and process, to provide appropriate scaffolding or support to students, and to constantly provide motivation and encouragement. Furthermore, Hung (2011) emphasizes the importance of matching PBL curriculum and problem design in successful implementations. These insights, while important, can seem overwhelming.

Woods (2013) addresses this issue by providing a detailed conceptual map into using PBL in 33 learning environment variations, ranging from traditional lecture to pure discovery PBL. This map considers dimensions such as whether the domain concerns primarily knowledge acquisition, skill development, or a combination; the learning technique employed (e.g., lecture, projects, etc.); the learning objective defined and by whom; and the assessment mechanism used. Traditionally, in the knowledge acquisition realm, lecture with subsequent exam questions is a common assessment structure. If one is interested in developing a skill, like in selling or customer service, a script-based approach might be used and students guided or coached on their performance. Woods (2013) also discusses options for situations where a combination of knowledge and skill development is desired. An appropriate choice in this case includes having an instructor pose a problem and challenge students to solve it with the instructor interactively working with learners.

Woods (2013) also emphasizes that in PBL the learning objectives can be developed by the instructor or the student themselves. Hung (2011) notes that for students to be involved in developing learning objectives requires them to be capable in a way that most medical students might be ready for, but that many undergraduates may not be, or for which they may need to be groomed before being ready. Therefore, if undergraduate instructors and programs desire to reach this level, curricular coordination amongst courses and throughout a course of study is pertinent. However, students often can and should be involved in evaluating other students and providing feedback and if this can be integrated into course and assignment structure, an additional learning opportunity results. Appendix 1 contains selected learning environments from Woods (2013) that are likely to be of interest to undergraduate instructors.

3. APPLICATION EXPERIENCES

To this point in the paper, the importance of meeting modern learning needs and some relevant theories have been covered. In this section, two application examples will be discussed. The first example details the implementation of PBL in an operations management course. The focus is on explaining the course objectives then discussing choices made with regard to implementation in terms of the theories in Section 3. The second example concentrates on a course where student assessment is designed into the structure of the course itself. In this case, students not only work on their own projects, but are also integral in assessing other students, and consequently the role of the instructor changes.

A Problem Based Learning Application

A PBL learning approach has been developed for an operations management (OM) course. OM is an upper-division, core course that is quantitative in nature. The material is new for most students so there are basic OM concepts and vocabulary to learn in addition to problem solving. Most of the OM problems studied lend themselves to spreadsheet solutions and experience shows that while many students have basic solution mechanics, they are challenged by the higher order learning associated with analyzing and evaluating, especially in terms of spreadsheet development.

Hung (2011) provides some guidance on how to address these student limitations, by recommending explicitly teaching PBL philosophy and process, ensuring students have appropriate support and scaffolding, and paying special attention to motivating students to be responsible, active learners. The first class meetings focus on explaining to students how the course will be conducted and how it should help them to learn not only the material at hand but to apply it to other problem areas, as well. The first assignment in particular (see Appendix 2) contains not only a problem to be solved, but also a detailed description of how the course is going to be structured. In practice, this is carried out within and throughout the context of the problem being solved.

The OM course requires both factual knowledge, often as a foundation, and problem solving application using spreadsheets. In terms of Woods (2013), this represents a combination of knowledge acquisition and skill development, or Problem-Based Mixed (#6) on Woods' (2013) conceptual map. This approach can use a lecture or problem-based approach. Hence, the factual course material is covered via pre-recorded lectures done outside of class time with quizzes to check for understanding. The in-class portion is conducted in a skills-based, problem solving, workshop-like manner.

Unfortunately, students are typically not ready for a Problem-Based Lecture-Learn (#13) approach when starting the course. Consequently, the PBL approach is modified over the course of the semester to better match with student development. This is done via four sections or problem areas in the course. These sections include productivity and location analysis, forecasting, statistical process control and process capability, and inventory management.

As seen in Appendix 2, the first course section is conducted with a skill development focus using a Problem-Centered (#8) approach, where text and script is used to pose a series of problems and information is also provided on how to solve them. Students are guided on solution design with an emphasis on skills (e.g., spreadsheet) development. In the next two course sections, the approach is slowly altered to a more Problem-Sequence Skill Focus (#9), with the final course section striving for a Problem-Based Lecture-Learn (#13) orientation.

For example, as the course moves from the first section to the second, the focus shifts from spreadsheet design basics to the concept of how to model the logic of a problem rather than solving for a specific set of numbers. Development progresses in sections two to three by introducing students to advanced spreadsheet functions and capabilities (e.g., optimization, regression, etc.). As the Problem-Sequence Skill Focus (#9) is implemented, support is provided but more emphasis is made on students using the built-in help system to figure out sticking points. In the final course section, inventory analysis, students are introduced to a problem (short case) and then challenged to solve it after a short lead-in lecture. Students are encouraged to work in groups and the instructor circulates throughout the class, interacting with students.

Assessment of student performance is of course important and, although the next section discusses assessment in detail, some coverage is warranted here. Walker and Leary (2009), and Hung (2011) both note the importance of matching assessment with development focus. As a result, while multiple choice assessments are used for factual material, spreadsheet-based application problems are used for exams. These exams are variations of the problems covered in class and even though the context may change to encourage higher-order learning concerns, they are structurally similar and of appropriate complexity so as not to be overwhelming.

An Assessment-Focused Application

Having students participate in not only the production of content but in the assessment regime is an attempt to develop active, intentional learners. This desire applies not only to traditional, in-person courses but to those courses offered online, too: In this case, a global business management course.

One component of the course requires students to develop and present course concepts using lecture capture software (Panopto). Presentations typically include textbook concepts along with researched resources and personal experiences with a process using the process and guidelines as detailed in Appendix 4.

The other students in the course then review the materials and complete a Qualtrics Assessment [QA] of the Rubric guidelines (Appendix 3). Qualtrics is a surveying tool similar to Survey Monkey. The composite result of the peer assessments is shared with each student following the conclusion of their presentations, with a view to identifying and remedying anomalies and shortcomings, if any. Comments from students range from the basic assessment activities, to how constructive the assessments are in exemplifying the assurance of learning goals that each student receives in the course objectives.

The enduring benefit of this process to students experiencing this assessment approach is that not only do they get to research and present their own findings on a series of topics, they also amass an e-portfolio of evidence to attest their competence and acuity in distilling concepts into discernable components. Additionally, beyond simply presenting the findings of their efforts, they receive constructive feedback from both their fellow students and the instructor. This in itself provides each student with tangible evidence of their competence, beyond something purely anecdotal, which they can present to future employers, as each student can choose to share their work with whomever they choose, even after the course ends.

4. SUMMARY

Active [and deep] learners are engaged in all stages of the learning process, whether individually or collectively, which is critical for success in the modern environment. This paper has presented the authors' attempts to encourage and implement such characteristics in their classes. These efforts include a novel, electronic-based assessment regime carried out by the students themselves, and which was facilitated by the instructor. In addition, the constructivist learning theory is implemented via a problem based learning (PBL) approach. PBL is comprehensive but may be complex and difficult to implement effectively for some. Ideas are presented to help instructors who are interested in PBL and looking for practical ways to get started. These include the process, tips, and tricks by which the authors implement PBL in their own courses, and examples of the tools they used to do so.

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Appendix 1

Selected learning environment variations for PBL from Woods (2013). The number in parentheses corresponds to the Woods original code number.

Primary Concern	Recommended Approach	Discussion and Implementation Tips
Knowledge Acquisition	Problem-initiated teaching (#7)	Meaningful, subject-oriented problems and learning objectives are created by the instructor and used to develop student interest in the topic and to highlight future course material. Can be done in small groups with a floating facilitator or even tutorless groups.
	Problem-initiated teaching with student generated learning objectives (#16)	A problem is posed to students. Class discussion is used to determine what needs to be covered in lecture. After the lecture, problems are solved individually or in small groups.
	Problem-based lecture learn (#17)	Small groups of students create the learning objectives related to the problem posed. Lecture is conducted accordingly and small groups are used in problem-solving.
	Problem-based learning with given objectives (#24)	Instructor poses problem and gives learning objectives. Students research, teach, discuss, and reflect. This approach requires students to already have necessary technical skills.
Skill Development	Problem-centered (#8)	In this approach, a text and script is used to pose a series of problems where information is also provided on how to solve them. There is a known solution to the problems and students are guided on the solution design with an emphasis on skills development.
	Problem-sequence skill focus (#9)	A series of activities in a workshop format with peers are conducted. Workshops are designed to develop process skills and learning objectives are accomplished by completing the activities designed by the instructor. Activities increase in complexity and scaffolding support is provided, as needed, and tailored to decrease appropriately as student capability and confidence is developed.
Combination: Knowledge Acquisition and Skill Development	Problem-based mixed (#6)	This approach can use a solid lecture based approach or a more PBL centric one and may evolve as needed. Students may be given the choice of which they prefer.
	Problem-based, lecture-learn (#13)	A lecture-oriented version of PBL. A problem is posed by the instructor complete with learning objectives. Students then work to solve problems, usually in small groups while the instructor circulates around the class.
	Problem-based, lecture learn skills (#18)	Similar to (13) Problem-Based Lecture-Learn except students, not the instructor, determine learning objectives. Often the problem cases are multi-week in nature. This is a high level of PBL requiring capable, motivated students.

Appendix 2

Cover page for initial course activity in operations management to emphasize PBL implementation concerns of Hung (2011) including the PBL philosophy and process, motivating students to become responsible, active learners, and providing appropriate support.

Excel Exercise—Productivity

A few words on course approach

In this course, students learn about operations management (OM) theories and concerns. In particular, students are challenged to solve quantitative OM problems, and to do so in a manner that builds decision modeling and problem solving abilities. Hence, spreadsheets and other computer-based tools, are used extensively.

A guided problem-based learning approach is utilized—where the amount of guidance provided and the focus on skills developed—vary through the semester and as appropriate for the topic being explored. In other words, OM theories and concerns will be used as drivers to develop student ability and confidence to solve problems more generally, especially using spreadsheets. It is intended, then, that upon course completion, students will not only "*know*" but can "*do*" as well. And that the knowledge, skills, and abilities developed by the student will translate to other courses and to their work careers. This approach is carried out in a workshop approach during class.

Productivity

Problem overview

The owner of the small business where you intern has become interested in measuring the efficiency of company operations. She wants a better view on how well her business is operating overall and how well it is using inputs (factors) like labor and materials. She asks you to create a spreadsheet model to calculate productivities from the single-factor and multifactor perspectives as she wants to monitor how productivity changes over time. She notes that while you will create the spreadsheet, one of the production clerks will maintain it and while she wants you to start on it today, she will not have the initial data for you until sometime tomorrow.

In addition, she notes several items to keep in mind as you build this model. The spreadsheet should be…

1) Correct with no errors.
2) Designed to prevent mistakes in use.
3) Informative and easy to understand.
4) Efficient to develop, use, and update.

A hint on how to begin

Any spreadsheet model you create must, first and foremost be, correct with no errors. How to ensure this? Check, double check, and then check again is a good start. Additionally, if you can get others to verify your work, great, but this is not always possible. Another idea is to find a problem related to the one you want to solve, where you already know the answers, and use that as a guide for building your spreadsheet. Where can you find such a problem? Company reports and similar spreadsheets currently in use are possible sources. Another is to find a solved problem, like in a textbook, and replicate that. Then, once you have your confidence, convert it or create a new one, for the problem you need to solve.

Appendix 3

RUBRIC: Preparation and Presentation of Course Materials GLOBAL BUSINESS MANAGEMENT

Group No.		Chapter No.		Date/s		

Your group will be tasked with presenting the materials for Chapters/Topics throughout the semester, details of each are provided in the respective Syllabus.

It goes without saying that your preparation is a shared experience in your group that will culminate in you collaboratively facilitating the presentation and ensuing discussion for each chapter/topic assigned.

Each group is required to research the concepts – both as shared in the group and as available in peer reviewed or refereed research - as you find fit either online or via our campus library records. Any other materials you wish to introduce, e.g. video, audio, written, etc. that will emphasize and support your positions on said concepts, is strongly encouraged.

Your group has 2 hours and 30 minutes split between the two assigned days, to present the materials for each assigned Chapter. As indicated in the **Guidelines for Class Presentations *Worksheet***, on the course site, it is incumbent upon each group to keep the discussion healthy and constructive and to strongly encourage all your classmates to contribute regularly and appropriately. The following rubric applies;

Presentation Rubric

MEASURE	POOR - 1	GOOD - 2	VERY GOOD - 3	EXCELLENT - 4
Preparation	Lack of organization, too much off-the-cuff material and/or unsubstantiated "facts"	Lack of organizational clarity once or twice, resource use limited to the assigned material	Generally clear organization, command of the assigned material, and apparent use of additional resources	Clear evidence of organization, command of the assigned material, and use of additional resources
Organization	Audience cannot understand presentation because there is no sequence of information.	Audience has difficulty following presentation because Members jumps around.	Members present information in logical sequence which the audience can follow.	Members present information in logical, interesting sequence which the audience can follow.
Subject Knowledge	Members do not have a grasp of the information; Members cannot answer questions about subject.	Members are uncomfortable with information and are able to answer only rudimentary questions, but fail to elaborate.	Members are at ease and answer most questions with explanations and some elaboration.	Members demonstrate full knowledge (more than required) by answering all class questions with explanations and elaboration.
Visual Aids	Members use superfluous visual aids or no visual aids.	Members occasionally use visual aids that rarely support the presentation.	Members' visual aids relate to the presentation.	Members' visual aids explain and reinforce the presentation.
Mechanics	Member's presentation has four or more spelling errors and/or grammatical errors.	Presentation has three misspellings and/or grammatical errors.	Presentation has no more than two misspellings and/or grammatical errors.	Presentation has no misspellings or grammatical errors.
Eye Contact	Members make no eye contact and only reads from notes.	Members occasionally use eye contact, but still read mostly from notes.	Members maintain eye contact most of the time but frequently return to notes.	Members maintain eye contact with audience, seldom returning to notes.
Verbal Techniques	Members mumble, incorrectly pronounces terms, and speak too quietly for audience in the back of class to hear.	Members' voices are low. Members incorrectly pronounce terms. Audience has difficulty hearing presentation.	Members' voices are clear. Members pronounce most words correctly. Most audience members can hear presentation.	Members use a clear voice and correct, precise pronunciation of terms so that all audience members can hear presentation.
Group Work	Cannot work with each other in most situations. Cannot share decisions or responsibilities.	Work with each other, but have difficulty sharing decisions and responsibilities.	Work well with each other. Takes part in most decisions and shares in the responsibilities.	Work very well with each other. Assumes a clear role in decision making and responsibilities.

Adapted from: http://ed.fnal.gov/lincon/w01/projects/library/rubrics/presrubric.htm AND: http://facstaff.elon.edu/bissett/Honors%20Discussion%20Rubric,%20Version%202.mht

Please score the group presenting according to the guideline in this rubric above.

This will constitute your peer reviewed grading of their classroom management, facilitation and presentation efforts.

Appendix 4

Guidelines for Online Presentations and their related Panopto Recordings

Technological Competencies

Please be advised that students must be tech- and net-savvy. Learning online is a difficult challenge and students, particularly those registered in a senior-level writing-intensive course, should already be well familiar with all aspects of learning technologies used in this course. Contact me if you are concerned.

It is expected for students to have become familiar with **Panopto**, an online presentation capture software system, by the time they prepare their assigned Chapter recording. To aid in this, all necessary training materials are accessible via links from our BBL9 course page.

1. **You need to download the Panopto recorder to your home computer—links to both the PC & MAC versions of the recorder are on BlackBoard [BBL9].**
2. **You need to be logged on to BBL9 to locate the correct recording folder when starting your Panopto recording.**
3. **All recordings must be located in the Panopto DropBox folder associated with our course, i.e.;**
   - **15375.201560: MIS-44163-601-201560: GLOBAL BUSINESS MANAGEMENT [drop box]**
   - ***Only recordings located in the proper DropBox will earn points for the assignment. Be forewarned.***

The specific requirements for Panopto Recording is as follows;

1. Please name each recording you make with the following 4 components;
   - **Your [1] LAST NAME [2] CH # [3]CHAPTER ELEMENT [4] FULL DATE**
     - Example: **Jones CH05 Opening Case Monday, March 16 2015**
     - Example: **Jones CH05 LO2 Monday, March 16 2015**
     - Example: **Jones CH05 Video Case Monday, March 16 2015**
2. You are most welcome to experiment with the Panopto Recorder, but when you are done, please delete all irrelevant recordings from the DropBox folder.
3. You are welcome to make use of the publisher's PowerPoint content loaded on BBL9, but I trust you have taken my lead from the recordings I have provided as examples, to enhance and embolden your presentation by adding not only your own anecdotal content, but also relevant external research content too.
4. By conducting valid and reputable outside research and including your findings in the recording/s, further convinces me that you have immersed yourself in the materials and

have fully familiarized yourself with both the historic and contemporary perspectives on and practices of the relevant subject matter.

5. Preparing a "script" lends a professional touch and gives the recording modularity while presenting your understanding of the materials, and providing a more sequential guide to the materials in the Lesson, as delivered.
6. Please ensure that you include in your recordings, the following elements of each Chapter:
   - The Opening Case, all Debates, the Closing Case and your assigned Video Case (presenting your findings and responses to the associated questions).
7. You will notice that I have used a number of methods to make my recordings [located from the link>>>**Past Semesters: Chapter Recordings By Instructor** under the heading **PRIOR SEMESTERS**], please feel free to break up your recording into as many pieces and parts as you like.
8. You are also welcome [***and strongly encouraged***] to add whatever you like to the recording/s
   - ***Please Note: The total length of your Chapter Recording should not be less than 90 minutes, and should not exceed 120 minutes.***
9. Please email me the all the Panopto Recording Links, Narratives, PowerPoints*, References, etc. by the deadlines as indicated both on in the Course Schedule and in the Individual Student Chapter Assignment Schedule.
10. If you would like to, please share your experiences through the recording session highlighting what you found user-friendly, frustrating, etc. and please make recommendations on what you feel could be done to improve the Panopto process.
    - ***Your feedback is invaluable to course improvements and research efforts.***

In summary:

- ***Using your FlashLine username and password, you need to log on to Panopto and must then choose the correct Dropbox folder for our Course to locate your recordings,***
- ***Please name your recording, before you start each Recording,***
- ***All recordings you make will be stored on the computer where you make the recordings, once you click STOP in the Recorder and provided you are still logged into the Panopto server, your recording will automatically upload to that Panopto server.***
  - ***Once successfully uploaded, you will receive an auto-generated email from Panopto confirm receipt on the server and will provide all the necessary links to your recording.***
  - ***You need to copy and paste all the VIEW links for all your final recordings in one email to me along with your Narratives, PowerPoints*, References, etc.***
  - ***Please remove all "trial" attempts on the Panopto Server – these clutter the DropBox.***
  - ***If you do not get an email from Panopto you will need to contact me directly.***

- ***Thereafter, I will upload all your content to a separate content area in BBL9 for the other members of the course to view and review*.***

  ** Please see the Presentation Rubric on BBL9 for more specific details*

  - ***As indicated in the Course Schedule, you will be required to conduct an Assessment, via Qualtrics, offering your perceptions and scores of each other student's efforts.***
  - ***Again, it goes without saying, that I am able to, through specific audit trails and statistical tracking mechanisms, reconcile each student's commitment and effort applied in viewing and reviewing the content on both Panopto and BBL9.***
  - ***Students not viewing and reviewing the fellow student's efforts on BBL9 will incur 5% penalty for not complying with course requirements.***

As always, please make copious use of my many virtual and in-person office hours.