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E-Mentoring the Online Doctoral Student from the Dissertation Prospectus through Dissertation Completion

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ABSTRACT

Faculty who mentor online doctoral candidates face many of the same challenges and opportunities as those mentoring doctoral candidates in traditional, face-to-face modalities. The main difference is that E-Mentoring is based on interacting in the online space rather than interacting face-to-face, which may present challenges for both the candidate and the mentor. The concept of mentoring, which originated from Greek mythology, defined a close relationship between the mentor and the student. In Ancient India, the word Guru from the Sanskrit language stood to symbolize a caring mentor and expert teacher. Structured E-Mentor programs are formalized programs which provide training, coaching, advice, and structure to increase engagement through the online dissertation phase of doctoral education. Doctoral Mentoring relationships are an intrinsically a deeply human process. Mentoring involves the nurturing of a novice or a less experienced person (protégé) by a seasoned and experienced person acting as the mentor in providing guidance, support, and dissemination of required knowledge for a given area of expertise.

Doctoral mentors play a large role in guiding the doctoral candidate through the dissertation process from identifying their topic through conducting the research study. E-Mentoring doctoral candidates in online doctoral programs entails many of the same opportunities and challenges as serving candidates in programs that are offered in a traditional, face-to-face modality. The difference is E-Mentor interaction takes place 100% of the time from anywhere. The E-Mentor chair/candidate relationship begins as soon as the doctoral candidate completes doctoral content courses and begins the dissertation process. This article focuses on E-Mentor the online doctoral student throughout the dissertation process and the techniques that chairs and committee members can frame, and guide their candidates as they travel through their doctoral dissertation journey.

Introduction

What is Mentoring?

The concept of mentoring has been around for thousands of years, coming to us from Homer's Odyssey. Mentor was the teacher of Telemachus, the son of Odysseus. But Mentor was more than a teacher. He was all things to all people-half-god and half-human, half-male and half-female. Mentor represented the union of both goal and path. As the Mentor represented the yin and the yang of life, so also mentors must pull and push their mentees. Mentoring requires strength in two different but complementary behaviors. First, mentors must lead by guiding interaction with their mentees. Mentors invest themselves in their mentees and uplift them. Secondly, Mentors must support mentees. Mentors push their mentees to become their best by encouraging development in areas of expressed need in their inventory ((Peterson, 1993).

Evolving from a historical perspective, the concept and process of mentoring have been and is a vital tool for development of human potential (Hernandez, 2001). Mentoring is utilized in practically all fields of human endeavor: sports, higher education, organizational management, youth development, and the doctoral dissertation process. There are two types of mentoring: Natural mentoring occurs through normal relationships of "friendship, collegiality, teaching, coaching, and counseling. In contrast, planned mentoring occurs through structured programs in which mentors and participants are selected and matched through formal processes" (Hayashi & O'Donnell, n.d., p. 1).

Kram (1983) describes the phases of the mentoring relationship that provides an influence on protégés. Kram's phases include:

- an initiation phase, during which the time the relationship is started;

- a cultivation phase, during which time the range of functions provided expands to a maximum;
- a separation phase, during which time the established nature is substantially altered changes in the organizational context and/or by psychosocial changes within one/or both individuals; and
- a redefinition phase, during which time the relationship evolves a new form that is significantly different from the past, or the relationship ends entirely. (Kram, 1983, p. 614).

E-Mentoring Evolves

The demand for Internet-based teaching and learning programs continues to grow as more and more online programs are being offered, especially at the graduate level. A significant transformation in higher education has evolved as the adult student attempts to remain competitive in a rapidly changing world. The transformation of teaching and learning and the creation of learning communities has opened the door for the expansion of the E-Mentor and the graduate doctoral learner. Internet-based virtual learning has created new ways of mentoring the doctoral learner in which exchanges between the student and Chair become significant and critical to dissertation success. E-Mentoring has evolved since the beginning of the Internet. Different techniques may be used by E-Mentors according to the situation and the mindset of the doctoral candidate, and the techniques used in modern organizations can be found in ancient education systems, from the Socratic technique of harvesting to the accompaniment method of learning used in the apprenticeship of itinerant cathedral builders during the Middle Ages (Aubrey & Cohen (1995).

There are many definitions of E-Mentoring depending on the context/ Single, and Muller defines E-Mentoring as:

> A relationship that is established between a more senior individual (mentor) and a lesser skilled or experienced individual (protégé), primarily using electronic communications, that is intended to develop and grow the skills, knowledge, confidence, and cultural understanding of the protégé to help him or her succeed, *while also assisting in the development of the mentor*. (Single & Muller, 2001, p. 108).

There are other names for E-Mentoring such as telementoring, cybermentoring, and virtual mentoring. The Internet capitalizes on the strength of the E-Mentor to provide effective feedback strategies throughout the process. Online mentoring is occasionally compared unfavorably with face to face mentoring. Online mentoring limits the ability to pick up on visual or social clues, makes immediate feedback difficult and can often be seen as impersonal (Black, 2012). However, E-Mentoring can make participants more willing to offer honest feedback. E-Mentors often use video tools such as s FaceTime, Google Hangout, Skype, and video chat through Facebook.

Blum and Muirhead (2005) have strived to address vital issues associated with mentoring online doctoral students in their e-book *Conquering the mountain: Framework for successful chair advising of online dissertation students.* The purpose of this book is to give online distance education faculty who are dissertation advisors an explicit framework for enabling distance education doctoral student to complete a dissertation without ever coming face-to-face. Online doctoral programs are growing rapidly, and distance educators and administrators are seeking relevant educational paradigms and instructional strategies for their degree programs. The authors share their experiences working with doctoral students in a virtual environment and the paper will highlight a small portion of the insights on mentoring strategies from the e-book.

Students pursuing the doctorate face the same challenges as the long distance marathon runner. Training for the dissertation process is not unlike training for a marathon. It requires intense preparation, dedication, and skill. In many ways, conducting doctoral research and writing the dissertation is like running a marathon, enduring hills and valleys, mountains, rivers and frantic road blocks along the way. It is a long and weary race but in the end will lead to the final race in the doctoral journey; defending and publishing the dissertation (Black, 2012).

As noted in *The Dissertation Marathon (2012) t*he main contrast between running a marathon and writing a dissertation is that **they both require an extreme amount of energy**. In both situations, the marathon runner and dissertation writer can't go all out at the beginning because they might not have the strength to make it through at the end. Marathon runners and dissertation writers must take every step carefully and slowly because **every step, no matter how slow, will bring the finish line closer.** Like a marathon, writing the dissertation requires ***perseverance***. This is why it is essential to condition the body and mind to endure. Working on the dissertation a little at a time conditions the body and mind to persevere even if it becomes tired and not in the mood. The candidate may get frustrated while writing each chapter but as the light at the end of the tunnel becomes brighter, the candidate will become refreshed and want to continue.

Role of the E-Mentor Dissertation Chair

Mentoring in Europe has existed since at least Ancient Greek times (Parsloe, E.; Wray, M. J., 2000). Since the 1970s mentoring has spread in the United States educational environments. E-Mentoring became popular in the 2000s as internet and online teaching, and learning tools became the norm in online education.

The role of the E-Mentor Is centered on a commitment to advancing the doctoral candidate's doctoral journey through personal engagement that facilitates sharing guidance, experience, and expertise. Like any relationship, the relationship between the E-Mentor and the doctoral candidate evolves throughout the dissertation process, with its share of changes and adjustments. Today's doctoral candidates come from diverse backgrounds and cultures, adding layers of complexity to the relationship. Although backgrounds and cultures may confound the relationship, a strong E-mentor/Doctoral Candidate relationship will overcome any diversity. Eventually, each E-Mentoring relationship will conform to the doctoral candidate's diversity keeping in mind the candidate's goals, needs, and learning style. What the E-Mentor and doctoral candidate share – a commitment to the doctoral candidate's scholarly goals and desire to succeed.

Matching the E-Mentor to the doctoral candidate most of the time is based on a search of faculty background and experience may be used to facilitate the beginning of the dissertation mentoring relationship. This mentee-driven selection process increases the speed in which matches are created and reduces the amount of administrative time required to manage the program (Odiorne, 1985). The quality of matches increases as well with self-match programs (Allen, T.D., Eby, L.T., Lentz, E, 2006.) because the greater the involvement of the doctoral candidate in the selection of their E-Mentor, the better the outcome of the mentorship. There are a variety of online mentoring technology programs available to the university that can be utilized to facilitate this E-Mentor – Doctoral Candidate matching process.

Selecting an E-Mentor is one of the most important decisions that a doctoral candidate will make during their doctoral journey. It may look like an easy and straight forward task, but there are often complications and issues that may come up during the process. Like dating and marriage, the key to selecting an E-Mentor is, to be honest and straight forward letting the potential mentor/chair know your expectations early in the process. When selecting an E-Mentor and dissertation committee, the most important thing that everyone must understand is that this is your dissertation, not theirs. Of course, like a marriage, disagreements and changes may come up, but both the candidate and E-Mentor must understand the most important person on the dissertation team is the candidate (Black, 2012). This relationship may be thought as a marriage, where trust and communication become the main goal of the relationship. The E-Mentor guides the marathon, helping the candidate to the finish line.

A key development in E-Mentoring, the online doctoral candidate, Is the large pool of qualified faculty today. Today's mentor brings invigorating experiences and perspectives to the doctoral dissertation process, but they also face many challenges. These challenges have necessitated a sophisticated change to the role of the E-Mentor heightening the vital role of the E-Mentor to prepare the next generation of scholars beyond the dissertation. Today the title *Dissertation Cha*ir is often interchanged with the title *Mentor or E-Mentor*. Consider this multi-faceted definition of mentor/chair:

1. Faculty must exhibit *genuineness*
2. Faculty must be *knowledgeable*
3. Faculty must create a *climate of trust*
4. Faculty must create a *climate of connectedness*
5. Faculty must be wiling to *exhibit, demonstrate, and model personal and professional ethic* (Fedynich and Bain (2011).

In the online teaching and learning world, the E-Mentoring doctoral dissertation chair is challenged by these dynamics to ensure the doctoral candidates success.

E-Mentoring doctoral candidates throughout their dissertation journey without traditional face-to-face interaction is not an easy task. Online teaching and education complicate the dissertation process because the E-Mentor is not physically attached to the student for easy student consultation and teamwork at critical timelines throughout the process. The entire dissertation process for many doctoral candidates appears similar to a mountain looming in the distance, inescapable, magnificent, but impossible to scale (Blum & Muirhead, 2005). Online doctoral students face additional challenges overcoming the barriers of distance education (Blum, 1999). Working in a distance education virtual medium requires more explicit objective setting than face-to-face teams (Helms and Raiszadeh , 2002)

E-Mentoring Through the Dissertation Process

The doctoral degree is the highest advanced degree in most fields of study. While the type of doctoral degree and the topic of the doctoral dissertation may differ, all

doctoral candidates conduct a research study and write a doctoral dissertation to complete their doctoral program. Conducting research and writing a dissertation is not easy, that is why a strong E-Mentoring/Doctoral Candidate relationship is key. Through the guidance, motivation, and specific feedback, the doctoral candidate will be successful. E-Mentors stress to the doctoral candidate to always have a positive mental attitude and keep an eye on their goal; to became a ***Dr.***

E-mentors do not have an online explicit list to help online students succeed through the dissertation process despite argument that "professors can learn advising skills by following some systematic advising processes" (Davis, 2004, para 2). It is up to the E-Mentor and the doctoral candidate to form a roadmap to complete all the milestones in the dissertation journey. This roadmap sets the stage to travel through the dissertation process with a focus on completing the doctoral candidate's dissertation. Sample roadmap instructions may look like this:

> Complete the top portion of this project plan with your committee information. Then, review the activities and responsibilities below. These are the activities that must be accomplished to complete your dissertation, along with who is responsible for each activity. Insert realistic due dates for each activity, based on your personal schedule. Remember, You need to complete all activities and win the dean's approval within five years of the date you began the program. Return this completed form to your Mentor for review, comments, and revisions. When you and your mentor have completed this project plan–contract, both should sign it.

Now that the roadmap is complete and agreed to by the E-Mentor and doctoral candidate the fun begins...

The Dissertation Prospectus

The early stages of the E-Mentor/Doctoral candidate's journey together focus on completing the doctoral dissertation prospectus. The prospectus, or the concept document, as some universities refer to it, begins the process of definition and clarification of a research project. When complete, the prospectus should identify the problems the proposed research study is designed to address and describe the importance and value of the proposed research.

The prospectus is developed for several reasons. First, the prospectus brings together and summarizes in an initial formal statement the learner's thoughts about their dissertation. This is helpful since it begins the process of putting into writing the ideas that will guide the dissertation. Second, the prospectus is used as the starting point for the dissertation journey in which the doctoral candidate begins detailed, serious work on their formal proposal and dissertation. Third, the prospectus provides a clear statement of the doctoral candidates dissertation's purpose, problem, hypotheses or propositions, design, and method. The prospectus or concept document is an exploration of:

The **Researchable Problem Statement** describing the general positioning of the research in terms of a general problem or observation that needs to be studied. The problem statement should include specific aspects of interest in the research, and very brief descriptions of method, design, population of interest, and sampling strategy.

The **Purpose Statement**, a highly refined short paragraph of several sentences clearly explaining and justifying the proposed study, defining the method and why it is appropriate, stating the design and why it is appropriate, identifying the key variables, the specific population of interest, and the location of the intended research. The structure of a proposal is closely tied to the purpose of the proposal (Grady, M. & Hoffman, S. S., 2007). A proposal's purpose is to explain and justify a proposed study to an audience of non-experts on the topic (Maxwell, 2005). The majority of committee reviewers reject proposals not because they disagree with what is presented, but because they do not understand the student's intent (Locke, Spirduso, & Silverman, 2000). Reviewers tend not to accept unclear ideas. Emphasize clarity, coherence, and connectivity among ideas throughout the document are the necessary components to write a successful proposal. (Grady & Hoffman, chapter 10 in Mullen, 2007).

The purpose statement is elaborated in the **Significance, Nature Of The Study**, and **Research Questions**. This discussion extends into an exploration of the deep congruence or coherence which exists in the past research between the question under study and the foundational conceptual and/or theoretical literature. Part of this discussion should identify important issues, perspectives, and controversies in the field.

The development of the concept or prospectus document is one of the more critical aspects to launching a clearly defined research project. Different institutions offer slightly different rationales for prospectus development. Gaining clarity about the expectations specific to the University is of paramount importance for a new doctoral candidate. Simply stated, the prospectus is a statement of intention. The prospectus is made up of three components; the problem statement, the research question, and the plan for the literature review. In order to complete an effective literature review including the specifics needed, considerable clarity about intent and direction will be required. A discussion of these specifics between each doctoral candidate and their E-Mentor will aid in accomplishing this important and challenging work.

Doctoral candidates and the E-Mentor will work together to complete the prospectus. The doctoral candidate should aim to have an approved Prospectus within a specified period established by their university. Throughout the process the E-Mentor will provide feedback on working drafts and prospectus development. Once the prospectus is approved by the E-Mentor the doctoral candidate's committee will review and evaluate the Prospectus. Once again, each university establishes the guidelines for completing and evaluating the prospectus.

The Dissertation Proposal

Now that the prospectus is complete and approved the E-Mentor guides the doctoral candidate into the dissertation proposal process. The first step is to agree on an original and researchable dissertation study problem aligning it to the dissertation topic that was approved by the E-Mentor. Coming up with the problem requires considerable interaction between the doctoral candidate and E-Mentor. Both agree that the problem statement is the most critical element of the candidate's doctoral dissertation. According to Simon (2011) the problem statement is the heart of a doctoral dissertation and where you need to begin. The problem statement explains the rationale for the research, validates its importance, determines the research design, and ensures reliability. After reading the problem statement, the reader will know *why* you are doing this study and be convinced of its importance. In their article, Strategies To Win: Six-Steps For Creating Problem Statements In Doctoral Research (2005) Drs. Kimberly Blum and Amy Preiss from the University of Phoenix, School of Advanced Studies stress:

> Writing a problem statement can be compared to a professional racecar driver strategically reducing speed before going around a steep turn. Slowing down increases the driver's ability to control the car and defeat drivers who accelerated too quickly and lost control of the car. Slowing down initially enables the driver to win the race. Students writing a problem statement should implement a similar strategy. Students should take time to consider what constitutes a viable problem before writing the problem statement. Doctoral learners should slow down, consider the problem to explore and devise a strategic plan. If students invest this time initially, they will experience less difficulty in completing the remaining parts of the proposal. (Blum, K. & Preisss, A. (2005).

Creating problem statements can be challenging and time consuming for both the candidate and E-Mentor but because the problem statement drives the purpose of the study, the choice of research design, and the resulting conclusions, agreeing on an effective problem statement is critical to the success of the doctoral candidates' dissertation (Burner, 2014).

Once the problem statement is set, the candidate is now ready to focus on the purpose of the study. The purpose statement is the study intent, which is the objective the study is designed to achieve. The process of developing the purpose statement provides an opportunity for the doctoral candidate and E-Mentor to reflect on the overall scope and focus of the dissertation project and anticipate issues that may arise. The purpose statement must be reflective of and aligned with the problem statement. The purpose statement defines the reason for the research or the research goals. The purpose statement begins by identifying the research methodology and design followed by how the variables will be analyzed. The purpose statement is succinct and to the point directly aligned with the problem. It s key that the E-Mentor ensures that the purpose statement aligns directly to the dissertation topic and problem statement.

Once the problem and purpose statements meet the E-Mentor's approval the doctoral candidate focuses on the research questions and hypotheses. A well-stated research question drives the investigation and implementation of the study. Dissertation research defines the questions that the results of the study will be used to answer and should be phrased in a way that will produce observable and measurable answers. Research questions guide the inquiry of the research by narrowing and focusing the purpose statement. They define the questions that the results of the study will be used to answer and should be phrased in a way that will produce observable and measurable answers. Typically, a problem statement will have one or two research questions associated with it. In quantitative studies, these research questions are most often descriptive, correlational, or experimental. In qualitative studies, the research questions are generally broad in nature. To be effective, a research question must be manageable and contain appropriate restriction, qualification, and delineation. The doctoral candidate and E-Mentor will work together to establish the best research questions for the candidate's dissertation The formulation of research questions must be aligned with the selection of the research method and design that will be used to generate the data for the study.

Now that the foundation of the doctoral student's dissertation has been established the doctoral candidate and E-Mentor begin to discuss and interact on the re-

maining elements of chapter. Once the E-Mentor reviews and approves Chapter 1 the doctoral candidate may move on to Chapter 2, the Literature Review. The literature review serves an important purpose in the dissertation. It supports the importance and timeliness of the dissertation topic and problem. The literature review is extensive in a dissertation proposal, and it is often the largest section.

According to Cooper (1988), a literature review uses as its database reports of primary or original scholarship, and does not report new primary scholarship itself. The primary reports used in the literature may be verbal, but in the vast majority of cases reports are written documents. The types of scholarship may be empirical, theoretical, critical/analytic, or methodological in nature. Second a literature review seeks to describe, summarize, evaluate, clarify and/or integrate the content of primary reports. The doctoral candidate will synthesize the literature as the E-Mentor reviews each synthesis of the candidates' literature feedback will be provided to guide the student to completing an effective and supportive literature review.

Now that the E-Mentor has approved chapter 1 and 2, the candidate many now move on at a steady pace focusing on how the study will be conducted. Chapter 3 includes a discussion of the research methodology for the study. The chapter begins with a detailed discussion of the appropriateness of the method, the design, and how the chosen method and design will help accomplish the study goals. Following a discussion of the study population, chapter 3 includes a discussion of the processes for collecting and analyzing data. The chapter concludes with a discussion of instrumentation, instrumentation reliability, and issues associated with the internal and external validity of the study. Chapter 3 often brings the doctoral candidate considerable confusion. The E-Mentor will work with the candidate providing guidance and feedback on each element of chapter with both the candidate an E-Mentor agreeing on each element.

With the dissertation proposal complete, the candidate is at the Half-Way Point… The next step is to add the front matter and back matter and submit to the dissertation for a quality review. Front matter may include:

- Title page
- Copyright page
- Signature Page
- Abstract (Heading only for proposal, complete for dissertation)
- Dedication (Heading only for proposal, complete for dissertation)
- Acknowledgements (Heading only for proposal , complete for dissertation)
- Table of Contents (with dot leaders, and page numbers)
- List of Tables (if more than 1 table included)
- List of Figures (if more than 1 figure is included

Back matter is optional but almost always is used when additional material is needed to support the dissertation.

At this point the E-Mentor and doctoral candidate may take a breath and take a short break as the candidate's dissertation committee completes their evaluation. The candidate's dissertation committee will provide feedback on issues in the proposal. The E-Mentor will work with the doctoral candidate to complete the changes recommended by the committee. Once the entire dissertation committee approves the dissertation proposal, the student then can move on to completing and gaining approval of their proposal by the Institutional Review Board to insure that the study is ethical and will not violate any of the subject's or university's rights. With both dissertation committee and IRB approval the doctoral candidate may proceed at a rapid pace toward completing their dissertation journey.

The Final Dissertation

Pacing is key at this stage of the dissertation process (Black, 2012). In most cases the E-Mentor is not involved with the doctoral candidates' data collection, but will need to insure there is open communication throughout data collection so that the E-Mentor may advise on data analysis. Now that the doctoral candidate has completed data collection and analysis the next steps are for the E-Mentor to establish the guidelines for writing chapters 4 and 5. Chapter 4 is fairly easy to write since it basically reports the results of the study without an explanation of what they mean. The purpose of Chapter 4 is to report, in appropriate detail, the results produced by the completion of the systematic and careful application of the analytical research techniques to the data. No statement should be made in the chapter that is not directly supported by the results of the data analysis.

In a brief introduction, the researcher will state the key features of and reasons for the data collection and data analysis techniques employed. In the body of the chapter, the writer reports the results and findings generated by the analyses of data without editorial comment**.** This chapter includes solely the analysis of data, the testing of hypotheses, and/or the careful dissection of research questions, introducing no interpretation of findings. The results of testing each statistical hypothesis must be clearly presented and without editorial comment. Significance of results and findings must be stated clearly, with appropriate qualifications and constraints. Tables and graphs can be used and are illustrative of the verbal presentation of data. Graphical representations do not take the place of a narrative, but they clarify the verbal presentation. The chapter ends with a summary of the key points covered in the chapter and transitions smoothly to chapter 5. Once Chapter 4 is complete the E-Mentor will evaluate the Chapter and provide detail feedback to be sure Chapter 4 meets the doctoral dissertation template.

As the E-Mentor approves Chapter 4 the doctoral candidate may now move closer to the finish line. Chapter 5 concludes the research study, providing insightful conclusions into the implications of the inquiry for various constituents and the recommendations, supported and justified, emerging from the analyses and findings. This chapter includes the candidate's conclusions and recommendations. Following an introduction to the chapter the conclusions are presented based on the literature review and the analysis of data. The candidate will introduce discussions that highlight the importance, significance, and meaning of the inquiry to constituents such as managers, employers, employees, researchers, communities, government agencies, business leaders, and others.

The candidate should clearly indicate how the conducted study is significant, substantial, and contributory to the related body of knowledge. This section should also describe the extent to which scholars and/or practitioners will be able to incorporate the study into their behavior. The conclusions should answer the questions: So what? and Who cares?

At this point that doctoral candidate and E-mentor will discuss and establish recommendations based on the results of the study. Once agreement is established the doctoral candidate can write the recommendations of the study and how the results of the study should be addressed in a positive way focusing on constituencies and the broader society. The ethical dimensions of the research are discussed and suggestions for further research are described and supported. The candidate will end the dissertation by summarizing chapter 5 in a brief paragraph.

Front matter is now updated by adding the abstract, dedication, acknowledgements and updating the table of contents. Back matter is added to support the findings and conclusions. The dissertation is now sent to the dissertation committee for final approval.

Approaching the doctoral candidate's dissertation journey finish line the doctoral candidate meets the dissertation defense. Most universities require a formal defense of the dissertation before the E-Mentor and committee sign a candidate's dissertation. In order to defend his or her dissertation successfully, the candidate must demonstrate competence in describing, discussing, and supporting all aspects of the study to the committee and, potentially, to a broad academic audience. The oral defense is conducted very differently at many institutions. Some are in person, some via Internet video, and others via teleconference. The candidate is responsible for presenting the methods and findings of the dissertation study, typically in a Microsoft PowerPoint slideshow or some other graphical format. Depending on the method used, advanced copies of the defense materials should be provided to the dissertation committee. The candidate should be prepared to respond to all committee questions concerning the dissertation during and following the presentation. Candidates must demonstrate a comprehensive understanding of their study and the context in which it exists in order to complete the defense successfully. Failure to demonstrate this level of understanding may result in additional work required by the E-Mentor, potentially extending the time required to complete the dissertation. A successful defense will end with a signed dissertation and moving on to graduation. It is now time for the E-Mentor and doctoral candidate to celebrate achieving this substantial milestone in the doctoral journey.

Finishing the Doctoral Journey

As the E-Mentor and doctoral candidate reach the top of the dissertation mountain, both may now take a sigh of relief. The doctoral candidate can now remove the title "candidate" indicating that the final title is now ***Dr.*** Crossing the doctoral dissertation finish line, smiles indicate success. This is a time for celebration, virtual hugs, and exchanging pictures. For the doctoral graduate the trophy includes the doctoral diploma, doctoral regalia and the doctoral hood. With the E-Mentor, faculty and staff sitting and cheering in the audience at commencement the President of the university confers the doctorate degree. As the new ***Dr.*** crosses the stage, the E-Mentor will be there to "hood" the new graduate with a colorful doctoral hood representing completion of the doctorate. An academic hood is the doctoral trophy, worn draped around the neck and over the shoulders, displayed down the back. The hood's length signifies the doctoral degree level; with the institution's colors in the lining and a velvet trim in a standardized color that signifies the scholar's field.

On to Rewards

As the new Dr. descends from the mountain peak, it is time to say "so long" but not "good-bye" to the E-Mentor. At this point the E-Mentor and new Dr. may face a sense of loss, but this is normal. The doctoral journey is an overpowering presence that consumes time and attention every step of the way. There is no greater gift for an E-Mentor than the satisfaction is seeing his mentee graduate and move on to extended professional opportunities but the relationship has not ended. E-Mentor and doctoral graduates continue collaboration beyond graduation. Collaborating on research, writing articles, and co-presenting at conferences adds not only to the graduate's career but adds additional satisfaction for the E-Mentor. It is a good feeling to see your graduate prosper and move ahead in their career. It is now time for the E-Mentor to begin the next doctoral journey with a new doctoral candidate reflecting on their recent doctoral relationship... The doctoral journey is now over and the E-Mentor and new ***Dr.*** may now bask in their accomplishments.

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Impeding Students' Efforts to Cheat in Online Classes

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ABSTRACT

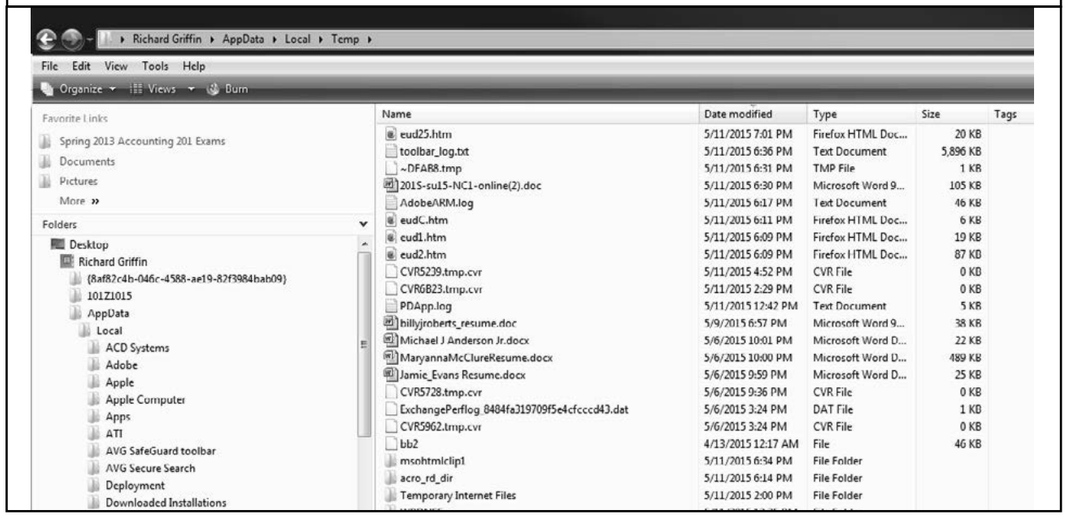
This paper identifies several methods a student could use to cheat while enrolled in an online course. Problems encountered in conducting an online course and in administering an online exam involve: (1) identifying the test taker, (2) preventing the theft of the exam, (3) combating the unauthorized use of textbooks and/or notes, (4) preparing an online exam and exam setup, (5) realizing a student may have access to a test bank, (6) preventing the use of cell phones, hand-held calculators, and/or Bluetooth devices, (7) limiting access to other individuals during the exam time, (8) ensuring a student is using a computer with adequate uploading and downloading capabilities, (9) identifying intentional computer crashes, and (10) noting the different methods of proctoring exams. The authors are full-time educators but are not primarily online teachers; however, they regularly teach one or more courses either in-load or as an over-load. This paper draws on the authors' experiences and efforts to teach online at both the lower and upper division undergraduate levels, as well as, the graduate level with efforts to give a student a comparable experience to a live classroom. The authors utilize Blackboard as their university's uniform course platform and refer to Blackboard's available options to inhibit cheating which share common selections with most online course platforms. An attempt is being made with this paper to help other instructors benefit from the authors' mistakes and successes.

Preventing the Theft of the Exam

Exam theft is an instructor's concern whether the test is administered face-to-face or online (Miller, 2012). When one question is compromised, the integrity of the exam is affected; however, when the entire exam is compromised, all of the instructor's efforts to create a meaningful assessment tool are damaged (Lanier, 2006). Even when exams are monitored online, copies of the entire exam can be made accidentally or on purpose. If an instructor desires to protect an exam from being copied in whole or in part, the instructor should be aware that Microsoft Word and similar programs will automatically make a copy of the exam on the student's computer when the document is opened. Illustration 1 shows a "screen capture" of a computer directory made automatically by a computer when a document is opened.

In the left pane of Illustration 1, the path to the temporary folder is shown as "Desktop\Richard Griffin (name of the computer user on this machine)\AppData\Local\Temp", and the contents of the "Temp" directory are shown on the right side of the illustration. Richard Griffin, an online instructor had been grading resumes prepared using Microsoft Word on May 5th. Notice the first file on the left has a May 11th date. On the left side of the right pane, one can also observe that the fourth file is a copy of the syllabus the instructor had opened from the course web site earlier in the day. Documents are automatically saved by the computer in this directory without affirmative action taken by the user. This directory may also be reached by looking on the computer's operating drive – C:\Users\rgriffin(Richard Griffin's user name on this computer)\AppData\Local\Temp. If an instructor was monitoring

Illustration 1
Unintentional or Involuntary Copying of Documents by a DOS Computer



a student taking an exam, the instructor should examine the student's computer directory in order to determine whether the exam has been copied in whole or in part and, if necessary, take steps to remove all downloaded copies of the exam including the computer's Recycle Bin which will store a deleted copy of a document until it is removed from the Recycle Bin.

A student taking either a face-to-face or an online class has the capability to take pictures of exams with a cell phone, tablet, and other device. One of the authors had a student in class during Spring Semester of 2015 who had a scanner built into the end of the student's ballpoint pen with the capability to copy anything slid under the tip of the pen. Luckily, this device only had the capability to copy one line at a time. For an online student, the computer allows screen capture to make a copy of the exam.

Even if an exam is open book and open note, exam security is a problem. Instructors do not want one student to pass on a copy of the exam to any other student who is going to take the exam later in the online testing window (assuming everyone is not taking the exam at the same time). In the online course, creating a question that algorithmically changes the numbers for each student or draws a different but similar scenario for each question can be helpful but, like many aspects of online teaching, can be very labor intensive at the beginning.

Preparing Online Exams and Exam Setup

If properly performed, the preparation of the exam and the platform on which it is to be administered can help reduce the sharing of exam content information. At least some research exists to indicate that the environment (online or face-to-face) in which a student takes an exam does not impact his likelihood to cheat (Hollister, 2009). While the majority of students will behave in an ethical manner during an online course including the testing in the course, the authors have experienced the impact of cheating by at one student in each online course taught; therefore, the Hollister research has not proven true. The authors attempt to make an online course as similar to a live classroom as possible; therefore, an online exam often includes true\false questions, multiple-choice questions, essay questions, and numerical problems as the exam for a live classroom would include (Watson, 2015). A multiple-choice question from an accounting online exam is shown in Illustration 2 as an example of how not to setup an exam question.

Looking at the question and the five (5) answers above, one can see that there are no numerals or letters before the answers. In a testing environment where Student X and Student Y are (1) taking the exam at the same time, (2) answering the same question at the same time, and (3) communicating with each other due to lack of proctoring, how would Student X reply to Student Y if asked by Student Y for the correct answer to question 21? Student X would reply "To provide financial statements to ..." as the answer. This communication by Student X would enable Student Y to take advantage of the correct answer. By taking two (2) steps, an instructor can reduce the effectiveness of the conversation between the students. The first step is to add a number or letter indicator to the beginning of each answer as shown in Illustration 3.

By presenting the question with a numeral or letter reference to the left of each answer, Student X would more likely answer "B" to the request by Student Y for the correct answer. The second step is to randomize the answers presented to each student so that answer listed as "B" for Student X is very likely to be different than the answer listed as "B" for Student Y. If the answers to question 21 are in a different order on both exams, the order would

Illustration 2
A Multiple Choice Question on the Exam Platform
Without Numeral or Letter References to Answers
(Less Effective to Thwart Cheating)

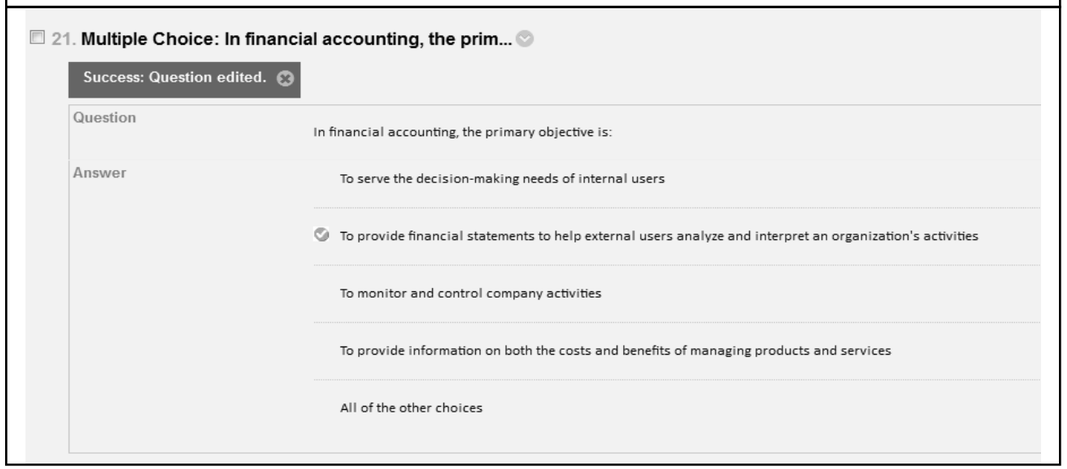
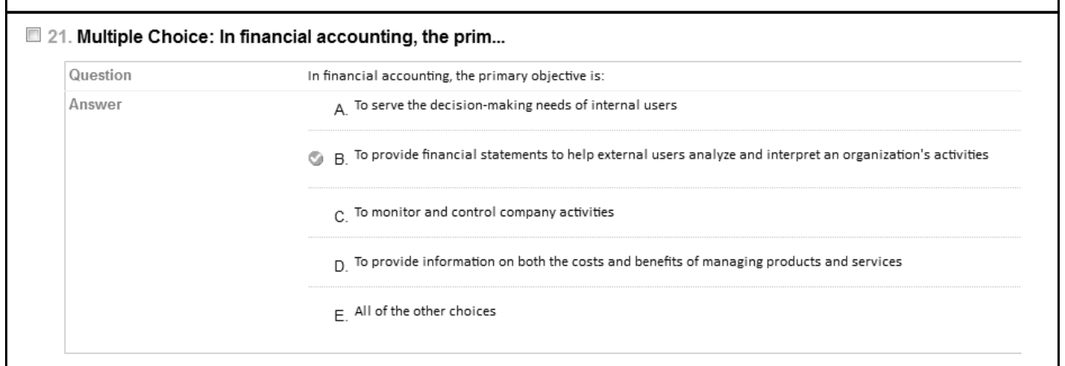


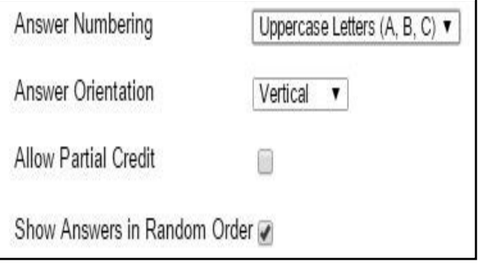
Illustration 3
A Multiple Choice Question on the Exam Platform
With Numeral or Letter References to Answers
(More Effective to Thwart Cheating)



not change the response in Illustration 2, but the response could be different in Illustration 3 resulting in the incorrect answer being given for Student Y's exam.

Blackboard (and other course platforms) allows the instructor to select a variety of options in administering the exams for the entire class. Illustration 4 shows the typical platform options available to instructors within Blackboard's Multiple Choice Question platform.

Illustration 4
Multiple Choice Question Platform Options



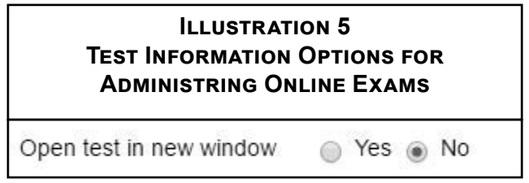
The "OPTIONS" heading is followed by four (4) instructor selections. The first selection involves the ability to number answer choices automatically using either a numeral or letter identifier for each answer. Regarding the "Answer Numbering" option, the default is set as "None." In Illustration 4, the option chosen is "Uppercase Letter (A, B, C)." The other choices available are "None", Lowercase Letters (a, b, c)", "Arabic Numerals (1, 2, 3)", and Roman Numerals (i, ii, iii)". The last selection involves the ability to randomize the answers displayed for each student. Regarding the randomizing of answers, the default is set to present the answers consistently on every student's exam. In Illustration 4, the instructor has checked the box to randomize the answers so that ordering of the answers for a particular question are different in order to allow the maximum number of possibilities on how the answers are presented for this individual question on each student's exams. Checking this box does not randomize the questions within the exam, checking will just randomize the order of the answers within each individual question for which it is checked.

Platform options for administering an online exam are covered using Illustrations 5, 6, 7 and 8.

With reference to Illustration 5, the instructor should note the option of "Open test in new window."

Good reasons may exist for allowing this option but the authors chose "no" which will not allow the student the option of opening the test with a new window for the reason demonstrated in Illustration 6.

Illustration 5
Test Information Options for Administring Online Exams



If allowed, a student using a pc computer could hold down the "Alt" key and simultaneously the "Tab" key and be able to switch to another screen. Of course, the student could also take this action unless the instructor uses some means to prevent its occurrence such as a locked browser.

Blackboard also allows "Test Availability" options to be selected by an instructor as seen in Illustration 7 where the wording used by Blackboard is shown.

The third option presented in Illustration 7 allows the instructor to allow a student "Multiple Attempts" to take the exam. An instructor may want all students to take the exam only once but may be concerned about addressing a student's late night computer crash that may occur while taking the exam. The authors strongly recommend the instructor leave the "Multiple Attempts" box as unchecked unless an instructor truly intends to allow a student to improve his grade on the exam by taking full advantage of all available attempts. The authors recommend that an instructor allow only one attempt at an exam (i.e., not check the "Multiple Attempts" box) and inform the students that any computer difficulties should be immediately reported to the instructor so that the difficulty can be properly documented and appropriately addressed. If, after examining the situation, the instructor is convinced that a genuine computer technical difficulty occurred with no involvement by the student, the instructor can erase the attempt and allow the student to restart the exam from an appropriate point (see additional discussion in a subsequent section below). This approach allows for a greater degree of accountability by the student and a greater amount of oversight by the instructor.

The fifth option presented in Illustration 7's "Test Availability" section allows for "Force Completion." An instructor who checks the "Force Completion" box would force the completion of the exam by a student during one sitting. In other words, the student would not be allowed to begin the exam, answer a portion of the exam questions, exit the exam, and return to the exam to finish the unanswered portions at a later point in time.

Illustration 6
Security Issue for Opening Test in New Window when Administering Online Exams

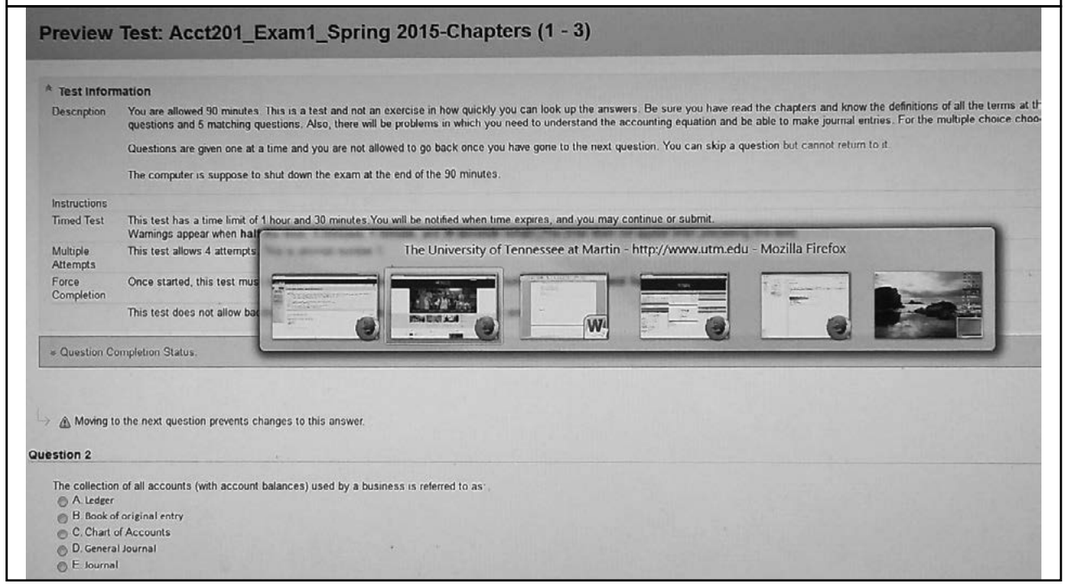
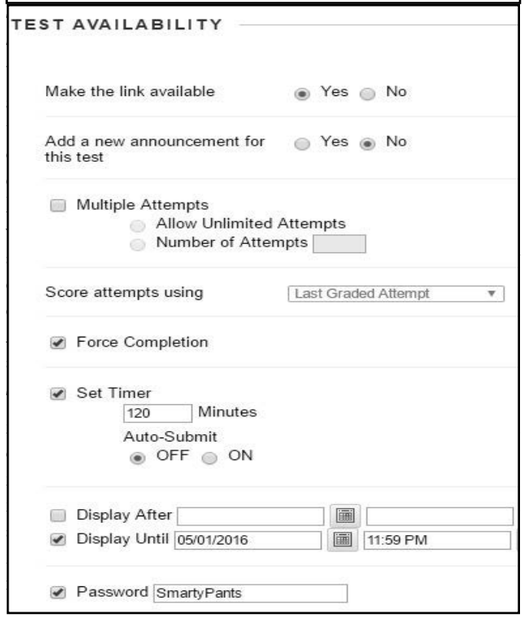


Illustration 7
Test Availability Options for Administering Online Exams



The final option presented in Illustration 7 allows the instructor to set a password for the exam. The authors recommend the establishment of a password for the exam even if the exam is to be administered with the use of an online proctoring service. Passwords are case sensitive; however, Blackboard does not require the use of a number or symbol as part of the password.

Platform Options shown in Illustration 8 are concerned with how an exam is presented to a student.

Options for how an exam is to be presented to the student are available. The first option is selecting whether to allow a student to observe the entire exam all at once or whether to allow the student to view one question at a time. The authors normally select one question at a time. The authors' experience in this approach has resulted in fewer computer crashes than making the whole exam viewable at the same time. Whether this result is because the exam will be saved each time the student goes from one question to the next or because the student suddenly realizes that more studying should have been done, the authors are unsure. If the "one (question) at a time" option is chosen, the instructor needs to decide if the student will be able to return to a question that has been skipped or previously answered (backtracking). The authors generally prohibit backtracking. Again, fewer student computer crashes occur in the authors' experiences. Choosing to present one

question at a time with no backtracking also enhances the authenticity of the exam if a student does experience a technical difficulties. In that case, Blackboard allows the instructor to view the student's time spent per question in order to determine at what question the student should return in order to complete the exam without question overlap. The instructor should be prepared to manually grade a test having these types of difficulties or issues. The procedure for accessing this information will be presented later in the paper.

An instructor also must decide how much information about the test results will be available to the student and at what point in time that information will become available. Illustration 9 shows the options available in Blackboard regarding this topic.

On the left side of Illustration 9, Blackboard gives an option on "When" the results are available. Within that drop box, the options are "After Submission," "One-time View," "On Specific Date," "After Due Date," and "After Availability End Date." After the instructor has chosen the "when" option in the first drop down box, he must then select the type of information to release with the choices being: Score per Question, All Answers, Correct Answer, Submitted Answer, Feedback, and Show Incorrect Questions. The authors encourage an instructor who prepares a purely objective style exam to select only the score per question option box because the authors have found that regardless of the box checked, the student can view his grade as soon as his exam has been graded.

In order to eliminate a student's ability to view his exam grade until the time preferred by the instructor and thus eliminating a student's desire to question the result of his individual performance on the exam until the instructor can review the overall exam results, the authors insert an "Essay Question" on each exam. The wording of the essay question is shown in Illustration 10 and can allow for a double benefit.

The first benefit derived from the above question is the gained ability to control the release of the entire exam score to the student because any essay question (even the one shown in Illustration 10 in which the student is not required to answer) requires the instructor to grade the question manually before the overall exam score can be determined. The second benefit derived from the above question is the ease over which the instructor can allow a curve over the entire exam for all students as the title of the question would hint. The initial number of points available for this question is set at zero. After all exam are submitted and the overall performance of the class is reviewed, an instructor who desires to allow a curve on the exam may do so easily by altering the points available for this "curve" question to the desired curve for the exam. When the instructor is ready to reveal grades, the master exam originally prepared by the instructor is edited. The instructor goes to the "Curve" essay question and clicks the "0" to the left of Points for the question in Illustration 10. When the "0" is clicked, the "Points 0 (Extra Credit)" in the upper left side of Illustration 10 expands to view in the upper left side of Illustration 11.

When the instructor inserts a value in the box entitled "Update Points" and clicks "Submit," the instructor is asked by Blackboard if all completed exams linked to this question should be updated. If the instructor answers positively, three tasks are achieved: (a) the score entered for the question on the master exam is saved, (b) the same number of points indicated for the question on the master exam is also entered automatically on each student's exam, and (c) each student's total exam score is automatically calculated and posted in the platform grade book.

Realizing a Student May Have Test Bank

Most instructors realize that students have access to a test bank for most textbooks. A recent search on eBay for "test bank" returned 797 listings as shown in Illustration 12.

Illustration 8
Test Presentation Options for Administering Online Exams

Illustration 9
Show Test Results and Feedback to Students
Options for Administering Online Exams

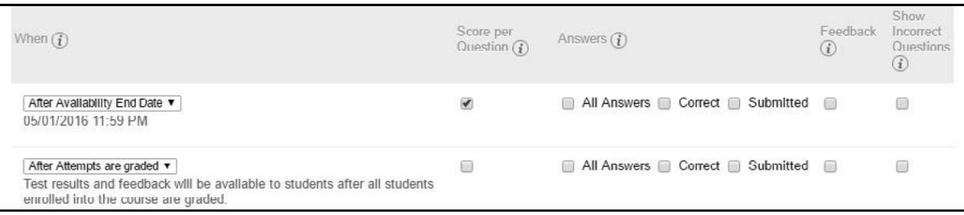


Illustration 10
Insertion of Essay Question Requiring Instructor Input
Before an Exam Grade Can Be Calculated

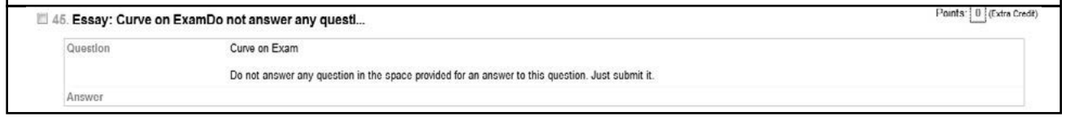


Illustration 11
Adjusting Points on an Instructor Graded Essay Question
Before an Exam Grade Can Be Calculated

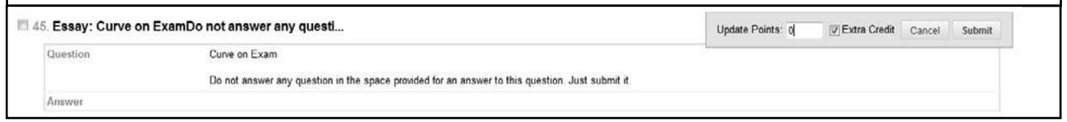
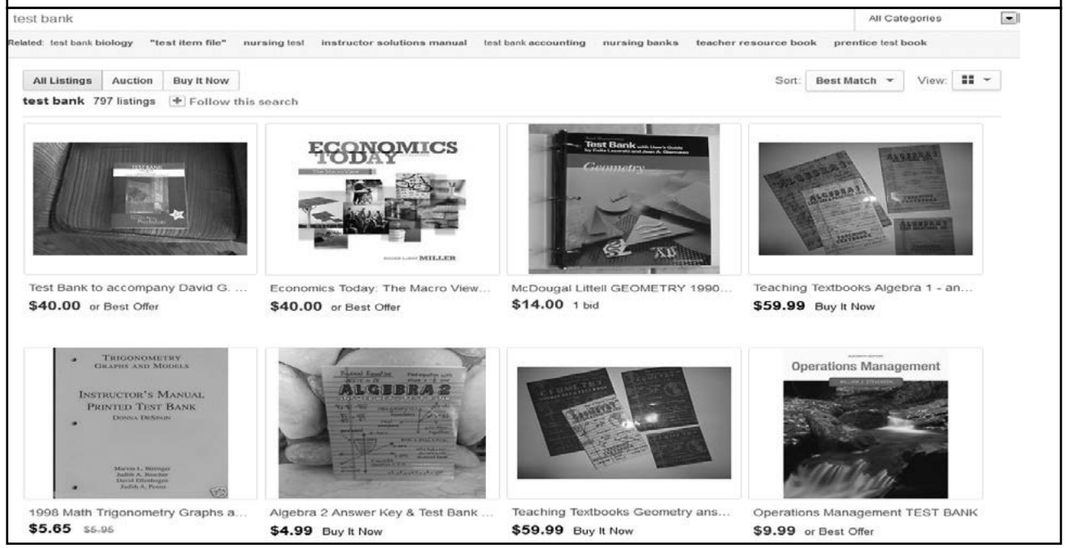


Illustration 12
EBay Search for Test Banks



More options to acquire a test bank could be found by clicking on "Related" within Illustration 12 such as: test item file, instructor solutions manual, nursing banks, teacher resource book, and other suggestions. If an instructor uses a test bank for purposes of official course evaluations, that instructor should alter the testbank questions in order to safeguard the integrity of the exam as a true measure of a student's knowledge of the material presented instead of a measure of a student's ability to acquire the test bank. The authors encourage instructors to use the test bank questions as templates in order to rewrite the question into a new creation not subject to an easy electronic search for a correct answer.

As can readily be seen, the entire question is not shown, only part of the first sentence of the question. If the test is timed, a student desiring to make inappropriate use his acquired electronic test bank file needs to have an idea what chapter the question is from and then make a quick scan the first five or six words of the question to match it to the exam being taken. The same is true of "Multiple Choice" questions as show in the sample in Illustration 14.

Illustration 14 presents a more worrisome example of how a student may cheat when the question posed on the exam is one involving a particular fact pattern for analysis. For example, the last question listed in Illustration 14 begins "Wallah Company agreed to accept $5,0000 in cash along with an $8,000, 90-day...". To find the answer to the question, a student only needs an independent internet connection and new window with Google access as seen in

By clicking on the second search result shown in Illustration 15, the student will be taken to a website that charges a fee for the correct answer; however, the third search result will take a student to a website shown in Illustration 16.

As you can see from the screen shot above, this website discloses the entire question, all answer choices, and the correct answer all of which are provided free of charge.

Another safety precaution taken by the authors when using the textbook's test bank is the decision not to group the True/False or Multiple Choice questions by chapter unless the exam only covers one chapter. Additionally, the authors alter the beginning language of each question which will make each question harder to identify. In some cases, the authors have reworded the question only in subtle ways so as to change the correct answer choice but have left the former correct answer as a possible choice. This method will cause a student who is using inappropriate test bank material under time pressure to choose the answer labeled by the test bank as being correct when, in fact, that answer is now an incorrect choice for the slightly altered test question.

A student with access to an electronic test bank will benefit from answers to objective and as well as subjective questions. Illustration 17 shows a screen shot of a sample set of questions that are essay and fill in the blank.

The first question seen in the above illustration is an essay question. A student with access to this electronic test bank could easily click on that first question and see the additional information shown in Illustration 18.

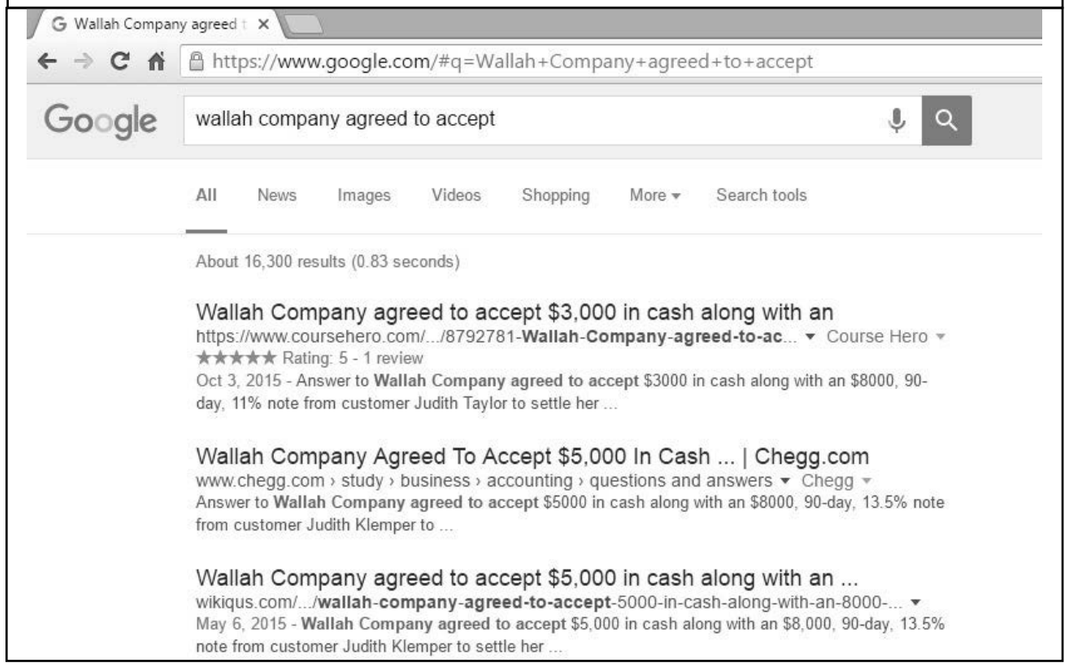
Illustration 13
Sample True/False Questions for an Electronic Test Bank

A wholesaler is an intermediary that buys products from manufacturers or othe...	True/False
A retailer is an intermediary that buys products from manufacturers and sells...	True/False
Cost of goods sold represents the cost of buying and preparing merchandise fo...	True/False
A company had sales of $350,000 and cost of goods sold of $200,000. Its gross...	True/False
A company had net sales of $545,000 and cost of goods sold of $345,000. Its g...	True/False
A company had a gross profit of $300,000 based on sales of $400,000. Its cost...	True/False
A merchandising company's operating cycle begins with the sale of merchandise...	True/False
Merchandise inventory is reported in the long-term assets section of the bala...	True/False
Cash sales shorten the operating cycle for a merchandiser; credit purchases l...	True/False

Illustration 14
Sample Multiple Choice Questions for an Electronic Test Bank

A company ages its accounts receivables to determine its end of period adjust...	Multiple Choice
Electron borrowed $75,000 cash from TechCom by signing a promissory note. Tec...	Multiple Choice
The amount due on the maturity date of a $6,000, 60-day 8%, note receivable is:	Multiple Choice
Paoli Pizza bought $5,000 worth of merchandise from TechCom and signed a 90-d...	Multiple Choice
MixRecording Studios purchased $7,800 in electronic components from TechCom. ...	Multiple Choice
Wallah Company agreed to accept $5,000 in cash along with an $8,000, 90-day, ...	Multiple Choice

Illustration 15
Google Search for Test Bank Question Having a Particular Fact Pattern

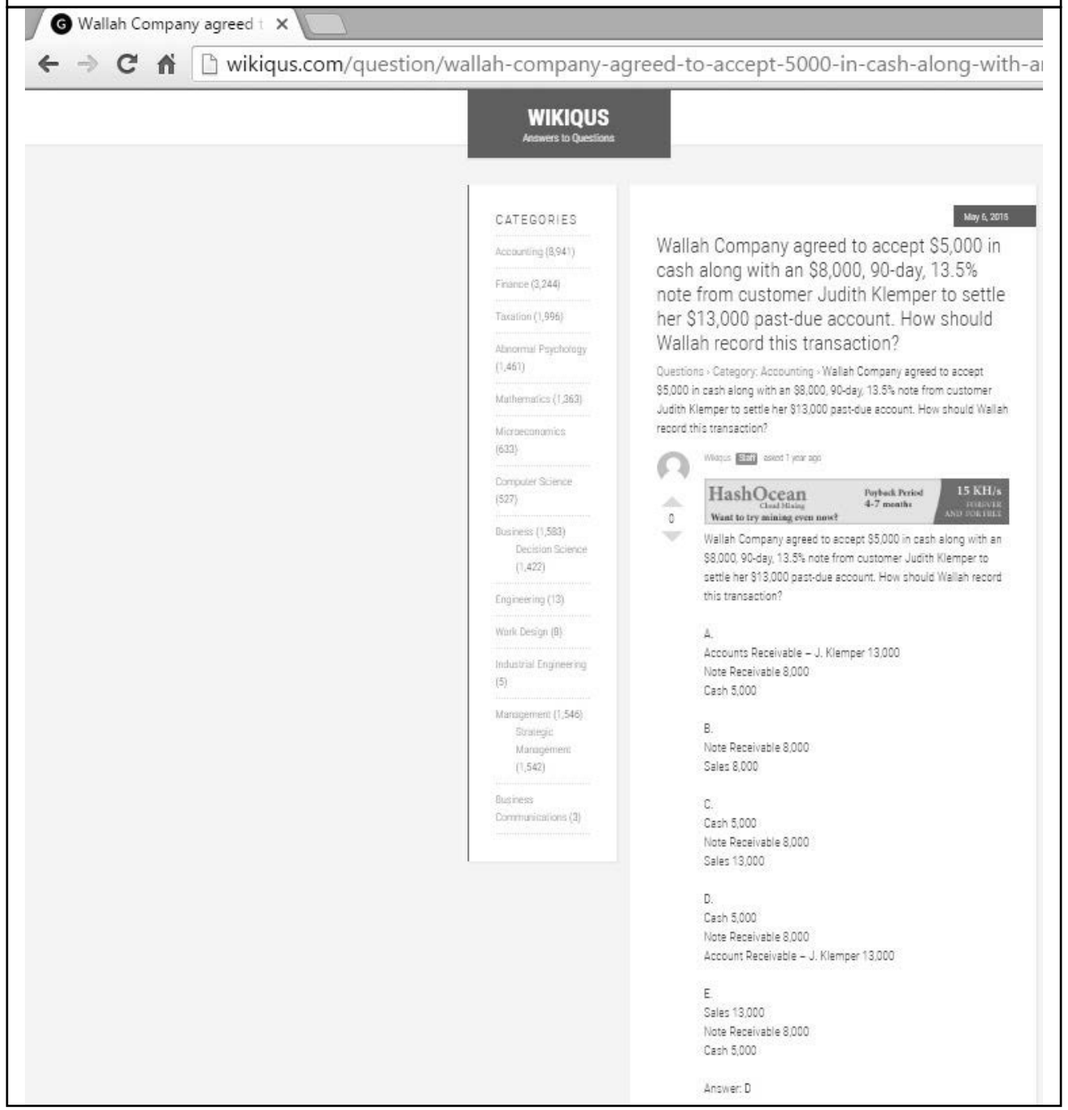


In order to impede the efforts of the student to gain an unfair advantage by using the test bank, the authors would rephrase the question as shown below:

> Dickens Incorporated ages its accounts receivable every July 31 in order to ascertain the amount of its bad debts adjustment. At the current fiscal year's end, management estimates that $16,900 of the accounts receivable balance would be uncollectible. The Allowance for Doubtful Accounts has a debit balance of $3,200 before any year-end adjustments for bad debts. Prepare the adjusting entry that Dickens Incorporated should make on July 31, of the current fiscal year, to estimate bad debts expense.

The rewording above focuses on the name of the company, the date of the adjustment, and the ordering of certain phrases. These small changes can significantly reduce the usefulness of the testbank. For additional safeguards, the authors could alter one or more of the numbers contained

Illustration 16
Sample Website Offering Answers to Objective Test Bank Questions



in the problem so that the answer would be also change. The best yet the most time consuming solution to the problem of a test bank being readily available to a student who desires it is for the instructor to write original questions. Also, one of the authors received permission from a textbook company whose books are used in the department to use questions from a competing textbook that has not been adopted by the department.

Illustration 17
Sample Essay and Fill in the Blank Questions for an Electronic Test Bank

Each December 31, Davis Company ages its accounts receivable to determine the...	Essay
A company that uses the allowance method to account for its bad debts had cre...	Essay
The following series of transactions occurred during 2009 and 2010 when Linwo...	Essay
Prepare general journal entries for the following transactions of Viking Comp...	Essay
Cairo Co. uses the allowance method of accounting for uncollectible accounts....	Essay
Prepare general journal entries for the following transactions of this compan...	Essay
A supplementary record created to maintain a separate account for each custom...	Fill in the Blank
A is a signed promise to pay a specified amount of money...	Fill in the Blank

Illustration 18
Display of Entire First Question Shown in Illustration 17

Details: Essay Question

Question: Each December 31, Davis Company ages its accounts receivable to determine the amount of its adjustment for bad debts. At the end of the current year, management estimated that $16,900 of the accounts receivable balances would be uncollectible. The Allowance for Doubtful Accounts account had a debit balance of $3,200 before any year-end adjustment for bad debts. Prepare the adjusting journal entry that Davis Company should make on December 31, of the current year, to estimate bad debts expense.

Answer

Dec. 31	Bad Debts Expense	20,100	
	Allowance for Doubtful Accounts		20,100

Desired balance in allowance account:	$16,900 credit
Current balance in allowance account:	3,200 debit
Adjustment to allowance account:	$20,100 credit

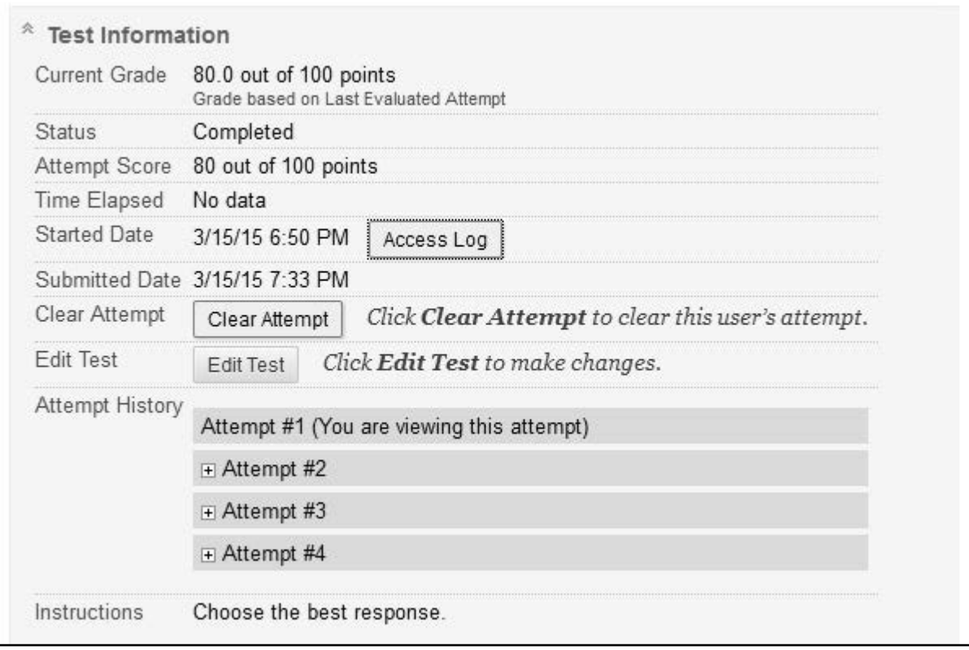
Student's Computer Experiencing a Crash During an Exam

When a student's computer crashes during an exam, the instructor should rightly be suspicious of the circumstances surrounding the crash. In some cases, a computer crash is a completely innocent result of a faulty connection or weather related issue on either the university's or the student's side of the line. The problem occurs when the crash is a result of a deliberate attempt by a student who has seen some or all of an exam's questions and who desires to delay answering those questions until after the student engages in additional study time or conducts a search of material for the exam answers (Cizek 1999). Often the platform through which an instructor administers an exam can assist in determine how much information was visible to a student prior to the crash; therefore, the settings chosen by the instructor in creating and administering the exam become even more useful. This situation is another example of why the authors encourage an instructor to present exam questions to an online student "one at a time" instead of "all at once" and without the ability to backtrack to prior questions. Illustration 19 is a screen shot of Blackboard's "Test Information" screen for an actual student's attempt on a 50 question exam created by one of the authors during which the student's computer crashed on three (3) separate attempts.

The section entitled "Started Date" has a box to the right labeled "Access Log." By clicking on the "Access Log" box, the instructor can view a log of all the questions viewed by the student, the time into test that the student first accessed the question (in the next to last column from the left), and the amount of time the student viewed the question (last column on the left), the last part of which can been seen in Illustration 20.

In the above illustration, the student did not reach question 45. The student's computer crashed after saving the work for Question #44. The student was allowed another attempt and told by the instructor to skip all questions

Illustration 19
Online Teaching Platform Test Information



until the student reached Question #45. As seen in Illustration 21, which is a log of the next attempt there were 49 questions on the exam; however, Illustration 20 showed only 44 question indicating questions 45 through 49 had not been viewed by the student.

One possible explanation of the problem experienced by the student depicted in the last two illustrations is that the student's computer lacked adequate upload and download capabilities. This lack of capability can be exaserbated when an instructor allows all exam questions to be presented to a student at the same time. Depending on the size of the file or additional graphics or videos that may be embedded, a student with an older or a less expensive computer may experience a great amount of trouble in taking the exam.

Other concerns faced by the authors regarding the administering of online exams are (a) the length of time that elapsed between the computer crash and the student's initial attempt to notify the instructor, (b) the method by which the instructor was contacted (i.e., a late night email from the student timed to allow the rest of the evening to pass before the instructor could likely reply to the student), (c) the length of time that elapsed between the instructor's reply about the crash to the student's receiving the information (i.e., a student who delays checking email hoping to gain additional study time for the exam), (d) the number of questions viewed (or captured by screen shots taken) by the student who experiences a computer crash, (e) the true identity of the individual who is taking the exam, (f) the student's ability to discuss a question with another person either using live conversation or electronic communication), and (g) the student's ability to use unauthorized textbooks, notes, devices (including handheld calculators with memory options) or other materials.

The answer to most if not all the previous questions posed is the use of a proctor. The authors have had experience with several methods of proctoring.

Different Proctoring Methods

The ideal testing environment involves a face-to-face meeting of the enrolled student the course instructor. This ideal environment is possible in an online class but is not usually practical because of the likely distance that exists between the student and the instructor and because of the time commitments of each party. When feasible, the

Illustration 20
Online Teaching Platform Test Information's Access Log

3/15/15 7:09:12 PM	Saved question 39	18:15	00:15
3/15/15 7:09:43 PM	Saved question 40	18:46	00:31
3/15/15 7:13:06 PM	Saved question 41 multiple times over a period of: 02:38	22:09	03:22
3/15/15 7:16:53 PM	Saved question 42 multiple times over a period of: 02:45	25:56	03:46
3/15/15 7:23:58 PM	Saved question 43 multiple times over a period of: 06:44	33:01	07:05
3/15/15 7:25:59 PM	Saved question 44 multiple times over a period of: 00:39	35:02	02:01
3/15/15 7:33:47 PM	Test submitted	42:50	07:47

*The times appearing under the Time Spent column may not accurately represent the time the student spent on each question. The student may have looked at other questions before answering and saving individual questions.

Illustration 21
Online Teaching Platform Test Information's Access Log (Last Attempt)

Access Log

The Test Time column shows times relative to the start of the test and the Time Spent column shows the time between the current Access Type and the previous Access Type. Time format is: mm:ss.

Date and Time	Access Type	Test Time	Time Spent*
3/15/15 10:55:49 PM	Test started	00:00	00:00
3/15/15 10:59:26 PM	Saved question 42	03:37	03:37
3/15/15 10:59:31 PM	Saved question 43	03:42	00:04
3/15/15 10:59:36 PM	Saved question 44	03:47	00:05
3/15/15 11:02:01 PM	Saved question 45 multiple times over a period of: 02:14	06:12	02:25
3/15/15 11:03:02 PM	Saved question 46 multiple times over a period of: 00:50	07:13	01:00
3/15/15 11:06:20 PM	Saved question 47	10:31	03:18
3/15/15 11:09:19 PM	Saved question 48 multiple times over a period of: 02:17	13:30	02:58
3/15/15 11:10:17 PM	Test submitted	14:28	00:57
3/15/15 11:10:17 PM	Saved question 49	14:28	00:00

*The times appearing under the Time Spent column may not accurately represent the time the student spent on each question. The student may have looked at other questions before answering and saving individual questions

authors have given students the choice of taking the exam online or coming to campus and taking the exam with an on-campus section of the course being offered. Some faculty members allow students to take an exam at a satellite campus office or to find their own proctors. These testing options raises questions about maintaining the integrity of the exam and/or the proctor and about the logistics of providing and retrieving the exam in a timely manner (Young, 2013).

The authors began using online proctoring for an online course in an effort to eliminate or reduce the instances of cheating on an online exam (Harmon, 2008). Several companies offer proctoring services. The following list is not exhaustive but are one the authors have actually used, considered, or are considering. Their list consists of Respondus LockDown Browser, Remote Proctor (RP Now), Proctor U, Examity, Kryterion, Proctor Free, Tegrity, and B. Virtual, Inc. The first one tried and still used in some cases is Respondus LockDown Browser. This option is free to the students and supposedly prevents the student from visiting computer sites or using other computer programs while taking an exam; however, the instructors have been sent screen captures which are supposedly not possible from students. In addition, students could still use cameras to make copies of the exam or utilize a smartphone, tablet, or second computer to access information. Respondus Monitor has been added to this service which integrates webcam technology, but the authors have not tried this feature at this point in time.

One available option is the use of Skype or FaceTime by the instructor for each student taking the exam. This option requires a large time commitment by the instructor and would not be feasible in a large class or a class that scheduled multiple exams. Nevertheless, they are useful monitoring methods on rare occasions.

In order to achieve results similar to the face-to-face examination setting in a traditional classroom without the large time commitment for the instructor, the instructors examined the options available with online companies providing some type of monitoring service. The online companies provide the service with either the college paying the exam cost or the students paying for each exam. After an initial trial period with one unnamed service used by the authors' university, the authors and other instructors at the authors' university who desire a proctored exam now require the online students to pay for the proctoring of each exam taken during that course. As long as an exam's time frame is clearly stated in the course syllabus, the student is incentivized to make smarter choices about scheduling his time to take an exam with the proctoring service.

The authors have first-hand experience with the use of two different companies offering online exam proctoring services. Both companies took similar steps to ensure the integrity of the student's testing environment and the integrity of the actual exam taken. As a general overview of the proctoring system, the process begins with the instructor logging into the proctoring service's website and creating the settings for administering a new exam including the window during which the exam must be taken by students. The instructor then notifies his students that an exam window has been established. The student logs into the proctoring service, locates the appropriate exam schedule for his course, and selects a period of time that falls within the instructor's established exam window. In the authors' experience, the proctoring service charges each student a flat fee based on the length of the exam and the requirement that the student set his exam time at least 72 hours in advance. The closer in time to the exam a student waits to register, the higher his exam proctoring fee will be. A student is able to take an exam with no prior registration; however, that student will pay a higher fee for the proctoring service.

When the time arrives to take the exam, the student signs into the proctoring service website being sure to have handy access to his government issued photo identification, a good internet connection, a web cam, a microphone, and any notes or materials he is allowed to access during the exam. The monitoring service will determine the identity of the student by comparing the student's government issued identification card or document with the person shown on the web cam who is attempting to take the exam. A picture of each is taken by the webcam for future comparison should a question arise at a later date. Those pictures are also available for the faculty to view after the exam is taken. The proctoring service will then verify the upload and download speed of the student's internet connection to ensure sufficient capacity exists for taking the exam. The student is then required to use his web cam to provide the proctor a 360-degree view of the room where the exam will be taken including the ceiling above the computer, the floor below the computer, the left and right sides of the desk, and the area behind the computer. When the student's testing environment has been verified as being free from obvious signs of unauthorized individuals and material, the proctoring service will ask the student to access the exam site and will take control of the student's computer in order to enter the exam's password which has been provided to the proctoring service but has not been provided to the student.

Two main differences between the prior and the current proctoring services were noticed by the authors. The first difference relates to the type of proctoring performed by each service. The prior proctoring service used the student's web cam to film the student taking the exam. That same service also used the student's computer to capture key strokes and screen shots every few seconds with no one monitoring the exam while it was given but with several employees reviewing data after the completion of the exam. That information was also made available for the instructor to review. The current proctoring service used by the authors' university uses a designated proctor to monitor the exam. The exam itself is not videoed. Instead, the proctor uses the student's web cam to take pictures at regular intervals to document the exam environment. If a student experiences a computer crash during the exam, the proctor stays in contact with the student and attempts to contact the instructor to explain the problem encountered. The instructor is given an opportunity to offer suggestions (if any) or to allow additional leeway in restarting a section of the exam. In the event an ethical issue or a other point of concern surfaces during the administration of the exam, the proctor service notifies the instructor at times previously selected by the instructor to receive that information which can include an immediate notification if so desired by the instructor.

The second difference is the steps taken to verify the identity of the student who is attempting to take the exam. While both services compared government issued photo identification cards to the student taking the exam, the current service takes an additional step in asking some basic questions of the student to which answers should be readily available. For example, one of the author was recently contacted by the current proctoring service and informed that while the identification picture and the person presenting that identification card appeared to be the same person, the proctor had reason to believe the person attempting to take the exam was not the student enrolled in the course. This belief was based on the student's inability to answer some basic questions about himself to which the student should have known the answers. The final result of the incident was resolved in favor of the student, but the university administrators were impressed with the extra level of attention the proctoring service provided in verifying the student's identity.

The current service has been used for two years and has relieved anxiety on behalf of faculty that wish to provide an online opportunity but at the same time make it close to a classroom testing experience. While the university is satisfied with the current service, it has considered other proctoring services for the purpose of determining additional safeguards that can be added to increase the integrity and consistency of students' testing environments. The authors and other instructors at their university are still seek technology methods to prevent the creation of an electronic copy of an exam administered online. The authors hope to share ideas on a successful outcome to this issue in the near future.

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Dual Enrollment Student Achievement in Various Learning Environments

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ABSTRACT

The purpose of this study was to examine whether variations in student achievement in college courses exist between high school students who took the courses as dual enrollment (DE) courses and academically comparable high school students (AIMS scholars) who took the courses upon matriculation to college. Additionally, the researcher explored whether differences exist in DE course grade for students by course environment (online, face-to-face at a high school, or face-to-face at a college.) The researcher used final course grades as determinants of student achievement. The study focused on DE student and AIMS scholar grades in English 111, Biology 101, Math 163, and History 101 courses that were taken between the 2009-2010 and 2013-2014 school years at a community college in Southwest Virginia. The population consisted of 429 AIMS scholars and 2,015 DE students. For this study 3,639 DE student grades and 706 AIMS student grades were used in calculations. The dependent variables in this study were final course grades; the independent variables were DE participation and course delivery environment. Welch's t tests were used to examine the variations in final grades for DE and non-DE students; ANOVA procedures were used to examine variations in final course grades for DE courses based on delivery environment.

Introduction

The No Child Left Behind Act of 2001 furthered dialogue regarding a more rigorous high school curriculum; this dialogue has continued throughout the past decade, and it has culminated in strong educational rhetoric by President Barack Obama as he called for a 50% increase in students who were taking dual enrollment (DE) or advanced placement courses by 2016 (Obama for America, 2008). During the 2010-11 school year 53% of collegiate institutions hosted students taking DE courses on their campus (Marken, Gray, & Lewis, 2013). This number has since increased, and the overall DE population currently includes over two million students nationwide (Schachter, 2014).

Statement of the Problem

Due to recent legislation more students have an opportunity to take DE courses; however, the extent to which DE is successful in preparing students for college can vary based on locale and access to a participating postsecondary institution (Edwards, Hughes, & Columbia University, 2011). This varying access has resulted in multiple methods of DE delivery that span various classroom environments. The U.S. Department of Education (2007) has demonstrated that such varying methods of course delivery are a nationwide norm. Because of this variation, researchers have raised questions about the effectiveness of varying methods of DE course delivery (Howley, Howley, Howley, & Duncan, 2013).

Despite research regarding the benefits of DE programs in general, there are few existing studies that disaggregate

DE student success according to DE course setting. Ozmun (2013) suggested that "disaggregating students by delivery modality" would provide a richer analysis of DE programs (p. 70).

The purpose of this comparative study is to examine if variations in student achievement exist between dual enrollment (DE) English, biology, history, and mathematics course environments and between dual enrollment students' grades and the grades of academically comparable peers. For the purpose of this study academic achievement is defined as final grade in class. Introductory English, biology, mathematics, and history courses were chosen for this study because they are often offered as DE options and because they are included in many general education curricula.

Background

Because of the popularity of DE programs in recent decades, states have begun to provide policies that govern such high school and college interactions. As of 2012, 46 states had policies that governed DE, and 12 of those states had mandatory participation from postsecondary institutions (Hofmann & Voloch, 2012). Although states have mandated participation, DE program delivery environment differs with instructor availability and region. Because of this, factors such as course delivery environment are left to the participating high school and college partnerships.

Program Benefits for Students

There are many academic advantages of DE that increase the likelihood of matriculation after high school. Fincher-Ford (1997) demonstrated that early objectives of these programs included transitioning seamlessly from high school to college, earning college credits before entering higher education, and "shorten[ing] the time required for high school students to complete an undergraduate degree" (p. xiii).

Accelerated learning programs such as DE were intended to provide the opportunity for students to be introduced to academic rigor so that they have an increased chance of continuing college beyond the first semester. A lack of college readiness accounts for many college students' initial academic failings; however, DE courses promote college readiness in multiple content areas including both technical education and transfer-level courses (Ganzert, 2014; Martin, 2013). Another key advantage of DE programs is that students who have taken these courses are more likely to continue their education beyond high school (Columbia University, 2012). Ozmun (2013) found that because DE students are more familiar with college norms, students who take DE courses may be more likely to "persist beyond their first semester or first year of college" (p. 62). Additionally, researchers have found that upon matriculation to a college or university, students who have taken DE courses perform better academically than students who had no previous DE experience (Jones, 2014).

Dual Enrollment in the Online Environment

Online delivery of DE courses occurs much less frequently than delivery on a high school or college campus (Blackboard Institute, 2010). Though Mellander (2012) contended that "students who attend superior high schools do not expect to take classes on the web" (p. 68), he also demonstrated that postsecondary academic institutions (including the Maryland and Minnesota university systems) required their students to take a certain percentage of courses that were delivered via an "alternative learning" method (p. 67).

Dual Enrollment in the High School Environment

Although original concurrent enrollment partnerships were designed to take place on the high school campus ("About NACEP," n.d.), college administrators and faculty express concern "about their ability to ensure the quality of the courses taught in high schools by high school faculty" (Kinnick, 2012, p. 40). Additionally, many college instructors felt that the dialogue with high school instructors was dominated by focus on paperwork and deadlines rather than course content (Howley et al., 2013). In contrast, high school instructors believed that their lack of knowledge about college policy and procedures acted as a distinct impediment to performance (Howley et al., 2013). Zimmerman (2012) critiqued, exclusively, the impact of the physical high school setting to DE progress. Because, he argued, the high school setting has its own etiquette and decorum that is distinctly different from the college setting, DE students within the high school setting are not fully benefitting from courses that are meant to be transitional.

Dual Enrollment in the College Environment

Instead of being confused and daunted by a college atmosphere, studies have found that DE students thrive when DE courses are taken at a college or university. For instance, the Community College Research Center (CCRC) found that students in Florida, New York City, and California who took DE courses on a college campus were 9% more likely to enroll in college, 6% more likely to pursue a bachelor's degree, and 5% more likely to attain a bachelor's degree than students who took DE courses on a high school campus (Columbia University, 2012, p. 5). CCRC also reported that there were no distinguishable benefits for students who had taken DE courses on a high school campus versus those students who had not taken DE at all.

Conclusion

Research has demonstrated that participation in an effective DE program increases the likelihood that students will be emotionally and academically prepared for the rigor of either a 2-year college or 4-year university. While there is conflicting evidence regarding the extent of the academic benefits of DE, the generally stated conclusion among schools and policymakers is that DE is an effective method of bridging the gap between high school and college.

Methodology

The purpose of this comparative study was to examine whether variations in student achievement in college courses exist between high school students with dual enrollment (DE) credit and academically comparable high school students with no DE credit. Additionally, the researcher explored whether differences exist in course grade for DE students by course environment (online, face-to-face at a high school, or face-to-face at a college.)

Design

Within this study the grades of non-DE students were compared with the grades of DE students respective to each content area. Additionally, the grades of DE students were compared based on DE course environment (online, F2F at a high school, and F2F at a college).

The design of this study was focused on the impact of DE delivery method on DE course achievement as well as the DE student grades in comparison with their non-DE peers. In order to evaluate the impact of DE delivery method, the research questions focus on method of DE delivery and content area-specific DE course achievement. Because high school students who enroll in DE have higher levels of academic preparedness than the average high school student (Allen & Dadgar, 2012), selection bias was addressed by comparing DE students to a comparison group of AIMS scholars. In order to be an AIMS scholar at the college where the study is being completed, "students must achieve a grade of at least 'C' or better in each of the 17 approved high school courses" ("AIMS Higher Scholarship," 2014, para. 3). There is no GPA cutoff or requirement for DE participation (Virginia's plan for, 2008). For this reason AIMS scholars and DE students are academically comparable.

The following research questions were used to guide this study:

1. Is there a significant difference in English 111 final grade for students who took English 111 as a dual enrollment course and AIMS scholars who entered college with no English 111 dual enrollment credit?
2. Is there a significant difference in dual enrollment English 111 final grade for students who took dual enrollment English 111 online, face-to-face at a high school, or face-to-face at a college?
3. Is there a significant difference in Biology 101 final grade for students who took Biology 101 as a dual enrollment course and AIMS scholars who entered college with no Biology 101 dual enrollment credit?
4. Is there a significant difference in dual enrollment Biology 101 final grade for students who took dual enrollment Biology 101 online, face-to-face at a high school, or face-to-face at a college?
5. Is there a significant difference in Math 163 final grade for students who took Math 163 as a dual enrollment course and AIMS scholars who entered college with no Math 163 dual enrollment credit?
6. Is there a significant difference in dual enrollment Math 163 final grade for students who took dual enrollment Math 163 online, face-to-face at a high school, or face-to-face at a college?
7. Is there a significant difference in History 101 final grade for students who took History 101 as a dual enrollment course and AIMS scholars who entered college with no History 101 dual enrollment credit?
8. Is there a significant difference in dual enrollment History 101 final grade for students who took dual enrollment History 101 online, face-to-face at a high school, or face-to-face at a college?

Data Analysis

Data analysis began with descriptive statistics that provide an overview of the population by demonstrating the percentage of the population that had not taken DE courses

as well as those that had taken biology, history, English, and mathematics as DE courses. DE data were further separated by course environment (online, F2F at a high school, and F2F at a college) for DE Biology 101, History 101, English 111, and Math 163. After descriptive analysis the researcher examined research questions in terms of collected data. Student letter grades were treated as interval data, which is typical in educational research in order to run statistical procedures and gather means (Kaplan, 2011). Data indicating a grade of "Incomplete" or "Withdrawal" were not included in calculations.

Research questions 1, 3, 5, 7, and 8 were analyzed using an independent samples t test. The t test is also a statistical procedure that has a well-established history in research (Pelham, 2012). When the results of these procedures yielded significant results, the researcher continued analyses by "estimating the size of the underlying effect" (Witte & Witte, p. 285). Although the nature of research question 8 was appropriate for Analysis of Variance (ANOVA), the sample size for the group of History 101 DE students who had taken the course on campus was quite small (n=5). Because this population distribution was nonnormal, omission of this group yielded more trustworthy results.

Research questions 2, 4, and 6 were analyzed using Analysis of Variance (ANOVA). ANOVA "tests whether differences exist among population means categorized by only one factor or independent variable" (Witte & Witte, p. 338). For instances in which the ANOVA revealed significant differences among the means, post hoc analyses were completed by testing against the mean using the Games-Howell procedure, which works well with unequal sample sizes (Games & Howell, 1976). Where needed, effect size was calculated in order to gauge the "difference between population means" (Witte & Witte, p. 287). All statistical analyses were completing using an alpha level of 0.05, which is widely accepted in the field of educational research (Leahey, 2005).

Findings

The study was focused on DE student and AIMS scholar grades in English 111, Biology 101, Math 163, and History 101 courses that were taken between the 2009-2010 and 2013-2014 school years at a community college in Southwest Virginia. The population consisted of 429 AIMS scholars and 2,015 DE students. For this study 3,639 DE student grades and 706 AIMS student grades were used in calculations. The research questions outlined earlier were used to guide this study. The distribution of subjects between AIMS and DE by course is presented in Table 1. (Unequal sample sizes were taken into account during calculations.)

The dual enrollment population was also divided based on course delivery environment. Four of the eight research questions required such disaggregation. The breakdown of DE course delivery environment is provided in Table 2.

Results: Research Questions 1, 3, 5, and 7

Research questions 1, 3, 5, and 7 focused on the difference in final course grades for DE and AIMS students in four content areas, English, biology, mathematics, and history.

Table 1
Presentation of Student Grades by Course and Student Type

Student Type	Course							
	English 111		Biology 101		Math 163		History 101	
	n	%	n	%	n	%	n	%
Dual Enrollment	1,456	85	719	78	1,116	92	348	72
Non-Dual Enrollment	262	15	204	22	102	8	138	28
Total	1,718	100	923	100	1,218	100	486	100

Table 2
Dual Enrollment Sample Characteristics by Course Environment

Course Environment	Course							
	English 111		Biology 101		Math 163		History 101	
	n	%	n	%	n	%	n	%
DE Online	239	16	65	9	102	9	72	21
DE at High School	1,062	73	618	86	984	88	271	78
DE at College	155	11	36	5	30	3	5	1
Total	1,456	100	719	100	1,116	100	348	100

All *t* tests yielded significant results, demonstrating that DE students performed higher (based on final course grade) than non-DE students. The results of these research questions aligned with the results with many other studies that have demonstrated the success of DE programs (Ganzert, 2014; Jones, 2014; Karp, 2012; Martin, 2013). The difference between DE and AIMS student grades was most evident in Math 163, with a mean difference of 1.25 in final letter grades for DE and AIMS students. (One point is representative of one letter grade). Although this content area had the highest mean difference in final course grade, there were also mean differences in English, biology, and history that were 0.89, 0.83, and 0.86 respectively.

It is possibly because the students who took these courses as DE courses had additional support systems in place that they were more successful than their non-DE peers. Farrell and Siefert (2007) as well as Karp (2012) reported the importance of emotional scaffolding and the feelings of academic safety that accompany DE programs. Because a comparison group of AIMS scholars was used in this study, it is not accurate to say that these DE students were simply better students than the AIMS group. Instead, factors such as student support services and academic rigor may be better indicators of this variation in student success.

Results: Research Question 2

Research question 2 focused on the mean difference between final course grade in DE English 111 based on course delivery environment: online, F2F at a high school, or F2F at a college. An ANOVA yielded significant results, and *post hoc* procedures demonstrated that final course grades in DE English 111 that was delivered on a college campus were significantly lower than DE English 111 that was delivered on either a high school campus or in an online environment. There was no significant difference in final course grades between the high school and online environments.

There are multiple factors that could contribute to both the lower grade in the college environment as well as higher grades in online and high school environments. Firstly, it is possible that the DE English 111 course that was delivered on a college campus was more rigorous. Columbia University (2012) demonstrated that there were no benefits for students who had taken DE courses on a high school campus versus those who had not taken DE courses at all. It is possible that students who took English 111 on a college campus were simply not prepared for the rigor of a college course or for the freedom of the college environment.

Results: Research Question 4

Research question 4 was focused on the mean difference between final course grade in DE Biology 101 based on course delivery environment: online, F2F at a high school, or F2F at a college. An ANOVA did not yield significant results, and *post hoc* procedures demonstrated small variations among the means. The means for each delivery environment ranged from 2.86 (online environment) to 3.09 (high school environment). The college environment mean final course grade was 3.0 (a B in the class).

Results: Research Question 6

Research question 6 was focused on the mean difference between final course grade in DE Math 163 based on course delivery environment: online, at a high school, or at a college. An ANOVA did yield significant results, and post hoc procedures (via the Games-Howell procedure) outlined significant differences between the online group and the college group and between the high school group and the college group. There was no significant difference in DE Math 163 final course grade between high school and online DE Math 163 groups.

These results are fairly similar, in terms of areas of variation, to the English 111 groups. It is evident in both analyses that students who took the courses on a college campus performed significantly lower than the students who took the course online or at a high school. The students who took DE Math 163 online had a mean final course grade of 3.07, those who took the course at a high school had a mean final course grade of 3.10, and those who took the course at a college had a mean final course grade of 2.20.

Results: Research Question 8

Because the sample size for students who had taken DE History 101 on the college campus was so small (n=5) a Welch's t test was used to examine the variations between final course grade for students who had taken the course online and at a high school. The results of this test were statistically significant; students who took the course online had higher final course grades than students who had taken the course on a high school campus. DE students who took the course high school had a mean final course grade of 3.60, whereas students who took the course online had a mean final course grade of 3.89.

These specific findings conflict with many perceptions of the online course environment reported by educational researchers such as El Mansour and Mupinga (2007) and Bergstrand and Savage (2013). Students are often unfamiliar with online course platforms, due dates, and

decreased instructor interaction, and they often feel disconnected from the course and their grades suffer. Two main issues could account for these differences. Students now are more familiar with technology because they have interacted with it both personally and within educational settings. For this reason a more self-paced, low-interaction course could serve both acceleration and enrichment for advanced students. Additionally, there could be an issue in terms of rigor in one of the educational settings. Because, for this content area, there was little difference in student success in online and F2F courses, it is evident that these online courses could present a cost-effective alternative to F2F courses at a high school if they are as rigorous and provide the same amount of college preparation (in the long term) as F2F courses.

Conclusions

Recommendations for Practice

Because DE programs are associated with increased student success, it is imperative that colleges continue to grow, fund, and support them. Not only do such programs result in increased Full Time Equivalency (FTE) for colleges, but they also provide necessary scaffolding and preparation for collegiate studies. For this reason, the following recommendations are been made in light of this study's findings.

In English 111 and Math 163, students who had taken the courses F2F at a high school performed better than students who had taken the courses on a college campus. For this reason DE courses delivered on a high school campus should also be evaluated according to college standards, including course observations. Although DE course syllabi are evaluated according to college standards, further review of environment would strengthen programs across the board.

Secondly, the online courses examined within this study did not yield significantly lower final course grades. For this reason, colleges and high schools should work to provide more of these online courses and also to monitor them in a way that colleges can continue to ensure their effectiveness. Because more students can often be put in an online class than in a F2F one (because of seating restrictions), these online courses can be a convenient, cost-effective solution to staffing issues .

Recommendations for Further Research

Although results of this study demonstrated both that DE is effective and that student success for English, mathematics, and history (but not biology) based on DE delivery environment does differ, there are still many areas of DE research that could yield significant benefits to the field. Data-driven research, in all fields, is necessary to promote program growth and development. Studies such as those suggested below would significantly address many of the areas of inquiry that this study's results show are necessary for advancement in the field of DE.

1. A study that expands the study to multiple colleges and college types (community college and 4-year college or university) could demonstrate whether this study's findings are commensurate across a college system.
2. This study could be expanded into a paired-samples study that addresses the question of whether higher final course grades, based on environment, equate to increased college success.

In conclusion, the results of this study demonstrated that DE is effective insofar as it results in higher course grades as compared to comparable non-DE students. Although there were significant differences in final course grades for English 111, Math 163, and History 101 based on DE course delivery environment, this type of analysis should be further carried out by colleges that offer DE courses within various environments at least on a bi-yearly (every 2 years) basis.

Ensuring that DE programs do shift with the nature of instruction and technology is not only a way to make sure that DE programs remain effective but that they are also efficient in carrying out the goal of promoting student success. Dual enrollment is an area that remains rich as an area for research; it is only through a study of the nuances of these programs that colleges can best serve their students and communities.

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Engaging TBR Faculty in Online Research Communities and Emerging Technologies

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ABSTRACT

The growing impact of online research communities and emerging technologies is creating a significant paradigm shift and consequently changing the current research landscape of higher education. The rise of online research communities exemplifies a shift from traditional research engagements, to online research communities using "Web 2.0," in which communities of researchers are the basic unit of research engagement. As institutional practices become increasingly digitized, the role of faculty, scholars, and professionals are constantly reshaped and re-negotiated. The rise and use of emerging technologies in the field of research, has the potential to significantly impact the individual researcher, their institutions and ultimately the State. The project Critical Conversations Research Network is a part of a broader initiative undertaken by the Tennessee Board of Regents Office of Academic Affairs. TBR's Critical Conversations for Jobs and the Economy is designed to complement Gov. Bill Haslam's "Drive to 55" initiative, which aims to bring the percentage of Tennesseans with college degrees to 55 percent by the year 2025. (Haslam, 2013). The initiative undertaken by TBR'S office of Academic Affairs consists of: (a) Conversational interviewing of selected scholars and researchers across TBR institutions through video recordings of important and critical research topics that affect policy implications in the state of Tennessee, (b) an interdisciplinary journal called Critical Conversations Interdisciplinary Journal (CCIJ) dedicated to promoting dialogue on topics of importance among scholars across disciplines at TBR institutions. The journal provides a platform for critical conversations through which all disciplines can inform practice and practice can inform all disciplines, providing guidance for future public policy decisions and (c) the proposed Critical Conversations Research Network which is the focus of this paper. The goal of the Tennessee Board of Regents Critical Conversations Research Network ("TBR's-CCRN") is to connect TBR's faculty, researchers and scholars in collaboration, dialogue and engagement, about pertinent research initiatives undertaken by individuals and institutions across the state. A secondary purpose is to highlight the practical implications of research for economic and workforce development and to assist policymakers to engage in data-driven and informed decision-making.

Introduction

Online research communities (ORC) and emerging technologies (ET) have become a growing phenomenon with many and varied implications for academic use in higher education. Online research communities are a part of an emerging and developing area in research, that employs the use of cutting-edge technologies and engagement tools. The idea of an online community is not a new one. On mobile devices and in the fast paced digitized world, social interactions no longer have to be based on proximity; instead social interactions can literally occur with anyone anywhere. (Harmon, 2005). Online research communities have become a part of that dynamic network of access by anyone at any time. Online research communities can be defined as groups of individuals with common interests who engage in a variety of meaningful research interactions, network and engagement in an online or virtual environment. These interactions can have a major impact on strategy and operations on an individual, institutional, state and in some instances on a global level.

According to Wenger, an online community consists of three basic elements: i) first, the notion of joint enterprise, that participants shared and identify as common goals; ii) second, participants mutually engage, co-create, learn and undertake significant activities together; and iii) third, participants have a shared repertoire, a set of communal

resources that have developed as part of their engagements. (Wenger, 1998).

Online research communities (ORCs) can be either private or public depending on the overall mission and goals and are typically closed password-protected communities whose members are selected based on specified profiles. (Comley, 2008). The profiles of members of an online research community are individuals with common interests, goals and a set agenda, for example frequent flyers. However, there are also instances when participation in the network are specialized experts from outside of the niche or network. Online research communities may vary in size but generally, it has been reported that the response rates of participation in an online research community (ORC) are usually higher than the open "naturally occurring" online communities. (NOOCs). (Dwyer & Hiltz, 2004). These communities tend to attract a collective group of individuals who are passionate about a given subject area of particular significance in a geographic location or of international or global dimensions. Recruitment to the community is targeted and strictly controlled and the agenda is clearly communicated at the recruitment stage. Those who wish to become a part of an online research community have to become a member via a specific site.

Online research communities can also act as an information system where members can post, comment on discussions, provide expert advice and or collaborate with each other on given topic or issue of interest. Online communities have become popular means for researchers and scholars to interact, collaborate and network with each other in a virtual platform. The most common forms of communication in an online setting are chat rooms, forums, e-mail lists or discussion boards. (Brandtzæg & Heim, 2008). Individuals also join online communities through video games, blogs and virtual worlds. In sum, online research communities are virtual communities whose members engage in meaningful and significant research and scholarly interaction and engagement via the Internet or virtual spaces. (Paragas, & Dela Cruz, 2014).

Baym (2007) suggests that online groups are taking new forms as participants spread themselves amongst multiple Internet and offline platforms distributing themselves throughout a variety of sites in a quasi-coherent networked fashion. (Baym, 2007). She notes that this new form of distributed community poses particular problems for its members, developers, and analysts and identifies several implications for theorists, researchers, developers, industry and independent professionals. (Baym, 2007). There are inevitably issues that can be addressed such as the validity of research findings generated by participants in the community (Stafford and Gonier, 2007) and issues related with the consequential maintenance of such communities (Comley, 2008).

Emerging technologies (ET) as distinguished from conventional technologies (CT) is a field of technology that broaches new territory in some significant way, with new technological developments. (Soares, 1997).Some examples of current emerging technologies include educational technology, information technology, nanotechnology, biotechnology, cognitive science, robotics, and artificial intelligence (Soares, 1997). Emerging technologies are those technical innovations which represent progressive developments within a field for competitive advantage. (Soares, 1997).

The use of emerging technologies in higher educational institutions is providing unique opportunities for students, administrators and faculty to use local strengths and specializations on a broader scale. For example, the use of social media interfaces through computer and mobile devices has become widespread among universities and colleges with, the two most prominent cited interfaces; Facebook and Twitter. (Siefert, 2013).

Facebook allows users to create profiles and consequently allows those user-operated profiles to interact with each other. It also allows the expression of interests and the discovery of commonalities between users and allows users to build and maintain connections and invite others to join a community. In contrast, Twitter is a social media interface that enables users to share a limited amount of user-generated content, quickly and easily, to an extensive number of other users. (Gesser, 2013).

Several research have investigated how scholars and researchers are using emerging technologies such as social media tools to further research activities giving insight into the kinds of activities that emerging technologies might reflect. (Nolan. 2013, Siefert, 2013, Seaman & Tinti-Cane, 2013, Gesser, 2013).

Nolan (2013) for example noted that academics can no longer afford to ignore social media as it is an increasingly important vehicle for institutions to continuously build relationships and constituencies. Seifert (2013) describes how the School of Advanced Study at the University of London is using social media channels to increase awareness and engagement about the impact of individual research projects.

The New Media Consortium (NMC) *Horizon Report:2014 Higher Education Edition* is part of a comprehensive research venture established in 2002 that identifies and describes for educational leaders, policy makers, and faculty, emerging technologies likely to have a large impact on teaching, learning, creative inquiry and research around the globe in the upcoming five years. (NMC *Horizon Report*, 2014). In 2014, the NMC project team identified six emerging technologies or trends that will impact higher education institutions (HEIs) over the next five years. According to the NMC *Horizon Report 2014*, social media is among the top emerging technologies that will influence teaching, learning, creative inquiry and research in the next twelve months and is one of the top two trends that stand out as unique opportunities for vision and leadership. (NMC *Horizon Report*, 2014 p.6). Furthermore, according to the report, social media, already very well established in the consumer and entertainment sectors, is rapidly integrating into every aspect of university life; with its maximum impact expected to manifest within the next year. (NMC *Horizon Report*, 2014 p.6). The report mentioned that for example, in the Faculty Thought Leadership Series, developed by the University of Hawaii Professional Assembly, faculty across several campuses convened to re-envision the future of the higher education teaching profession, with social media as a major component. (NMC *Horizon Report*, 2014 p.6). Recordings of the meetings were broadcast on YouTube and anyone could join the real-time discussions through Twitter. Other examples abound in which social media is being used by decision-makers to engage with stakeholders in new and highly cost effective ways. (NMC *Horizon Report*, 2014 p.7).

Social network sites have become, for most of us, part of our daily routines. Consequently, individuals find themselves in a network of friends that bypasses offline contexts, mixing contacts from different realms of life (Stutzman & Hartzog, 2012).Social Networking Sites (SNSs) are characterized by three distinctive features. First, they allow individuals to create a profile within a web-based system to define their visual presence. Second, members can add connections with other members, creating a list of meaningful associations. Finally, users are able to navigate through such associations to access a wider network (Boyd & Ellison, 2007). Offering a full range of features, SNSs incorporate aspects of the social, leisure, and informational services that Hamburger and Ben-Artzi (2000) once used to define the Internet, and have revolutionized the manner in which individuals communicate and maintain social networks.

The Project

Higher education institutions in the Tennessee Board of Regents system have a unique window of opportunity to integrate and leverage the current tide of emerging technologies and online communities in profound ways. Emerging technologies and online communities can be integrated effectively into the core and fabric of current instructional practices, research, creative inquiries and innovation that occurs at TBR institutions in the State of Tennessee. Currently, there are no online research networks that connect TBR's scholars, faculty and researchers in broad scale research initiatives state-wide. The creation of TBR's Critical Conversations Network (TBR-CCRN) responds to that need. The creation of TBR's Critical Conversations Network (TBR-CCRN) is a part of the broader initiative on Critical Conversations for Jobs and the Economy undertaken by TBR's office of Academic affairs. It is also a strategic response to the need to connect faculty and students from all TBR institutions to share, engage, network and collaborate in critical conversations regarding research across the state. A goal of TBRs- CCRN is to advance research throughout TBR institutions and the State, on specific scholarly topics. TBR's CCN will consist of several thematic and sub -research collaborative groups that focus on macro-majors in the TBR system as designed by Vice Chancellor, Tristen Denley. Thematic or macro-major research networks would consist of temporary collaborative groups of scholars, researchers and faculty networking, sharing and disseminating pertinent research information in their respective fields and working on a specific research topics primarily through virtual communications at TBR's-CCRN. TBR's -CCRN participants will comprise of faculty researchers, administrative staff who are also active researchers and scholars from across TBR institutions in the State of Tennessee. TBR's–CCRN participants will synthesize knowledge, examine the state of research, and stimulate collaborations or otherwise identify promising directions in research areas of significance research for economic and workforce development in Tennessee. Priority products for the research network include substantive reports that integrate the state of the knowledge in Tennessee and set forth promising research directions.

Goals of the Tennessee Board of Regents Critical Conversations Research Network

The goals of TBR's–CCRN are to:

1. Connect TBR's research Faculty, scholars across the state of Tennessee and encourage them to engage, network and collaborate in critical conversations regarding pertinent research and findings.
2. Maintain a proactive and sustainable research network that connects talented scholars and researchers across TBR institutions utilizing virtual communication tools and social networking platforms
3. Connect and engage researchers, legislators and decision makers to engage, network and collaborate in critical conversations that inform decision-making across the state

4. Demonstrate the practical implications of research for economic and workforce development and to help policymakers make decisions.
5. Address empirical questions that will increase the understanding of fundamental educational, scientific, technological and social issues that will yield significant improvements in policy and practice.
6. Showcase the practical implications of research for economic and workforce development and to help policymakers make decisions
7. Supports interdisciplinary research approaches and initiatives on topics related primarily to Health sciences, Education, STEM, Social sciences, Humanities, Business, and the Arts.

Project Concept

Professor Mike Thelwall in his contribution to the Research Trends Newsletter 2014 on "*A Brief History of Altmetrics*" noted:

"No one can read everything. We rely on filters to make sense of scholarly literature, but the most traditional filters are being swamped. The growth of new online scholarly tools allows us to make new filters. These altmetrics reflect the broad, rapid impact of scholarship in this burgeoning ecosystem. We call for more tools and research based on altmetrics." (Thelwall, 2014). Traditional research is at crossroads for institutions of higher education and educational boards statewide and nationally. Figure 1 below vividly demonstrates and outlines some aspects of transition and change that is occurring in the field of research .

Market research companies have used online polls for several years to collect quantitative data but the development of online research community tools such as discussion forums, blogs or social networks to collect data are a more recent but rapidly expanding phenomena (Harmon, 2005). With the introduction of online research communities and the infusion and integration of emerging technologies, opportunities abound to move the current state of research across TBR institutions to a more dynamic synergistic and inclusiveness making adequate and effective use of emerging technologies.

TBR's prototype CCRN design concept focuses on the development, utilization and diffusion of emerging technologies into new application areas such as online research networks. TBR's prototype CCRN concept is based on the opportunity model that facilitates the transition from the current status quo of traditional research methods to a new dynamic platform of engagement and collective *research capital*. TBR's prototype CCRN was developed utilizing the NING software and a concept map adopted from the Fulbright Minds Social Entrepreneurship online research community. With over 2 million communities created to date, Ning is the world's largest SaaS platform for deploying vibrant social communities and web sites. Founded by Marc Andreessen and Gina Bianchini in 2004, Ning was acquired by Mode Media Corporation (formerly Glam Media, Inc.) in December 2011 to bring together Ning's world-class social-native technology to help consumers and brands create and engage with passionate social communities across all digital mediums. (Ning, 2014). Ning's unique online communities features and tools includes publishing tools, community features, social integration, smartphone and tablet–ready platforms, custom design and URL and privacy moderation controls. (Ning, 2014).

In the concept development phase, I chose to use Salmon's 5 Stage Model for e-moderation as a mechanism for conceptualizing the process of the design as it allows me to consider the role of participants and moderators in the proposed prototype research network (Salmon, 2004). Whilst this model was developed with learning communities in mind, it has since been used in a number of other ways to structure online communication processes (Lynch, Heinze, and Scott, 2009) and offers practical advice on the use of online communication (Chowcat, 2005; Moule, 2007). Figure 2 below, illustrates Salmon's (2004) 5-Stage Model for e-moderation.

This model of online community building and facilitation describes a five-stage process mapping the different stages of engaging participants using online communication technology. In the figure demonstrating the model, the level of engagement is indicated by the interactivity column (far right hand side) and the darkness of the color. Engagement starts from stage 1 "Access and motivation" and progresses up to stage 5 "Development." Each of the stages is subdivided into two triangles representing the roles of the e-moderator and the technical support staff. These roles vary at each stage.

The first stage of the 5 Stage Model is concerned with accessing the system, when participants are issued with access information by the technical support and welcomed

Figure 1
Research at Crossroads
Image Adapted from TBR's 2014 Maxine Smith Fellowship Presentation By Dr. Jasmine Renner On:
"Engaging Tbr Faculty In Online Research Communities And Emerging Technologies."

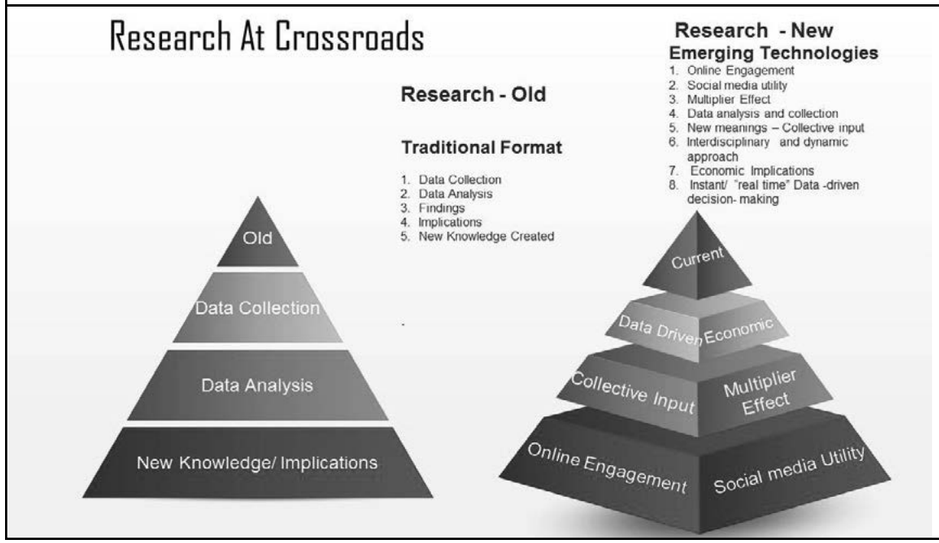
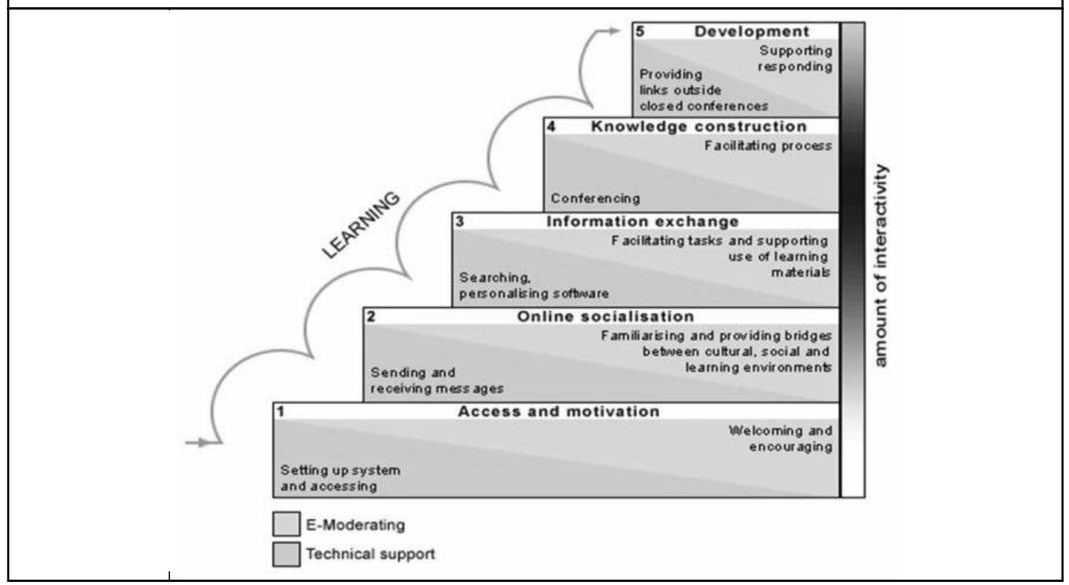


Figure 2
Adapted from Salmon's 5 Stage Model for e-moderation
(© Copyright 2004, All Rights Reserved.
Permission obtained from author for reproduction and use for educational purposes.)



by the e-moderator. The second stage focuses on online socialization of the participants in the community; they are encourage to familiarize themselves with the environment and socialize with others. The information exchange stage puts more emphasis on interaction and engages participants with the materials. The final two stages are where the participants should already be familiar with their environment and thus are able to proceed with knowledge construction and development.

TBR's Critical Conversation Research Network–Nodes

Organization–The prototype CCRN will utilize and mirror Vice Chancellor Tristen Denley designation and categorization of macro-majors utilized across TBR's institutions. This allows for effective management of research capital and information and provides a deliberate strategic and systematic filter for organizing research information across fields for TBR institutions in the State of Tennessee. The list below provides a cursory categorization of macro-majors as designated by Vice Chancellor Tristen Denley.

Macro-major categories as outlined in by Vice Chancellor Tristen Denley.

The prototype nodes in the research network mirror the macro-majors categorization above and will serve as an organizational and practical tool for channeling the various kinds of research and scholarly activities that will be generated in the network. Scholars, researcher and faculty will be encouraged to participate, network and engage in the various sub- thematic collaborative groups to harness, leverage and disseminate important and pertinent research that informs policy – and data informed decision-making.

Project Focus

The proposed TBR-CCRN will be the first within the Tennessee Board of Regents system. TBR's -CCRN participants will comprise of scholars, faculty, researchers from across TBR institutions in the State of Tennessee. The project focused on designing a "prototype research network" that connects researchers and scholars across TBR institutions in meaningful research engagements.

Activities that will be undertaken by the proposed TBR's CCRN are:

Online Research Engagement

Relationships are the life blood of meaningful online communities and interaction. Participants of online communities often share information about themselves, find out what their peers are doing, , think about topics of exchange, disseminate vital information and exchanges resources and messages. TBR's prototype CCRN will facilitate the engagement of TBR researchers, scholars and faculty in online research communities and virtual groups and circles to collaborate, network, disseminate and co-create new information from an inter and multi-disciplinary perspectives. This online research experience will augment already established relationships, while providing spaces for individuals who are separated by physical distance or other barriers to connect with each other. A study conducted by the University of Massachusetts Darmouth found that 100 % of surveyed universities and colleges use social media for some purpose. Faculty cited the inclusion od videos and blogs as among the most common applications of social media for instruction. Another survey by the Bobson research group and Pearson revealed that 70.3% of faculty use social media in their personal lives and 55%use these networks specifically in professional contexts. (NMC *Horizon Report*, 2014 p.9).

Dissemination of Pertinent Research Products and Findings– Broader Platform in "real-time"

Research paradigms are shifting to include more online communities and emerging technological tools. Scholars, researchers and faculty spend some of their professional development time on the internet, exchanging new information, networking with peers and colleagues, learning new facts and most importantly disseminating information of their research through submission to peer reviewed journals and publishers. TBR's prototype CCRN will inject a "game changer" into this model by promoting the art of dissemination of pertinent research findings in "real time. " In addition the opportunity for 24/7 access to important information, data and findings is revolutionary. Online research communities amplify the potential for rich collaboration and instant access and dissemination of important and pertinent research findings.

Informing Data- Driven Decision-Making

Data has been measured, collected and analyzed in the consumer sector since the early 1990s to inform companies about customer behaviors and preferences. There is a growing interest in using new sources of data for personalizing the research experience and for performance measurement. As scholars and researchers participate in online activities, they leave an increasingly clear trail of analytics data that can be mined for insights. Learning analytics experiments and demonstration projects are currently examining ways to use data to modify learning strategies and processes. A recent trend in research has sought to employ analytics to improve teaching and learning. As students and faculty generate more data, there is a growing interest in developing tools and algorithms for revealing patterns inherent in those data and then applying them to the improvement of instructional systems. This in turn will have the practical effect of informing data-driven decision making on pertinent issues of practical, policy and political implications in the State of Tennessee.

Emerging Technologies–The Multiplier Effect

Today's web users are prolific creators of content. For educational institutions, social media enables two-way dialogues between students, prospective students, educators and the institution that are less formal than with other media. As social networks continue to flourish, educators are using them to as professional communities of practice as learning communities and as a platform to share interesting topics and research findings. Social media is changing the way people interact, present ideas and information and judge the quality of content and contributions. Educators, student, alumni and the general public routinely use social media to share news about scientific and other developments. The impact of these changes in scholarly communication is significant. TBR's prototype CCRN seeks to effectively utilize emerging technologies such as social media tools to harness collective research information gathering, and dissemination and facilitate accessibility to that information in "real time." Understanding how social media can be leveraged for pertinent research findings is a skill increasingly expected of our researchers and scholars.

Social Media Tools and TBR's-CCRN

Figure 3 below provides a visual screen shot of a pro-type o proposed social media tools and groups that can be utilized in the network. Please note the images depicted are purely for academic demonstration purposes with final

Figure 3
Prototype TBR- CCRN Social Media Sites
(For Illustrative Purposes Only)

images to be determined and approved by the required TB authority during the actual development phase of the network.

Project Impact

The anticipated impact of TBR's CCRN is categorized into three domains namely; the Individual, Institutional and State Level. I utilized a Funnel Analysis to depict the various potential impact the proposed CCRN may have on three distinct levels namely the Individual, Institutional and State Level.

What is a Funnel Analysis?

Funnel analysis involves using a series of events that lead towards a defined goal-from for example from user engagement in a mobile app to a sale in an eCommerce platform. A funnel is a well-defined flow on your website such as (the checkout process, registration, and lead generation) where users take a series of actions before reaching some sort of goal. The funnel analyses are an effective way to calculate conversion rates on specific user behaviors." (cite)

The first step in a funnel analysis is to find where these funnels occur. To analyze where funnels occur, there is a need to analyze two components. 1) the current conversion rates of a particular page. The conversion rate is what percentage of users who hit the registration page are registering. 2) the current drop-off rates. At every stage in the funnel, there is an inherent potential to lose some people. But the funnels gauge and record impact of the proposed site. For example if your front page is entirely focused on getting people to try the demo, research has shown that you will likely lose at least half of your visitors before they make it to the next step.. Funnel analysis therefore helps designers to envisage impact of the proposed site (quantitatively) and to approach potential problems or challenges from the point of view of a user.

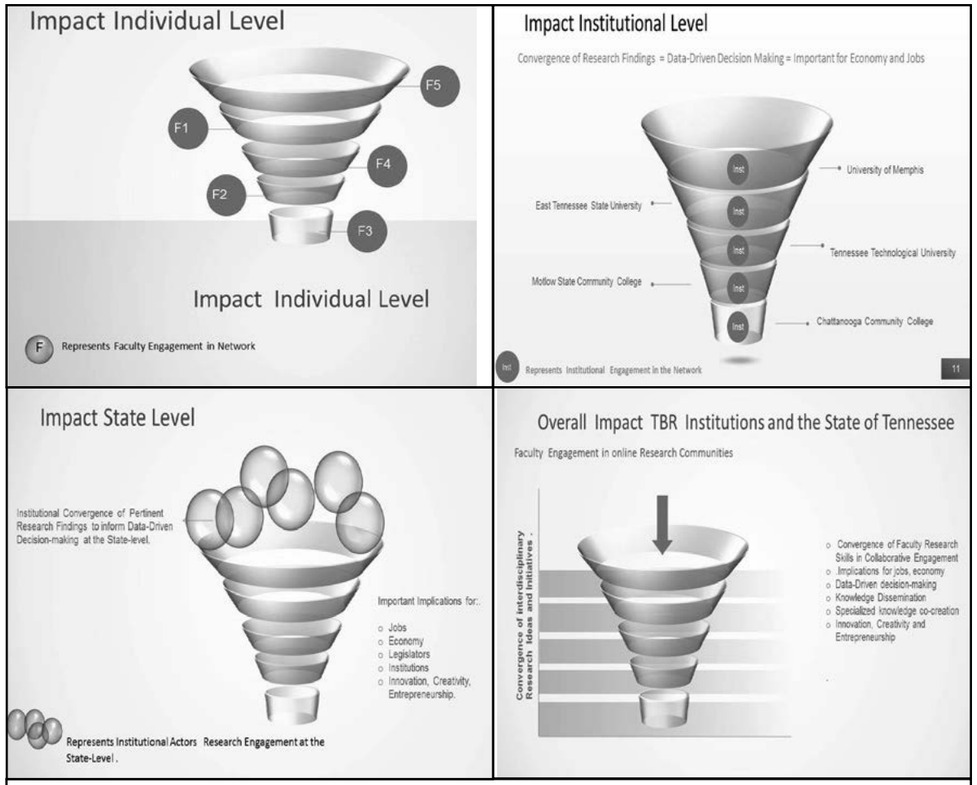
Figuring out funnels from a proposed online research network is one of the most important things that can be done to increase a quantitative understanding of the proposed network and website.

Find on the facing page, a visualization of how the funnel analysis process will impact TBR's –CCRN in four different dimensions

Conclusion

Success in the field of "research" requires an understanding that a number of significant principles of engagement have changed. In a hyper connected world, information flows much faster and more freely. Institutions of learning as a result are subjected to a growing level of collective intelligence and value creation from outside the university's walls brought about by the increased collaboration of faculty, administrators and students in what is now a much larger ecosystem of data. This has led to current research models that replace traditional models where individual production of research capital is giving way to more online and in certain respects, collective peer production. Community based networks are becoming more prevalent than management hierarchies; where free real time global data flows are replacing traditional data collection. Therefore the generation of valuable research capital will be made possible by the generation of scholarly works created through the collaboration of researchers and scholars in the networked economy.

Online research communities are a part and parcel of this growing and potent networked economy. Online communities are powered by social power structures such as open source, crowdsourcing, specialized and thematic communities, that are proving to be more effective and efficient. William Gibson in his key note address at the O'Reilly Emerging Technology Conference; *The Shape of Things to Come* said: "The future is here, it's just not widely distributed. The shape of things to come is already implicit in a thousand small clues. Then, in a sudden shift of mindset, it becomes obvious to everyone." (Gibson, 2008).



Images adapted from TBR's 2014 Maxine Smith Fellowship presentation by Dr. Jasmine Renner on: "Engaging TBR Faculty in Online Research Communities and Emerging Technologies."

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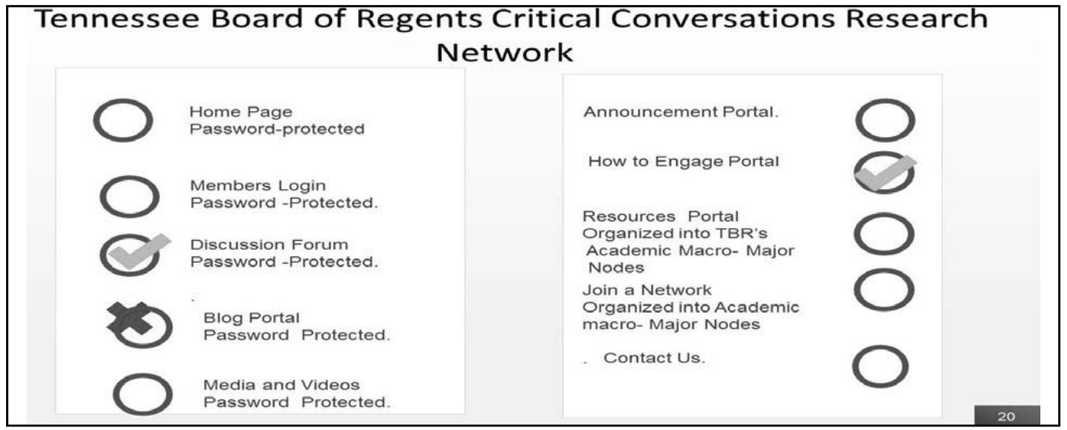
Appendix 1
TBR- CCR N's Organization and Categorization



Appendix 2
TBR's- CCRN- Landing Page. Password protected

Appendix 3
TBR's- CCRN- Login Page. Password protected

Appendix 4
TBR's- CCRN- Announcement Page

APPENDIX 5
TBR's- CCRN- FAQ PAGE

APPENDIX 6
TBR's- CCRN- DISCUSSION PAGE

APPENDIX 7
TBR's- CCRN- RESOURCES PAGE

Incorporating an Honor Code into an Information Assurance Program

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ABSTRACT

Plagiarism and cheating is on the increase around the world. Academic misconduct hurts the student committing the offense, other students who know about the offense, the faculty, and the academic reputation of the school where the misconduct occurs [1]. One of the steps that a school can take to fight academic misconduct is to incorporate an honor code and its' values into their programs. The faculty teaching in ABC College's (pseudonym) Information Assurance program initiated a college-wide implementation of a simple honor code. This article presents best practices from a variety of schools, and hopefully begins a dialog on what can be done to eliminate or minimize academic misconduct from the Information Assurance educational system.

Introduction to the problem

Academic misconduct in all forms is increasing in higher education. Cheating is becoming more common in universities and Information Assurance programs are not immune from this plague of academic misconduct. Cheating consumes faculty time and can damage a school's academic reputation and destroy student morale.

A department chair/faculty member at ABC College (pseudonym) added up the number of hours spent addressing a single instance of academic misconduct. An IA student was found plagiarizing in a class. The student's work in his other three classes was examined and it was determined that plagiarism had been committed in the other three classes. The college's academic discipline process was followed and the student was expelled. The student appealed the expulsion and was reinstated into all classes until the appeal process was exhausted. After all appeals were filed and meetings held the student's expulsion was upheld. At the end of the process, all four faculty members, the Director of the Information Assurance Center, the Chair of the Information Assurance department, the director of Online Learning, the Vice President of Academic Affairs, the Associate Director of International Students, and the Chief Academic Officer had spent time in meetings with each other or the student. The cost to the college was easily several hundred man-hours and tens of thousands dollars.

To minimize or prevent this waste of resources, a faculty member recognized that the college needed to have an honor code. Discussions with colleagues within the IA department and college officers revealed their support of an honor code. The first problem encountered was the realization that any honor code adopted had to adopted by the entire college. This expansion of scope required a lot of changes to the original plans and paradigms. The project instantly became much larger and much more difficult with many more stakeholders than originally thought.

The faculty member was willing to advocate for an honor code to help the college with accreditation. The college has been designated as a Center of Academic Excellence in Information Assurance education by the National Security Agency. One of the requirements to maintain this accreditation is to practice sound security policies internally and implementing an honor code would demonstrate the college's commitment to academic integrity.

Honor Codes in Education

An academic honor code encourages ethical behavior, and requires students to commit to the values of honesty and personal integrity [1]. Honor codes place responsibility on the students and their fellow students to maintain academic standards and to provide a level academic playing field for all students. For example, the U.S. Military Academy's honor code clearly states, "A cadet will not lie, cheat, steal, or tolerate those who do" [2]. Students at the Academy are given a copy of the code on a laminated card that they are asked to carry with them at all times [3]. This card serves a reminder which is necessary because in a study, 40% of university students felt that they should whistle-blow on their fellow students but only 13% said they would actually do it [4]. Turner and Beemsterboer [1] propose that an honor code must contain the following elements:

1. A statement of the values upheld by the code and school
2. A list of the academic violations and the categories of unacceptable behavior
3. A list of the potential consequences and punishments for violations
4. A description of the group that will be investigating and making any decisions based on the outcomes of the investigation
5. A description of the investigation and decision making processes
6. A statement promising confidentiality of the investigative process and the outcomes of the investigation and decision making process
7. A statement promising that records will be kept of the process
8. A statement promising a decision within a stated period of time
9. An appeals process for students to appeal their punishment

The problem of academic misconduct is not limited to students. Faculty members commit plagiarism from their own work and the work of others [5]. Schools and academic journals have often downplayed plagiarism by faculty to avoid embarrassment and damage to their reputation and brand image [5; 6]. It is important that faculty serve as role models for academic integrity to their students and the learning environment [7].

Online Pedagogy

Academic misconduct in online programs may be higher than in on-ground programs as people cheat more when they feel disconnected from their faculty [8]. Many IA programs are completely online and allow students to do everything from application to graduation without ever setting foot on a campus. Online pedagogy must take the nature of the online environment into consideration. Implementing an honor code into an Information Assurance program that is totally online and at a school that offers several online degree programs and approximately half of its course sections online must take that into consideration in developing an honor code implementation plan.

The Approval Process at ABC College

Once the decision was made to pursue implementing an honor code, the faculty member made a presentation to the department chairs and program directors. The presentation included a memo that outlined a proposed implementation plan and a copy of a mocked up poster for the honor code that every full time faculty member would sign. The response to the honor code and the poster was favorable at this level. The proposed honor code was modeled after the West Point honor code and kept as simple as possible. The wording of the proposed honor code was "A ABC student will not lie, cheat, steal, or tolerate those who do"

The next step was to present the proposed honor code and implementation plan at the next academic department meeting. The academic department meetings are attended by all fulltime faculty members and representatives from the Assessment Office, the Office of Online Learning, Scheduling, and Administrative Support. The initial response was again favorable as many of the faulty felt that we needed to do something to address the problem. A committee of three faculty members was formed to develop an implementation proposal for the honor code. The committee developed an initial project plan, budget, marketing plan, and collected feedback from a variety of people in the academic community. The three member committee came back to a subsequent meeting of the academic department and requested that the faculty vote to approve the honor code.

The faculty voted against adopting the initial honor code because of the phrase "or tolerate those who do" at the end of the honor code. Several senior faculty members felt that it would be too difficult and expensive to enforce that clause of the honor code. Not having an honor code was preferable to having a non-enforced honor code. The rejection only delayed the process by about four months while the advocate drafted a revised honor code that would avoid the problematic phrase.

The honor code wording was revised to "The ABC academic community will maintain the highest ethical standards in our quest for academic excellence. We will not lie, cheat, steal, or claim credit for the ideas and work of others. We commit to respecting the intellectual property of others and will always acknowledge the authorship of intellectual property in all forms." This wording was approved by the full faculty and the project moved forward.

The revised honor code was sent to the college officers for approval. The officers were pleased with the honor code and approval was received from every officer within two weeks of sending them the honor code.

The Implementation Process at ABC College

The college moved quickly to implement the honor code. The Chief Academic Officer pointed out that the Higher Learning Commission likes to see an honor code but they need to see it publicized across the school at every opportunity. The champion for the honor code made arrangements to get this publicity done in as short amount of time as possible.

The first step was getting the new honor code incorporated into all of the syllabi at the school. The Director of Online Learning made the necessary steps to include the honor code in all of syllabi in the online course tool. Hard copies of the honor code were distributed at a faculty development event to the faculty and copies were also provided to all faculty members to hand out to their students at the start of the fall semester. The faculty members were asked to put the honor code in all future syllabi that they developed.

The honor code was incorporated into the school Website within a month of launching the honor code. Care was taken to make certain the honor code was placed in the appropriate pages on the Website. The implementation went much faster and smoother than initially expected. The school's administration, faculty, and staff seemed eager to place the honor code into use and the project received immediate cooperation at every turn. The implementation timetable is summarized in Table 1.

Some of the proposed implementation ideas were not accepted. For example, the college opted not to issue a press release about the adoption. The college also opted not to place the honor code on the back of the student identification cards. The college has always printed the mission statement on the back of the cards and adding the honor code would have placed a lot of text on the card and forced the use of a small font that would make reading either the code or the mission statement difficult.

Students coming into a school with an honor code must be informed of the honor code and be aware of the potential consequences. The admissions department worked on ways to incorporate the honor code into the new student orientation and enrollment materials. The students, faculty, and staff accepted that the honor code would be enforced and would remain in effect.

Conclusions

Stopping academic misconduct is not a simple task. There is no silver bullet or single solution. Implementing an honor code is one part of a larger solution. ABC College feels that the honor code was a necessary and effective step in slowing academic misconduct. Applying the honor code to faculty, staff, and students set a high standard for the conduct of everyone in the coming years.

What worked at ABC College may not work in your educational community. Different schools have different cultures, policies and faculty values. School culture played a large role in the ABC implementation and will no doubt play a large role at other schools. Each school must decide whether using an honor code to draw a line in the sand is what they want to do.

Table 1
Implementation Timetable

Task	Completion Month
Submission of the first version of the honor code to the chairs and program directors	March
Committee formed to draft an implementation plan	March
Submission of the first version of the honor code to the full time faculty members	March
Rewriting the honor code to a version that was acceptable to the faculty	July
Submission of the second version to the full time faculty members	August
Officer approval of the second version of the honor code	September
Inclusion in the catalog	September
Inclusion in every online syllabus	September
Printed copies of the honor code given to faculty for distribution to all on-ground students	September
Copies of the honor code distributed to all faculty at faculty development day for inclusion in future syllabi	September
Inclusion in the school Website	October

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Teaching Environmental Ethics: Moral Considerations and Legislative Action

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ABSTRACT

As one of the first business ethics textbook states, by way of observation, "Custom, convention and the accepted courtesies of a society are not the foundation of ethics even though they provide valuable hints as to what men think...Law enshrines many of the ethical judgments of a society, but it is not coextensive with ethics" (Garrett, 1966, p. 1). Therefore, "changes in the law tend to reflect changes in what a society takes to be right and wrong..." (Shaw, 2008, p. 11).

We think Garrett and Shaw are correct; thus, we work to have our students understand that ethics differs from legal codes but that ethics drives the law. These two points can effectively be shown with regard to environmental ethics. We offer a model that can help students see the relationship between law and ethics. First, we briefly explore the development of environmental ethics and highlight the broader ethical considerations related to the environment. Then, we trace the legal history that followed philosophical analysis.

Introduction

As one of the first business ethics textbook states, by way of observation, "Custom, convention and the accepted courtesies of a society are not the foundation of ethics even though they provide valuable hints as to what men think...Law enshrines many of the ethical judgments of a society, but it is not coextensive with ethics" (Garrett, 1966, p. 1). Therefore, "changes in the law tend to reflect changes in what a society takes to be right and wrong..." (Shaw, 2008, p. 11).

We think Garrett and Shaw are correct; thus, we work to have our students understand that ethics differs from legal codes but that ethics drives the law. These two points can effectively be shown with regard to environmental ethics. We offer a model that can help students see the relationship between law and ethics. First, we briefly explore the development of environmental ethics and highlight the broader ethical considerations related to the environment. Then, we trace the legal history that followed philosophical analysis.

Environmental Ethics: Rights, Justice, Utility, And Care

Environmental concerns have been with us since the 1960s, originating in large measure from two important publications. When Rachel Carson's Silent Spring appeared in 1962, people were introduced to biological degradation and ecological analysis. As well, the book had emotional impact—who wants to lose bluebirds, a symbol of happiness?

Later in the decade, Garrett Hardin's famous essay, "The Tragedy of the Commons," provided more grist to the ecological mill. His 1968 article, appearing in the widely circulated journal, Science, alerted the world that unless patterns of behavior changed, "Ruin is the destination toward which all men rush" (1244).

Within a short while, ethicists and legislators alike developed responses. Google scholar loosely catalogs 2,730 books and articles between 1900 and 1959 under "books and articles on environmental ethics." Between 1960 and 1969, 2,340 are listed; between 1970 and 1979, 8,280 are

listed, and between 1980 and 1989, that number doubled, with 16,200 items listed. Business ethics textbooks mirrored the interest in environmental ethics. Thomas Garrett's ground-breaking textbook, *Business Ethics* (1966), had no listing in its index for "environmental ethics." On the other hand, Manuel Velasquez's equally groundbreaking, 1982 business ethics textbook, *Business Ethics-Concepts and Cases*, had a whole chapter dedicated to environmental ethics. Legislators were not far behind, as we will see later.

While ethicists are today parsing out finer, narrower problems, the original work by ethicists used basic ethical concepts to establish the backbone of environmental ethics. Textbooks in applied ethics, including business ethics textbooks, such as Shaw's (2008) and Velasquez's (2011), focus on some combination of the ethical considerations of rights, justice, utility, and care, and focus on the two problems Hardin (1968) identified: resource depletion and pollution. Thus, our students learn that environmental ethics is the application of rights, justice, utility, and care to the twin problems of pollution and resource depletion. Hardin (1968) suggested that people act as though resources were unlimited, free goods whose use came without cost. The result is wasteful consumption and environmental degradation. He also observed that people did not and do not take responsibility for the environment because they think that "I am only polluting a little bit when I drive my car. Don't blame me." This form of thought, the relative contribution rationalization (RCR), is meant to remove responsibility from a person to change his or her lifestyle in order to accommodate the natural world.

If a person were to embrace the RCR, what sort of ethical arguments might be offered to justify changing that irresponsible attitude? Or, phrasing the question differently, how can protection of the environment and environmental ethics be justified? The ethical standards of rights, justice, utility, and care serve as the basis for understanding appropriate behavior.

The consideration of environmental rights, articulated by Blackstone (1973), would protect individuals from the injurious effects of pollution and resource depletion. In its simplest form, the argument using negative rights states that pollution violates a person's right to health. Pollution injures people and the right to health protects people from unwarranted and uninvited intrusion.

However, pollution already exists. There are toxic waste sites and Superfund cleanup sites. Damage to the environment has already occurred, with the consequent, probable damage to future inhabitants of the nearby areas. Young children have not created the toxic sites, yet those children have a right to health, requiring a clean and safe environment. Hence, the current, older population must take action to protect the rights of young people. In other words, children are positive right holders and the older population are the duty bearers for removing the harmful toxins.

The argument about positive rights extends itself to considerations of justice. Young children and young adults have not lived long enough to affect the environment negatively. They have not consumed very many resources, nor have they lived long enough to pollute the earth. Nonetheless, the burden of pollution and resource depletion will fall on them, either by way of harming them or by way of assuming the responsibility for restoring the environment. In short, young people have a burden without a benefit, which is a violation of capitalist justice, where benefits are distributed roughly proportionally to the burdens assumed and contributions made to society.

The capitalist notion of justice appears to be violated when the undeserved burdens of environmental degradation are placed on young people. The same notion of justice can be applied to businesses which pollute. If all the costs of production, including environmental costs, are not reflected in the price of some good, then the producer is receiving undeserved benefits while the population at large receives undeserved burdens. For instance, the burden of air pollution could be borne by those who are warned not to leave the house during an ozone alert. While the polluting company or companies enjoy the benefits of selling their products, those with breathing difficulties suffer the hardship and restriction of confinement indoors.

Further, as Freeman, Haveman, and Kneese (1973) argue, the negative effects of pollution fall unevenly in the population. That is, the burden of pollution is felt by certain groups more than others. Freeman et al. (1973) show that the effects of pollution fall inordinately on the poor and minorities in particular. The inequitable distribution of negative environmental consequences is unjust. The poor have a lower quality of life compared to the affluent.

But then, all people have a lower quality of life due to pollution and resource depletion. As such, pollution violates the demands of the utilitarian principle, namely, to maximize desired satisfaction, taking into account all affected parties, all possible policies and actions, and all foreseeable effects. Given the history of production, i.e., that "externalities" have not been adequately taken into account, the utilitarian arguments for free markets and mass production lose force since resources have not been allocated efficiently. Further, if producers do not have to account for externalities, then waste of resources will occur were an item to be overproduced. Also, there would be no incentive to minimize or even reduce pollution during the production process. Were externalities accounted for, producers would likely take action to lower their costs and thus serve environmental ends simultaneously. The greater efficiency is consistent with the utilitarian principle.

Not only would the current generation have some gain, but especially future generations. While it is difficult to argue for the rights of non-existent human beings, as Feinberg (1981) argued, it is easy to argue that future inhabitants of this earth must be considered when environmental policy is drafted or enacted. The roots of this idea can be found in Albert Schweitzer's 1915 grasping of his first principle, reverence for life: "The man who has become a thinking being feels a compulsion to give every will-to-live the same reverence for life that he give his own. He experiences that other life in his own." (Schweitzer, p. 131). For one thing, future generations are vulnerable and dependent upon the generations preceding them. The ethic of care calls for protecting those who are vulnerable and dependent. Another argument for remembering future generations in policy decisions derives from John Rawls (1971). In his famous original position, where people know nothing of their individual identities, people would not know in what generation they are. Rational and self-interested people, coming together to form a society and ignorant of their generational status, "in effect, then, ...must choose a just savings principle that assigns an appropriate rate of accumulation to each level in advance" (Rawls, 1971, p. 287). Participants in the formation of society, not knowing when they might occupy a land, would ensure resources awaiting them.

Other arguments can be drawn from the notion of care, and strong environmentalists have done precisely that. People like Peter Singer (1975) and Tom Reagan (1983) have argued that animals have moral status. Some argue that the moral status of animals is equal to that of human beings – and anyone who disregards that equality is guilty of speciesism (Singer, 1975). Others treat moral status on a sliding scale or a continuum and while ranking animals as less deserving of full moral status, they argue that animals do deserve the respect associated with rights. For instance, while a dog has less moral status than a human being and can expect less respect in terms of rights, a dog ought not be kicked and beaten. Even a moderately favorable position on animal rights is sufficient to generate concern for the environment.

Finally—and despite a lack of literature on the notion—aesthetic rights may exist. A cursory glance at the mission statements of many conservation groups points to that sort of right. Many conservation groups suggest that people have a right to a pretty, i.e., aesthetically pleasing, environment. For example, the Sierra Club wants people to "enjoy the planet." The establishment of national parks by many presidential administrations in the United States appears to be guided by this little grounded and somewhat unexplored right. The spectacular sights of Yellowstone and the Grand Canyon, so this line of thought holds, must be preserved in perpetuity for the enjoyment of future generations, who have a right to see such sights. In addition, allowing visitors inexpensive access to the national parks inspires the populace to better citizenry. Doremus (1999) suggested that the creation of the national park system reflected a national desire to "stimulate healthy contemplation and pure reflection, which in turn would regenerate spirits dulled by the constant labor of the ordinary citizen's life" (p. 441-442).

This last justification for environmental ethics, namely, aesthetic rights, has ethics and law entwined. The law has grown to embrace the environment, but the law itself falls prey to what Jacques Ellul observed: "all technical progress contains unforeseeable effects" (1962, p. 419). The upshot of Ellul's analysis of technical progress is that whatever policy is adopted or item produced, it should solve three problems because it will create two. Such may be the case with legislation regarding the environment. The law, driven by ethics and relying on a conceptual foundation drawn from applied philosophy, has to deal with the real world, such as free market arrangements, and its uncertainties.

An emphasis on ethics clarifies the goals and scope of environmental law and policy. Flournoy (2003) urges a more robust examination of the interplay between environmental ethics and law if we hope to achieve sound environmental policy: "If neither the public nor the decisionmakers articulate the ethical issues involved, we cannot ultimately know whether our laws and policies are consistent with our ethics" (p. 116).

Environmental Ethics and The Law

As Hardin (1968) observed, a reliance on market forces alone is insufficient to combat pollution and depletion of common resources like air and water. The market creates few incentives to conserve resources that are essentially free to the polluter. Legal commentators also recognize this problem. Grad (2014) states, "Air and water are regarded as free goods, and not being paid for, they are used prodigally in industrial production and in the production of power, and they suffer the adverse consequences of pollution and abuse" (p. 1-9). It is unsurprising, then, that regulation has stepped in and attempted to fill this void, representing an application of Hardin's solution to environmental problems: "mutual coercion mutually agreed upon" (Hardin, 1968, p. 1247).

The law's solution to the problem, however, has developed slowly. Federal regulation of pollution is a relatively recent

phenomenon—the Environmental Protection Agency ("EPA") was born in 1970 (Buck, 2006, p. 25). Historically, disputes about pollution were handled through the common law tort of nuisance. If a plaintiff can show that he or she has sustained property damage or personal injury as a result of pollution, the plaintiff can recover compensatory damages or, in some instances, obtain injunctive relief (Grad, 2014, p. 2-37). However, tort law is insufficient to address environmental harms that are diffuse and affect a large number of people—the standing doctrine makes it difficult for private individuals to pursue environmental damages suffered by the community at large. In addition, in the tort context, courts may be reluctant to grant injunctions to stop pollution if it appears that the benefits the polluter provides to the community are greater than the harm borne by the individual. Moreover, nuisance cases can be difficult to prove because the plaintiff has to overcome the hurdle of causation. Harm may be caused by a combination of pollution sources, which makes it difficult to determine which entity should bear financial responsibility for damages (Farber, 2014, p. 99). Perhaps the biggest shortcoming associated with nuisance law is that it is largely reactive—it does not prevent pollution from happening; it simply provides compensation once the damage has been done (Cole & Grossman, 2011, p. 398). The inadequacy of tort law as a mechanism for addressing pollution and resource depletion led to regulation at the Federal level.

The push for environmental regulation in the 1960s and 1970s was largely driven by ethics, and it focused on protecting two interests: public health and the aesthetic value of nature (Grad, 2014, p. 1-5). Commentators have noted that the bulk of the resulting environmental regulation reflects a utilitarian bent, applying cost-benefit analysis to determine how to maximize societal wellbeing through maintaining human health (Purdy, 2003, p. 877-878). Utilitarianism is appealing in the environmental regulatory context because it is largely quantitative: "well-being is rendered into dollar equivalents to produce a single bottom line combining all the beneficial and harmful effects of a decision that is under contemplation" (Purdy, 2003, p. 877). However, environmental laws also reflect a concern for human rights—limiting pollution protects the individual's right to be free from interference with his or her health and property interests (Flournoy, 2003, 85). In addition, laws that seek to place the burden of pollution on the polluter reflect the ethical consideration of distributive justice. Finally, the ethic of care, which focuses on the interconnectedness of humans and nature, appears in laws that preserve habitats and species (Velasquez, 2011).

Generally, the law employs several techniques to serve the ethical values discussed above. The current regulatory framework does not promise to end pollution or resource depletion; rather, it seeks to mitigate their effects by lowering pollution levels to a range that decreases the risk to human health (Grad, 2014, p. 1-9). For example, direct regulation sets forth standards for the amount of pollutants a party may discharge into the air and water. Similarly, many businesses must obtain permits before discharging wastes; thus, states attempt to prevent pollution before it happens (Reed, Pagnattaro, Cahoy, Shed, & Morehead, 2013, p. 619). Failure to comply with these standards can result in civil and criminal penalties. Additionally, regulators can try to influence the behavior of polluters by rewarding industries through tax credits when those industries use pollution control mechanisms, and "punishing" industries through special taxes when those industries create more than their fair share of pollutants (Farber, 2014, p. 96). Finally, regulators can create a market in pollution permits, which allows the state to set pollution standards while businesses are relatively free to allocate those permits according to market forces: "the government can create tradeable permits that firms can sell to each other. By limiting the total number of permits, the government 'caps' emissions, but the distribution of pollution rights between various emitters is left to the market rather than being decided by the government" (Farber, 2014, p. 97).

Specifically, the mechanisms for combating pollution and resource depletion are embodied in several pieces of legislation. Modern environmental regulation began in the 1970s with the enactment of the Clean Air Act and the creation of the EPA (Percival, 1997, p. 164). Under the Clean Air Act, the EPA is responsible for establishing national ambient air quality standards, and individual states are responsible for developing plans to meet those standards. The goal of these standards is to ensure that air quality does not pose a significant threat to public health (Reed et al., 2013, p. 616). Pollution of another significant aspect of the commons—water—is regulated by the Clean Water Act. The Clean Water Act directs the EPA to set industry specific standards for pollutant discharge into water; these standards are known as "effluent guidelines" (Jennings, 2012, p. 363). For point sources (industries that discharge directly into waterways), an EPA permit is required. The permitting process generally requires the discharger to comply with guidelines to pretreat the substance prior to its discharge (EPA, 2010).

Hazardous waste also poses an environmental threat. In 1980, Congress reacted to the Love Canal disaster with the enactment of the Comprehensive Environmental Response Compensation, and Liability Act ("CERCLA"). CERCLA, also known as "Superfund," gives the Federal government authority to clean up sites where leaking or spilled hazardous materials pose a danger to human health (Farber, 2014, p. 223). CERCLA creates a fund to pay for the costs associated with the cleanup. The fund is supported by taxes on polluters and compensation recovered from the entities responsible for the spill. During remediation, the EPA oversees the cleanup and then seeks reimbursement from potentially responsible parties ("PRPs") (Reed et al., 2013, 889). Under CERCLA, PRPs are subject to strict liability, and they can be held jointly and severally liable for the cleanup costs (Percival, 1997, p. 165). PRPs include the current owner or operator of the site—even if that owner was not in possession of the site at the time of the contamination; the owner or operator of the site at the time of the waste disposal; the generator of the waste; and the transporter of the waste (Clarkson, Miller & Cross, 2015, p. 889). Strict liability requires the imposition of liability without regard to the individual fault of the actors. Joint and several liability means that each PRP can be held responsible for the entire harm, and the EPA can choose to collect the entire amount due from any one of the PRPs if the harm "is indivisible or not reasonably capable of apportionment" (Kilbert, 2012). The rationale behind this "polluter pays" model is that it requires the polluter to internalize some of the costs it imposes on the commons: "the landowner is required to internalize formerly externalized costs into her private cost-benefit calculations before engaging in the production of societal 'goods' that carry with them the production of societal 'bads.' In so doing, the polluter theoretically produces an economically efficient level of such 'goods' and 'bads'" (Gergen, 1994, p. 628).

Regulations reflect the law's attempt to impose the basic tenets of rights, justice, utility, and care discussed above. The burdens resulting from pollution and resource depletion have been traditionally diffused among members of the community at large, or borne by later generations who had no role in creating the harm. Laws attempt to shift the burdens to the entity that is in the best position to prevent the harm—industries creating the waste.

While regulation can help mitigate the effects of pollution and resource depletion, it is largely a stopgap measure, and it cannot answer all of our environmental problems. The best solution may lie in Hardin's (1968) suggestion that we should change our behavior by thinking differently about the morality of pollution and resource depletion. Purdy (2003) observes that we have reexamined the moral dimensions of our relationship with the environment in the past, and we should continue to do so because "[c]hanging values lie at the very heart of changes in the environmental-law regime" (p. 885). Freygogle (1994) argues that we must begin to see our relationship with the environment as a moral one, such that we view abuse of the environment as an offense to society rather than a matter of individual economic cost-benefit analysis (p. 842).

Conclusion

Environmental ethics, specifically the considerations of rights, justice, utility, and care, provide the underpinnings for many of our current environmental laws. Through applying these approaches to environmental problems and studying the regulatory framework in place to address them, students see how ethics influences the law. As our relationship with the environment is viewed in moral terms, sound legal policy follows.

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Human Machine Learning Symbiosis

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ABSTRACT

Human Machine Learning Symbiosis is a cooperative system where both the human learner and the machine learner learn from each other to create an effective and efficient learning environment adapted to the needs of the human learner. Such a system can be used in online learning modules so that the modules adapt to each learner's learning state both in terms of knowledge and motivation. This paper describes the benefits of such a system and a proposed design that integrates human learning in both the cognitive and affective domains with machine learning which adapts to both.

Introduction

Learning can be viewed as the transformation from a current state of knowledge and abilities to an improved state of knowledge and abilities. Humans learn through a wide variety of artifacts such as computers, books, real-world interaction and teachers taking them from a given state to another. Effective learning artifacts help take the learner from where they are to a new state, however, each human exists at a unique state of knowledge and abilities.

Human teachers are exceptional tools for learners because of their ability to adapt to the state of the learner. A tutor helping a single learner can be effective often because they can take the time to understand the individual learner and what would help them progress. The teacher in a classroom of similar learners can engage the learners in a learning exercise that helps them all. However, learners in the same class may be similar, but are not the same and the teacher adapts adjusting the experience or addressing learners individually. In larger classes, the teacher has more of a challenge adapting to individual learners. Complicating the process is the human learner must expend effort to learn which requires motivation. The human teacher is adept at providing motivational input to learners along with the content itself. However, teachers come at a cost of the teacher themselves and their infrastructure. In a society with many potential learners, the potential for teaching costs can be extraordinary.

In many online learning environments, computer learning tools are used to augment or replace the teacher in order to increase the availability or decrease the cost of the learning experience. However, as the tool becomes available to more learners, its design assumptions about the current state of the learner may become further off the mark making the tool less effective. Further, as the learner learns he or she may outgrow the tool or fall behind the tool. Attempts to make adaptive tool, where based on learner responses, the tool can present more advanced information to those who have mastered certain levels and present remedial material to learners who are not progressing widens the range of learners that can be served. The cost now shifts to the teacher's ability to redesign tools with the many paths that learners may need. Since these designs can be applied to many learners, they can be used

at a lower cost per learner that the human teacher alone. However, the coarse grained adaptability may make learning less efficient to the individual learners when compared to direct teacher interaction. Further, such systems are usually weak at motivating the student.

Machine learning is a method of computer problem solving whereby the explicit structure of the problem is not coded by the programmer, but rather is discovered by the machine by analyzing data over time. In complex problem solving, machine learning can be more cost effective than traditional computer algorithm design because the human programmer spends less time with the details of the problem structure and allows the computer to discover that structure. This can be a computer intensive process, but with falling computer prices the economics more and more justify letting the computer explore the solution space over a human programmer explicitly testing the combinations.

Embedding machine learning in online learning modules has the potential for modules to adapt to greater degrees and more individualistically to learner's unique characteristics than traditional structured learning tools. Further, their lower cost can increase the availability of such techniques to a wider audience. Developing a learning machine that is symbiotic with the human learner is at the heart of new learning systems that may greatly accelerate learning while increasing availability and decreasing costs.

Previous Research

Human Learning

Human learning involves the acquisition of new knowledge and skills through effort put forth by the learner. The effectiveness of learning activities is effected by both the current state of knowledge and skills of the learner and learner's motivation to put forth effort to change to improve those states. A number of paradigms on learning research have emerged historically and have been focused through scientific methods, particularly in the last century and a half. Each new family of research was able to ask new questions and put the human learner in new light showing another characteristic of the complex way in which humans learn. What is interesting is that each new wave tended to add new knowledge by creating new methods and perspectives that added depth to our understanding of learning. However, applying multiple perspective to activities has been a challenge since so many factors need to be considered in real time. In fact, the complex decision making of the human teacher is still one of the most important learning tools. A machine learning approach is a step toward systematically considering a wide range of learning characteristics, content, and environments and to apply multiple learning theoretical perspectives.

The behaviorists helped our understanding of the effect of reward systems on behavior and on how contingencies, or partial results, could be used to develop the learner to the desired behavioral level (Skinner, 1968). Although later theorist criticized the early behaviorist work, much was still informed by the basic principles of motivation, learning, and rewards, the sophistication of these constructs has grown considerably over time. Skinner (1968) noted that although some aspects of human learning appear to have simple stimulus and response relationship that may be amendable to straight forward curriculum programming, those stimuli alone would not constitute effective teaching. He observed "A good program does lead the student step by step, each step within his range, and he usually understand it before moving on; but programming is much more than this" (Chapter 4, page 3). These observations lead to the need for learning systems to address learners at multiple levels and from multiple theoretical perspectives.

Cognitive Learning

The spacing between learning activities has been shown to change the effectiveness of learning activities. For example, students "cramming" for a test may show a short term effectiveness, but the memory level may decay quickly thereafter. In general, dividing study time over multiple session increases its effectiveness (Carpenter et al., 2012). The implication for a machine learning system is that using only the learning activities and outcomes as input would be insufficient. When and in what order the learner participates in the activities effects outcomes and needs to be included as inputs to a machine learning model so that the machine learning system can find the best timing and combination of activities.

How learning activities are interleaved can dramatically change their impact on the learner (Rohrer, 2012). For example, most learning environments will have more than one activity around a learning objective. A learning design where several learning activities around one concept are completed sequentially, before moving on to another concept may not be as effective as alternating learning activities between the two concepts. Concepts that are similar can easily be confused and can be difficult to differentiate between and such an interleaved learning approach can help the learner understand the differences. The implication for a machine learning system is that input on past student performance should be known temporally so that ordering effects can be learned by the system. The interleaving that has been studied has focused on experimental design where concepts within a subject area have been interleaved. For example, Kornell and Bjork (2008) found interleaving helped students learn how to differentiate painting from artists with similar styles. Little has been done asking the broader question of how different subjects should be interleaved and how the timing of learning activities across subjects should be conducted. A machine learning approach that uses input across subjects or academic classes could yield useful information on the broader question of interleaving activities. Rohrer (2012) notes that the research on interleaving has been limited to short term learning activities and simple patterns of interleaving. A machine learning approach has the ability to consider a wider range of data and may be able to find larger time scale patterns of interleaving. Further, in a real world setting, patterns of interleaving may be at the whim of student habits and, therefore, data available to machine learning systems may be biased based on social norms, culture, and current practice.

Effect of Affect

The affective state of the learner changes their ability to use, focus upon, and learn from learning systems. Affective state at any one time may be more or less conducive to learning and may change dramatically for one over time. The degree to which the learners affective state effect learning also varies by individual. Alternatively, the use of a learning system can change the affective state of the learner. For example, particularly challenging learning task that the learner is not prepared for may dishearten the learner and reduce their confidence in successfully mastering such material. On the other hand successfully completing a learning exercise can boost confidence for future activities.

During deep learning experiences, that is when learning about something novel and difficult, learners are put in a state of disequilibrium whereby what they understand does not match well with the new material being presented. The state of disequilibrium leads to the negative affective states of "confusion, frustration, boredom, curiosity, and anxiety" (p. 14) and may be a necessary part of learning (Graesser and D'Mello 2011). Positive affect is usually not felt by learners until they have moved back into a state of equilibrium relative to the learning material and have overcome a hurdle or succeeded in an objective (Graesser and D'Mello 2011). Graesser and D'Mello interpret the Csikzentmihalyi concept of flow as situation where many cycles of disequilibrium and equilibrium follow together. A consequence of this interpretation of flow is that the right level of disequilibrium needs to be introduced so that the learner can have the positive experience of returning to the equilibrium state. With too difficult a task, the learner will never come back to equilibrium to reach the positive state and will become frustrated and may disengage. With too simple a task, the learner will not need to leave the equilibrium state to begin with and will have a minimal feeling of accomplishment. Making the application of gaging learning activities difficult is that the appropriate level of difficulty varies widely by the learner.

The balancing of equilibrium through learning activity and difficulty is mediated by feedback mechanism. To the extent that feedback is given, it can encourage the learner to exert more effort to complete a more difficult exercise. Feedback can also reinforce the success so that the learner experiences the expected positive affect. Some researcher such a Graesser et al. (2008) found confusion to be a similar construct to disequilibrium as a prerequisite for learning. For example, Graesser et al. (2008) found that an automated tutoring system could engender confusion in the learner when giving hints designed to make the learner think further and would reduce confusion when the tutor gave specific facts. Graesser et al. also found that positive feedback from the automated tutor when a learner grasped a concept increased the students eureka emotion. Their research was exploratory but the results seem promising and worthy of further research. They also note the eureka concept is intended to be a major breakthrough in learning although it was measured here as a relatively small breakthrough and, therefore, the study may have been more accurately measuring delight, rather than eureka. Nevertheless, strong correlation between comments from the automated tutoring system and the learners affect were measured.

Bosch and D'Mello (in press) studied an automatic tutoring system for teaching computer programming and found the affective states of confusion and frustration following learner errors and those states were lessoned when the system gave them guidance. Shute et al (2015) studied the video game Physics Playground, designed to support physics education and found frustration lead to higher performance in the game and ultimately to higher post test scores in the subject matter. DiMello et al. (2014) suggest that confusion, when introduced properly and when resolved properly, can have a beneficial effect on learning.

A learner's level of disequilibrium or frustration in the moment of an education experience influences outcome; however, general student traits that are more persistent over time, also influence a learner's ability to engage in a learning activity. Galla et al. (2014) developed the Academic Diligence Task as a measure of self-control in an academic setting. They found it "demonstrated incremental predictive validity for objectively measured GPA, standardized math and reading achievement test scores,

high school graduation, and college enrollment, over and beyond demographics and intelligence" (p. 2).

Gamification is the process of using game-like elements such as points, badges, challenges, and levels of difficulty to encourage people to act and boost customer participation. Its significance has become increasingly important in the corporate sector, and it is forecasted to be a substantial portion of social media marketing budgets in the future (Findlay and Alberts 2011). Gamification has come to involve studying and identifying natural human tendencies and employing game-like mechanisms to give customers a sense that they are having fun while working toward a rewards-based goal. An example of gamification would include Nike Plus, an online community that motivates individuals to exercise more by enabling players to earn points and set goals. Gamification lessons are another way to understand the feedback mechanisms that could be used by a machine learning system as a feedback tool.

In a business context, the potential value of gamification is an increased level of customer engagement. Customer engagement facilitates repeated interactions that strengthen the emotional, psychological and physical investment a customer has in a product offering or brand (Brodie et al. 2011). This research proposes that the same principles of gamification and customer engagement used in industry can be applied to the classroom setting, particularly with respect to student engagement. Student engagement has been used to depict students' willingness to participate in classroom room activities, including attending classes, submitting required work, and participating in classroom discussions (Natriello 1984). Students who are engaged show sustained behavioral involvement in learning activities accompanied by a positive emotional tone. They select tasks which cognitively challenge them, initiate action when given the opportunity, and make concerted efforts as they participate in learning tasks (Skinner and Belmont 1993; Chapman 2003).

Customer engagement (CE) has been defined as the "intensity of customer participation with both representatives of the organization and with other customers in a collaborative knowledge exchange process" (Wagner and Majchrzak 2007, p. 20). CE manifests in an individual's participation in and connection with an organization's offerings and activities (Van Doorn et al. 2010; Vivek et a;. 2012). Bowden (2009) viewed customer engagement as a psychological process comprising cognitive and emotional aspects. Further, Bowden proposed that CE is an iterative process, beginning with customer satisfaction and culminating in customer loyalty.

CE may be manifested cognitively, affectively, behaviorally, or socially. The cognitive and affective elements of CE incorporate the experiences and feelings of customers, and the behavioral and social elements include participation by current and potential customers, both within and outside of exchange situations (Vivek et al. 2012). Potential or current customers build experience-based relationships through intense participation with the brand by way of unique experiences they have with the offerings and activities of the organization (Vivek et al. 2012).

As aforementioned, gamification is a tool that organizations may use to promote customer engagement. Because CE involves eliciting cognitive, affective, social and behavioral responses from consumers, effective gamification efforts must be successful at engendering these same reactions. Vivek et al. (2012) suggested that participation and involvement are key requisites to CE. Implicit in participation and involvement are cognitive, affective, social and behavioral components. Thus, this research suggests that both participation and involvement are essential components to successful gamification initiatives. Further, it proposes that gamification tools can not only be affective at engaging consumers in the business environment, but such tools can also be effective at creating student engagement in the classroom. The study that follows investigates the efficacy of two instructional methods in creating student engagement, one in which gamification techniques were employed and the other in which a traditional lecture format was enlisted. The details regarding the design of the study, along with its findings, are discussed next.

Online Learning

Bowen et al. (2012) found that machine-guided instruction used in a hybrid course could be used with one hour of weekly face-to-face instruction and achieve equal learning outcomes to a traditional course employing three hours of weekly face-to-face instruction. Bowen's example shows an increase in learning efficiency within the context of students having complete certain prerequisites in a relative homogenous educational environment and still replies on the support of the human teacher, although at a reduced level. These results beg the question how can such learning opportunities become more effective and less costly.

Toward a Symbiotic Model of Human and Machine Learning

Proposed Machine Learning based Learning Tools

Our proposed Interactive and Intelligent Education Delivery System (IIEDS) is a software-tool, through which a full course can be delivered to a student in an interactive and intelligent manner.

Teachers' Perspective

A teacher or an instructor will be able to transfer his/her teaching material in IIEDS's required format. Once the input is given, then in the absence of the teacher, IIEDS will guide and engage a student learn and help solve an exercise effectively.

Modules of IIEDS

The IIEDS will have two (02) modules: (a) Lecture Delivery Module (LDM) and (b) Exercise Module (EM). These methods are described below.

Lecture Delivery Module (LDM)

To deliver, lecture-slides will be readout by the software for the students. Student should be able to pause, repeat, and fast-forward as well as will be able to click the highlighted terms and jargon to check the related information for further details, as needed – which could be supplied beforehand or, can be supplied from Internet (links and readouts) to be explored by the interested students.

The module will record the behavior of the student, suggest further reading and information and will ask questions to raise intuition of the student. Student may skip or answer. For correct answers, student will be encouraged and will be asked next (deeper) questions. For wrong answers, the theory behind the question will be readout again. If it is still wrong, the link of related information from Internet could be provided. For having repeated wrong answers, the instructor should be notified by the system. All these behaviors will be recorded including the solution provided by the instructor to overcome the failing situation. This will form the foundation of reinforcement learning (Dogan and Olmez, 2015; Kaelbling and Littman, 1996) (Sutton and Barto 2016), (Szepesvari 2013) implemented via machine learning techniques (Rashid et al., 2015; Iqbal and Hoque, 2015) for both IIEDS and the students.

Exercise Module (EM)

This EM module will be invoked or, independently started at the end of each section of the lecture. Here, questions and solutions will be delivered in the order from easy to hard or, as predicted by the software based on the experience (generated from the Machine Learning technique ran in the background) – the behavior of the students such as how fast he is answering what level of questions, correctness and how he is slowing down, etc. will be recoded. Necessary steps will to be taken by the instructor to place additional information to bridge the gap if connecting steps are missing for a student to go to the next level of challenging questions. EM will also include tests and quizzes.

Architecture of the IIEDS: The engine of the IIEDS will be built based on Machine Learning (ML) techniques and will incorporate the following features:

- Based on the collection of the behavioral entries and response-features such as various mouse-clicks and responses, amount of time to get to a particular level, lesson delivery pattern and timing: interleaved or non-interleaved delivery of the similar topics (as discussed in the Cognitive Learning section of this article), and success and failure rate per questions per level etc. will be recorded and use as features in the proposed ML approach.
- Based on the computed (using Extra-Tree classifier (Geurts and Wehenkel, 2006) and/or TensonFlow (Abadi, et al., 2015) effective feature-sets will be determined. The feature-selection step will not only help the next steps of ML but also will help us identify the key features involved in the student's learning.
- Based on the (effective) feature-set, a classifier will be built which will classify student's current performance level per lesson – we may define 10 different levels of performance score or grades, for example. An efficient classifier such as support-vector-machine (SVM) (Hsu, Chang et al. 2010) or, deep artificial-neural-net (ANN) based TensonFlow could be applied for multi-class classification to rank the performing students appropriately.
- The IIEDS itself will be a reinforced learner with a goal: what information needs to provide and when, how to provide better pathways to a student to help the student become the top ranker based on game-theoretic approach (Tomlin, Lygeros, and Sastry, 2000) as well as reinforcement learning based approaches. Top-ranking target can be defined by setting the goal to score ≥ 90%, for example.

Training of IIEDS

To train IIEDS, it will simply need to be used by students – the more it is used, the more it will obtain the experiences and will be able to provide effective as well as need-based-variable pathways or suggestions to the students based on their individual feature-parameter values.

Utilization of the IIEDS Tool

IIEDS can be used in both synchronous and asynchronous modes. It will be interesting to see what different experience IIEDS can get from the synchronous versus asynchronous users – which can also help justify better mode. Train IIEDS using synchronous users to generate and capture intelligent moves and then allow asynchronous user to use the mature IIEDS, for example, and this can turn into an effective learning approach.

Expectation from IIEDS

IIEDS is a learner, and being a learner IIEDS will capture effective and intelligent moves by the users – thus, IIEDS will be an excellent tool to store the collective efforts which can keep growing richer by the usage – and in return, IIEDS can deliver most suitable pathways for a student based on the student's need determined by the performance and feature-parameter values. Eventually, IIEDS can be regarded as a personal teacher, standing by the student to provide encouragement as well as assistance as needed.

Enhancement of the Intelligence of IIEDS

The IIEDS can be made more powerful by enhancing its intelligent and capacity to scale. Primarily, IIDES will collect several optimal sequences of actions via reinforcement learning that helped students achieve higher score. The dataset will be invaluable in generating more creative pathways from the samples. Utilizing short schema (Hoque, Chetty et al. 2007) or, short action-steps from the collected successful action-sequences, novel and interesting pathways can be generated fast and intelligently using our effective evolutionary algorithm (Hoque and Iqbal 2015). These pathways can then be cross-validated using IIEDS again.

As the feature-space of IIEDS is expected to be very high, naturally scalability can be a concern while enhancing the intelligence of IIEDS. Fortunately, we have already developed novel approach, named hGRGA (Iqbal and Hoque 2016), to handle such scalability issues within our evolutionary approach. The idea will be transformed for this IIEDS application. Thus, this overall recurrent approach can make the IIEDS grow its intelligence effectively.

A Build and Learn Methodology

Understanding levels of affect in real time and adapting appropriately has the potential to greatly improve the effectiveness learning environments.

The build and learn; evaluate and learn methodology integrates systems development with the scientific method allowing for both proof of concept to test feasibility of technology and behavior measures to measure efficacy of system on outcomes (Nunamaker, 1991). The methodology is important to this study both because we will be creating new never tried environments and because the fast pace of technology change can be taken advantage of in iterations of the test cycle.

Efficiency Outcome Measures

One measure of efficiency is course design efficiency which is the cost of course design with the value. A number of related measures can be developed as a comparison between traditional course design approaches, faculty intensive online course design, and Connected Thinking Lab design approaches. The Connected Thinking Lab design approach pairs a course designer with a faculty member in the design of multimedia content, student assessment, and collaborative exercises. If done well, faculty will make better use of their time contributing as subject matter experts as course designers efficiently craft artifacts. The hope would be that time and cost saved of the faculty member is greater than that of the course designer. Equation 1 shows the time efficiency of course design using traditional methods vs Connected Think Lab methods. Equation 2 shows the cost efficiency of course design using traditional methods vs Connected Think Lab methods. This model measures the efficiency of methods in two ways. First, the study will compare design times of new methods to traditional methods. Secondly, it will compare how new methods design efficiency changes over time to capture the likely learning curve effective of application of refined design processes.

Measures that can contribute to efficiency calculation include:

- Faculty design hours in a traditional course (FDH_{tc})
- Faculty design hours in Connect Thinking Lab course (FDHctl)
- Course designer design hours in Connected Thinking Lab course (DDHctl)
- Course (C)
- Faculty cost (FC)
- Course designer cost (DC)

Equation 1
Course Design Time Efficiency

$$Design\ efficency = \frac{FDH_{tc}}{C}\ vs\ \frac{FDH_{ctl} + DDH_{ctl}}{C}$$

Equation 2
Course Design Cost Efficiency

$$Design\ efficency = \frac{FC \times FDH_{tc}}{C}\ vs\ \frac{FC \times FDH_{ctl} + DC \times DDH_{ctl}}{C}$$

On the other hand, the efficiency of the student balancing school, work, and family is important as well. A challenge with traditional teaching formats for students is the time commitment of meeting at a particular time and place for class. Students must therefore consider both cost of tuition ad time. Time can be divided into the two categories, time spent on synchronous activities and time spent on asynchronous activities. Time spent on synchronous activities can be divided into time spent on same place synchronous activities and different place synchronous activities. Synchronous same place time is often the most expensive time for students because they must forgo time at work or with family and must travel to the location. Synchronous distance classes reduce travel cost, but still have opportunity costs while asynchronous activities allow students to schedule learning activities around work and family commitments.

Student Costs:

- Tuition (T)
- Student time in asynchronous learning activities (STA)
- Student time in synchronous distant learning activities (STSD)
- Student time in synchronous face-to-face learning activities (STSF)

Where the magnitude of the costs can be ordered base on the early discussion as:

Classroom modules then will be redesigned to either increase the efficiency of a student time or shift the activity to a lower cost time period.

Equation 3
Relative Costs of Student Time

$$STA < STSD < STSF$$

Other efficiency measures in the assessment include course delivery time efficiency, course delivery cost efficiency, which can be measured from both the university and student perspective, as well as design and delivery efficiency normalized on a per student basis.

Conclusion

"New ideas about ways to facilitate learning—and about who is most capable of learning—can powerfully affect the quality of people's lives" (NRC, 2000, p. 5). Achieving human computer symbiosis has the potential to drastically change availability and efficiency of advanced education.

The machine learning approach allows for the consideration of many more variables simultaneously in the both the design of learning systems and the design of research on such systems. Since human learning is influenced by a wide range of competing factors, this approach may find new interactions between factors leading to richer learning environments.

Furthering science in human computer symbiosis will require multi-disciplinary approaches to better understand the human learning process and how artifacts such as machine learning impact the human learner. For the whole system to work in concert, theories from the cognitive sciences, education, and computer sciences need to be integrated and evaluated concurrently.

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The Risks and Opportunities Associated with Weak Arithmatic Skills of Accounting Students[1]

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ABSTRACT

This paper explored the authors concerns about students enrolled in their introductory accounting course. Anecdotal evidence suggested that students struggle with basic arithmetic concepts that underlie basic business transactions even though their math placement and ACT scores are high. A survey of 125 students in a first accounting course was conducted in the spring of 2010 to assess the basic arithmetical skills. The results indicated that the ACT scores and math placement tests do not reveal weakness in basic arithmetic. We find that faculty and students will experience frustration due to the impaired arithmetic ability. By taking for granted that students possess basic skills in arithmetic faculty will exclude exercises from the curriculum that will build the kind of arithmetic abilities students need to think on their feet about basic business transactions. We conclude by arguing that making curricular accommodations to cope with the deficit in arithmetic is not in the student's best interest. A competitive advantage for students can be created by addressing the deficit head on rather than adjusting the curriculum to work around the problem.

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Introduction

This paper was prompted by a shared complaint and frustration with the apparent inability of undergraduate students to do basic arithmetic. Class sessions are interrupted because students cannot follow the arithmetic that underlies basic business transactions. Faculty would like to assume that students possess basic arithmetic abilities and then become frustrated when the students fall short of this desire. That frustration leads the faculty involved away from responding to the environment they encounter with an intention to create opportunities for the students to gain a competitive advantage through skill development. So this paper explores the issue of student's struggling with basic arithmetic concepts.

The impact of the seemingly reasonable assumption about arithmetic is quite serious. It has even reached a level of concern that comments have appeared in the Accounting Review. Kaplan (2011, page 380) noted the following shocking outcome:

> "I learned earlier this year that a major bank employs 500 accountants to mark its entire global portfolio of securities to fair value each day. The chief accounting officer told me that they cannot hired graduated from U.S. accounting departments for this task. The students so not know sufficient economics, mathematics, and statistics to perform the fair value calculations. This deficit is a direct result of accounting scholars not doing research on fair value measurement and therefore not being able to teach our students how to perform such calculations."

Aside from the Bankers exaggeration we are not willing to assume the cause of the problems are with research. We

train students in a long list of contemporary issues that is growing faster than the available contact hours. How do we cope, if not by letting something go? We would argue it is equally plausible that the cause is the shift away from arithmetical processes, they are assumed to be within the student's grasp.

So when Kaplan criticizes the academy stating " by responding slowly, if at all to major (page 370) new challenges and opportunities in the environment in which accounting is practiced, accounting scholars have become less familiar with emerging professional challenges and opportunities." Our concern regards a view of what the "environment" is. As the business curriculum has shifted we would argue there has been an over-response to the environment. In addressing new issues we have created yet another. We forgot the role of a sound, guttural sense of arithmetic in the full range of business transactions and processes. This territory, assumed to be below our threshold of concern, is now therefore an issue.

So, now the professional environment includes weak ability to perform basic arithmetic. Increasingly incorrect or inappropriate decisions flow from the lack of appreciation of basic arithmetic relationships. (Moore, 2009) Put another way the language of arithmetic has been lost. Since arithmetical ability is taken for granted it is not necessarily included in the tests that focus on mathematical preparedness for College. So, this paper explores our frustration arising from encounters with students who earned good scores on math placement tests and yet they struggle to process the arithmetical relationships in common business transactions. Specifically, we explore the nature of arithmetic assessment in testing and preparation of a first course in accounting.

The American College Testing program (ACT)

The American College Testing Program (ACT) was founded in 1959 by E. F. Lindquist and is a not-for-profit organization headquartered in Iowa. At that time the first of the Baby Boom generation was approaching college age and higher education institutions were planning significant increases in their enrolment numbers. The existing Scholastic Aptitude Test (SAT) had been in use since 1926 and was designed to measure a student's overall aptitude for learning. The ACT was developed on a different philosophical model and has always intended to measure a student's ability to do first year college-level work based on what they have learned in a typical high school college preparatory curriculum. The emphasis therefore is on what they learned already, not their innate ability to learn in general. (Atkinson, 2009)

The authors' anecdotal experience indicates that the basic arithmetic competencies of business students are relatively low, when arithmetic competencies primarily represent the four basic functions. At the same time, the average ACT mathematics profile for these same students remains relatively strong. Are we becoming grumpy old men or is there another less disturbing explanation? The purpose of this paper is to determine if the anecdotal evidence can be supported with more objective measures. The arithmetic skills of students present a significant teaching constraint. We cannot pretend to give effective education in financial reporting in the absence of fundamental prerequisites. Specifically, the authors briefly explore answering these two questions:

1. Can students learn, to some reasonably satisfactory degree, in a first course in accounting, with the apparent lack of mastery of basic arithmetic skills (i.e., addition, subtraction, multiplication, and division), critical thinking, and analytical reasoning skills?

2. What does the math section of the widely used ACT purport to measure and what does it appear not to measure?

The Program of International Student Assessment (PISA) is conducted by the Organization for Economic Cooperation and Development (OECD). PISA is an annual assessment of problem solving skills and the degree of applied learning on a national scale. The USA's participating students have slipped from a position of global leadership to rankings of 25th in terms of mathematics and 24th in terms of science. The report noted:

> "Several other facts paint a worrisome picture. First, the longer American children are in school, the worse they perform compared to their international peers. In recent cross-country comparisons of fourth grade reading, math, and science US students scored in the top quarter or the top half of advanced nations. By age 15 these ranking drop to the bottom half. In other words, American students are furthest behind just as they are about to enter higher education or the workforce." McKinsey, pg 8, 2009

The current situation changes the intellectual place where university accounting educators first meet accounting students in an introductory or principles of accounting course. It is their responsibility to take their students from that place of first encounter to one of global competitiveness. In his recent book, Academically Adrift: Limited Learning on College Campuses, Arum and Roksa (2011) noted that university business majors average 9.55 hours of study per week. Since this is not enough to recover

from their relatively poor high-school preparation in reading comprehension, writing and, in particular, basic arithmetic skills, the impact of their reduced skill sets and competencies must affect the scope of their university curriculum.

All business students, regardless of their specific major, will benefit from good numerical literacy. The daily process of critical thinking and analytical reasoning is essential for academic and subsequent business success. Successful students must think on their feet and be clever and entrepreneurial enough to detect opportunities for growth and profit. Some entrepreneurial aspects should be embedded into almost every part of the undergraduate business curriculum. There are limited opportunities for an individual faculty member to remediate for prior academic (elementary, secondary or collegiate) weaknesses, so we surmise that accommodations are made — leading to further faculty angst. Generally, our colleges admit based on reported psychological test scores (e, g., ACT, SAT) well-qualified students, but they have a decreasing facility with "basic street math" (arithmetic). Arithmetic for the authors' purpose in this paper, consist of the basic four operations: addition, subtraction, multiplication and division.

Along with the reported relative declines in this nation's overall education (competencies, not grade levels and/or degrees achieved), the continuing decline in our native students' mathematical literacy will likely have a slow but progressive negative impact on the national level of managerial productivity. A previous study explored the relationship between the ACT test and success (grades earned) in the first accounting principles course (Yunker and Krull, 2009). This study explores anecdotal experiences that the decline in practical arithmetic skills may not be captured in the reported ACT math scores.

The ACT's emphasis on Algebra, Geometry, and Calculus may no longer be a good measure of arithmetic preparedness for the study of the first course in accounting. It seems good students now simply learn how to do well on the ACT. Many take ACT prep or review courses to improve their ACT scores. Do the reported math scores mean the participants have arithmetic competencies? This dynamic muddies the water making it harder to fulfill our social responsibility as accounting educators. The sum of our individual decisions, grounded in a rational sense of moral hazard will not be known for many years to come.

Is it worth stating or speculating that there are perhaps no apparent consequences on the CPA exam—perhaps because it is not tested there either.

Building on Previous Studies

There is a large body of research that documenting the exploration of factors that will indicate student success. The work of the Pathways commission is a possible framework for building this analysis. As a general observation there is a weak correlation between various entrance examinations and success in a post-secondary program. It seems that there is some overriding dynamic that has yet to be articulated.

The origin of this paper was to re-visit the frustration over arithmetic weakness by extending the work of Yunker, and Krull (2009) in their study entitle "The influence of mathematics ability on performance in Principle of Accounting." They found that ACT and math placement scores were weaker predictions of success than a simple test of basic arithmetic. In looking at their finding it seems, students have learned how to do well on placement tests without, remarkably, having a good grasp of the underlying arithmetic. This gives us further evidence that the ACT assumption that higher mathematics requires sound arithmetic has uncoupled.

In their paper, Yunker, Yunker, and Krull (2009) built on a series of papers that have in turn advanced the research into mathematical preparations. These started with Pritchare, Romeo, and Saccucci (2000) who looked at the connections with mathematics and a success in a principles of accounting class. Ballard and Johnson (2004) did a similar study with economics students. Yunker, Yunker and Krull used the Ballard and Johnson testing instrument to tie the studies together, as does this paper.

The big discovery was that the placement tests were not capturing a weakness that was predictive of success became the focus of the next layer of studies. So, for example, Folley, Peres, and Poirier (2008) found the SAT to be a poor predictor, math assessment to be a bit better and so postulated that pre-requisite curriculum in mathematics needed further exploration.

A related set of developments can be traced in the efforts of the American Accounting Association to ensure accounting education is responding to changes in the professional environment. For them this encompasses the ongoing state of curriculum, recruitment, and testing methods. There are some unfortunate conflicts between the professional and academic expectations as evidenced in the Kaplan (2011) commentary. Black (2012) summarized 30 years of progressive studies into educational reforms, the most recent of which is the Pathway's Commission.

A particularly interesting aspect of the Pathway's Commission (Behn, 2010) is their recommendation for a new

model of curriculum. In broad terms there is a concern that what goes on in the classroom is directed towards the issues to be faced. However, taking an open systems approach we cannot assume the inputs, that is students arriving on campus, are a consistent commodity.

Consideration of this previous work helps us ferret out a more specific purpose for this paper. That is to explore the extent and implications of the changes in mathematical emphasis in schools. Consider if Manchester United announced that entry into its development program will be heavily influenced by a players speed. This will cause coaches, who want their athletes to succeed, to favor speed training at the expense of other developmental activities. Why? Regardless of their belief in a well-rounded athlete, time away from "speed" training diminishes their player's chance of being promoted to the program. So the coach then has an incentive to shift time to away from skill development and give that time to speed training.

The extension of this analogy points to opportunities that may arise from this research. Emphasis on the ACT, SAT, and math placement tests has an inevitable impact on the coaches (teachers) upstream from the universities. A good high school will emphasize the calculus, geometry, and advanced algebra that are predominant in in these admissions tests. They have to do it because they are now hurdles in the admissions process. We postulate this shift is at the cost of time spent emphasizing arithmetic. So to bring this together, one can see that the ACT and SAT will not be good predictors of arithmetic since they do not include those items.

Post-secondary education that is in tune with the contemporary environment will adjust to the current strengths and weaknesses of freshmen arriving on campus. So, rather than complain about a skill deficiency, an opportunity exists to rely on the new strengths of students and shift time back understanding arithmetic at the college level. In consideration of the environment there is a bias towards factors that students will face at the expense of what they went through to be admitted to university.

Our Study

The business core at Bradley University (Bradley) includes two freshman level accounting courses: ATG 157, Accounting Principles-Financial, and ATG 158, Accounting Principles-Cost Management. The design of the ATG 157 course presumes the students possess basic elementary-school arithmetic skills. For enrolling freshman in their required university mathematics courses of their general education requirements, Bradley uses the reported ACT math score in conjunction with its own designed math placement test to measure essential mathematical reasoning. Any student with an adequate combined score on the ACT mathematics component and the Bradley math placement test may take ATG 157 in their first semester, while others must wait until a lower-level math course is completed, such as Math 109 College Algebra.

Anecdotal observations by the Bradley Department of Accounting reveal a general concern about the lack of students' arithmetic ability, regardless of their combined ACT math and Bradley math placement scores. Consequently, many students struggle with the arithmetic needed to do calculations supporting basic business transactions covered in ATG 157. The anecdotal experiences do not seem to connect with students' reported ACT math scores and Bradley's math placement scores. A trial survey of students at Bradley's summer freshman orientation in July 2009 lent credibility to this concern. This current study was undertaken to gain more insight into the practical arithmetic skills and various other competencies associated with students' performances in ATG 157. The study will enable the Bradley accounting faculty to examine its concerns regarding its students' mathematical reasoning with a view to curriculum revision.

Students registered in ATG 157, Accounting Principles – Financial, in the spring semester of 2011 were surveyed. Four sections were offered that had 135 registrations at the time of the survey. (32, 35, 30, and 38, respectively). A total of 125 students were present and elected to take the special survey on the first day of classes. To maximize analytical flexibility, some students were excluded where their data such as the ACT math scores, Bradley Math Placement Scores, and demographic data were missing. That leaves us with 89 students for which we have individual full data sets.

Twelve of the 89 students withdrew from ATG 157 before earning an overall course grade. The 77 students that completed the course achieved an overall GPA of 2.8 on a 4.0 scale for ATG 157. That group was made up of 52 male students and 37 female students. They had considerable diversity in their academic experiences. Their average semester credit hours completed before the Spring, 2011 semester were 37, while the least experienced had seven hours and the most experienced had 125 hours. Bradley has five undergraduate colleges and a "university" college where undecided students may reside until they choose a college major. Table 1, at the top of the facing page, profiles the students in four ATG 157 sections, categorized by their chosen college of origin with abbreviated names ease of reading.

The students were asked to answer twelve basic arithmetic questions with a ten minute limit. A copy of the survey is provided in Appendix A. These questions were split between basic adding or subtracting, multiplication, and

Table 1

College of Record	Student Count	Withdrew	GPA[1]	ACT (Math)	Bradley Math (PLlacement)
Business[2]	35	6	2.7	23.7	20.5
Communications[3]	13	3	2.4	23.2	16.0
Engineering[4]	17	0	3.2	28.1	29.9
Education[5]	1	0	4.0	28.0	31.0
Arts/Science[6]	4	0	3.0	23.5	22.3
Exploration[7]	19	3	2.5	24.7	24.0
TOTAL	89	12	2.8	24.7	22.6

word problems involving a simple linear relationship. Calculations were kept very simple, and the students were not permitted to use their calculators. This enabled the faculty to prohibit calculator based prompts to compensation for an inability to mathematically describe and arithmetically complete the sort of basic arithmetic computations underlying many basic business transactions. The survey was administered on the first day of class. There is a risk the test was not taken seriously that may be offset by a desire to do well at the first meeting of a course.

Hypopthesis Development

In step with the first small data set at this point in time, our teach experience and building upon previous studies it is possible to develop five hypothesis out of this study. Previous studies all point to the weak predictive value of the ACT/SAT. This study points to the need to explore the gap predictive gap along a new line of consideration as follows:

H1: There is an overall weakness in arithmetic skill that the ACT does not capture effectively.

Following along this we will again look to gain validity by aligning with previous studies (Yunker, Yunker, and Krull, 2009)) which affirm that arithmetic is an important factor in predicting success in Accounting 157. By isolating the arithmetic this effect is predicted to be statistically strong.

H2: The arithmetic Quiz will be a better predictor of ATG 157 success than the ACT mathematics score.

Our anecdotal experience with students points to an inability to understand arithmetic relationships. The language of math is missing. It is very hard for many therefor to translate words into quantitative relationships. As a result we expect exposition problems to me the most problematic and therefor the most predicative.

H3: Arithmetic problems presented in a word exposition format will be more difficult than other formats.

The significance of the problems grew exponentially with the ATG is a sound predictor of success in business studies. If we build on the idea of Accounting as the language of business, there has to be a positive correlation, arithmetic perhaps become that alphabet of that language.

H4: There is a strong connection between arithmetic, ATG 157 and success in business studies.

Our final concern is that individual faculty can make little changes to the system. As discussed teachers, like coaches have to respond to the admissions criteria. Changes to admission processes, like reliance on the ACT, has implications on the skill set of the incoming class.

H5: Faculty responses to the lack of basic arithmetic enable students to proceed in spite of a skill deficit, needed for professional progress.

STREET MATH RESULTS

The overall average percentage score on the twelve item survey was 54 percent, of which about half (27 percent of the 46 percent missed resulted from wrong answers. The remaining incorrect responses (nineteen percent) resulted from questions that were left blank.

Table 2

Question	1	2	3	4	5	6	7	8	9	10	11	12	ALL
Correct	96%	90%	38%	83%	53%	42%	56%	11%	87%	48%	28%	17%	54%
Wrong	4%	10%	60%	16%	25%	51%	26%	52%	9%	21%	19%	28%	27%
Blank	0%	0%	2%	1%	22%	8%	18%	37%	4%	30%	53%	55%	19%

The performance deteriorates as the survey progresses. Only 1 percent of the responses to the first 3 questions were left blank. This grew to 46 percent of the responses for the last three questions. One could ask if the ten minute limit was too short a period of time for the students to demonstrate their competencies. This was also observable when questions were similar. Question 7 asks, "Last year, Jake's salary was $58,000. At the end of the year, he received a 10% increase in salary. What is his salary this year?" Question 10 asks, "Take 62% of $12,000. The result is?" However, 56 percent were able to answer question no. 7 correctly, while only 48 percent were able to answer question no. 10. This may indicate the questions, shown in Appendix A, were perhaps too difficult for the students to manually answer with the pressure of a ten-minute time limit. Of course, this assumes that all the participating students worked diligently to answer all of the survey items.

ATG 157 does not make use of any advanced mathematics, just basic arithmetic. However, the Bradley accounting faculty has repeatedly experienced unequal arithmetic abilities across ATG 157 students when it comes to their analyzing basic business transactions requiring arithmetic manipulation. The students' unequal abilities create a stressful classroom dynamic. The survey revealed pronounced differences across the five colleges and the undecided majors.

Table 3
Average Survey Results by College

College of Record	Number of Students Male – Female	Portion Correct Male – Female
Business	21–14	51%–57%
Communications	3–10	33%–41%
Engineering	15–2	62%–88%
Education	0–1	NA–83%
Arts/Science	2–2	50%–50%
Exploration	11–8	57%–52%
TOTAL	89	54%

In addition to the differences across the colleges, we found a significant gender gap. Males produced eight of the top ten math placement scores. Females produced seven of the bottom ten Bradley math placement scores. Recall, there were 52 and 37 male and female students, respectively. These scores point to some perplexing questions as to why the majority of accounting majors are female.

The gender gap is significant in some of the specific questions. Question 7 stated: "Last year, Jake's salary was $58,000. At the end of the year, he received a ten percent increase in salary. What is his salary this year?" Only 56 percent of the students provided the correct answer. However, only 32 percent of the females answered correctly as compared to 73 percent of the males. One would assume that a prerequisite to closing the national salary gender gap will be an ability to compute salary changes!

In addition to a possible revealed gender gap performance, we see that business students were slightly less able to demonstrate competency in computing a salary increase. Only 49 percent of the 35 business students were able to answer question 7 correctly. When split by gender, we found that 62 percent of the males registered in business could answer the question. The numbers are small, but it is still noteworthy that only 29 percent of the fourteen females registered in business could answer the same question. This is a distressing gap in arithmetic ability for students that have selected into a College of Business major.

We expected basic profit relationships would fall within the natural area of interest, especially for business students. Question 3 asked the students: "If a television costs $500 and the sales tax is $25, what is the local sales-tax rate in percentage terms?" Whereas question 8 asked the students: "XYZ company's profits this year are $2,500,000. Its profit rate on sales (in ratio terms) is 0.10. What are its sales this year?" Both questions required arithmetic manipulation of a basic ratio. It was a surprise that business students scored about the same as the overall group. 63 percent of the business students determined an incorrect tax rate and 46 percent calculated an incorrect sales amount.

This of course leads back to the Bradley Accounting faculty's angst over the use of ACT scores to assess basic mathematical ability in the admission process and mathematics course enrollment. How is it possible that 89 percent of the surveyed students with a relatively strong ACT math profile could not determine the correct sales figure for question 8? We noted that 43 percent of the business students did not even attempt this straightforward question. In terms of ACT scores, the top ten students in this study had an average ACT math score of 28.5. That places those ten students a bit above the 90th percentile of all their peer high school graduates. It is a shock to note that five of these top students were unable to answer question 8 correctly.

These arithmetic survey results support the ATG 157 faculty concerns that students lack basic arithmetic competencies and the applied, practical functionality to process basic business transactions. They have serious deficiencies in the basis functional life skills. No wonder the USA cannot compete even against the developing global economies and jobs continue to move overseas! As a group, the

surveyed students are not ready to think about business on their feet or apply critical judgment to financial assertions. However we have a puzzling reality. Previous studies (Yunker, et. al., 2009) indicate that the ACT and the math survey may be reliable indicators of potential success for university level learning.

Indicators of Success.

The surveyed population of 89 students had an average ACT math score of 24.7. An ACT math score of 24.7 is impressive. According to the ACT interpretation guide, this is around the 80th percentile for recent high school graduates. It is reasonable to conclude that such a selective group will be successful in their undergraduate education studies. Many previous studies have indicated that the ACT math score, math placement tests, and credit hours provide some indication of future success. Here are the results from our 89 survey subjects.

Table 4

ATG 157 Course Grade	W/F/D	C	B	A
Grade Frequency (89)	19	22	29	19
ACT Mean Math Score	23	23	25	28
Mean Math Placement	19.1	18.3	22.9	30.6
Mean Semester Credits	26.3	29.6	36.3	53.9

Our subjects produced a result consistent with previous studies. The higher grades in ATG 157 were consistent with higher ACT math scores, higher math placement scores, and greater university experience. But good students prepare for the ACT and math placement test. Good students are persistent and form more productive study habits as they gain post-secondary experience. However, good students prepare for these exams so overall they do well. We can also see that academic experience improves performance. This too makes sense as better students will persist and improve their study skills.

Table 5

ATG 157 Final Grade	W/F/D	C	B	A
Grade Frequency (89)	19	22	29	19
Survey Grade	47%	49%	55%	58%

Previous research showed the math survey we used is a reasonable predictor of success. The table above reveals this was also true with this group. However, this observation is not satisfactory when we see that students earning an overall course grade of an A averaged only 58 percent on this measure of basic street math. Our focus is on professional studies and yet we are attracting students with a relatively weak arithmetic skills profile. We are left to wonder what systemic accommodations have crept into the curriculum to accommodate this arithmetic weakness.

There is a major validity issue here in light of the 89 participants' overall weak arithmetic competencies. It seems we find a way to allocate grades that is consistent with the various achievement measures. Perhaps all we are doing is validating that good students get good grades.

The crucial need for competent women in business merits an additional look at the data. In terms of our population, nine of the top ten ACT reported math scores were male students with a mediocre average grade of 78 percent on the math survey. The comparative math average for the top ten females is 58 percent. This represents a massive recruiting error. Why are we not attracting equally capable women? It is encouraging to note that the females earn a higher overall GPA in the ATG 157 course 2.9 versus 2.7 for the men. Despite their lower overall demonstrated arithmetic competencies on the survey, they earned a significantly higher rate of "A" grades. In subsequent work on this topic, the authors will consider why women are apparently more willing to apply themselves to their ATG 157 studies than the men are.

Findings and Conclusions

The purpose of this paper was to explore faculty frustration with their students' inability to process the arithmetic behind basic business transactions. The apparent disconnect between sound ACT-MATH scores and classroom performance did not make sense to us. Without some understanding of the underlying phenomena, faculty are at a loss to respond of show due empathy. So, specifically we set out to explore arithmetic skills as the variable which may explain much of this contradiction.

A significant body of research exists on the topic of standardized tests that has had limited applications to accounting educations. Harper (2009) provides a reflection from two experienced professors who retook the SAT so they could better understand a child's experience. The surprise was the marginal increase in their score, indicating their much improved understanding was not being measured. It becomes more obvious in admission decisions, for example Kolluri, Singamseth, and Wahab (2010) that the assumptions of ability, based on scores are not well established. Instead Harper realized that good students train for the test and do well, so the results are more of an indication of access to good test preparations.

So we can see that the development and convenience of tests like the ACT had some unintended consequences for

accounting educators over the last 30 years. Initially these tests gave a measure of mathematics in the context of a curriculum where students had solid skills in arithmetic. As the tests importance to in the admissions process increased, relative to the GPA, school promoting university-admissions would naturally track the tested topics. We see now that this also would make arithmetic less important too, and easy to enable with increasingly available technology. The assumption that is now appears to be an error about arithmetic, as the mathematics on the ACT can be handled with minimal use of basic arithmetic. Our problem then becomes, the arithmetic needed to think on one's feet and negotiate typical business transactions, is no longer available.

This leads to our concern about how the ACT-dependent admissions process may affect the decisions of students interesting in our profession. We can start by considering that the ACT is an early filter in the educational process of entering the profession. The profession needs entrants who understand financial transaction, can think on their feet, to audit or negotiate transactions. Good arithmetic skills are crucial to many aspects of this entrepreneurial process. It is a great impairment to the profession if member are weak in this skill as found in this study.

Are there substantial numbers of high-school seniors that have good arithmetic skills, but lack access to ACT preparation, or seniors that lack an interest in mathematics? For example their experiences with work have them able to make change but have left them with no skill or interest in calculus. We know from this study that there is a group that do well in mathematics but do poorly with arithmetic. Given that, perhaps there a strong possibility that there is a good sized group of seniors that are good at arithmetic but show poorly in mathematics—especially those topics emphasized on the ACT/SAT test. The size of this group should be investigated along with the ways our use of the ACT test discourages them from entering the education stream feeding the profession.

We see in the math education literature an additional filtering concern. We have found that good students will succeed by preparing for the ACT-exam but that does not mean they have that they have good sense for basic arithmetic relationships. But, faculty adjusts so that these students can still succeed (Ehlert, 2005). We know from other research these students avoid quantitative approaches by suppressing adaptive activities that could change the situation. (Siegel, Galassi, Ware, 1985) (Pajares, Miller, 1994) We propose that a good area for future research could examine how this reduces or correlates with the capacity to design, prepare and utilize analytical procedures in both controllership and audit functions. Again pointing to how we maybe enabling a skill set to be neglected that has been an historic strength or an accounting education.

In conclusion we feel that our exploration of our frustration with our student's apparent inability to do arithmetic adds an extra dimension to Kaplan's (2012) commentary. Kaplan warned that our scholarship should reflect more awareness of the environment. While he did not say so explicitly, the environment includes the skills and aptitude of those entering the profession. Today's students are no doubt as motivated as previous generations. Their strengths should not be assumed to be the same as earlier cohorts. Individually we cannot the use of the ACT or similar instruments. However, we can adjust our time and emphasis to show we understand who is in our classroom and down-stream professors they will have. A better emotion than frustrations would be to embrace the opportunity and provide incentives for our excellent students to gain a competitive advantage.

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(Footnotes)

1 GPA of students completing the course.

2 Foster College of Business Administration.

3 Slane College of Communications and Fine Arts.

4 College of Engineering and Technology.

5 College of Education and Health Sciences.

6 College of Liberal Arts and Science.

7 University Exploration Program (students who have yet to identify a college and major).

Appendix

ID Number: _____

This is not a placement test. Your scores here are being used for research purposes only. You will have 10 minutes to answer the 12 questions listed. Calculators are not permitted. Please use the space provided on the front and back to make any necessary computations.

Your College:

- ☐ Foster College of Business
- ☐ Communication & Fine Arts
- ☐ College of Education & Health Science
- ☐ College of Engineering & Technology
- ☐ College of Liberal Arts & Sciences
- ☐ Academic Exploration Program/University Program (UNV)

You are entering as a:

- ☐ Freshman
- ☐ Transfer student

11. 122,302 + 652,365 = ? _____

22. 861,365 – 241,211 = ? _____

33. The formula for calculating sales tax is $S = A \times r$, where:

S is the sales tax

A is the cost of the product

r is the sales-tax rate

If a television costs $500 and the sales tax is $25, what is the local sales-tax rate in percentage terms? _____

44. The cost of a long-distance phone call is 15 cents for the first minute, and then 3 cents per minute for every additional minute. How many cents would a 24 minute phone call cost? _____

55. By the end of the year, the population of Galesburg is expected to increase 2% from the current population of 45,000. If this prediction is accurate, what would be its new population at the end of the year? _____

66. 56.7 x 3.1 = ? _____

77. Last year Jake's salary was $58,000. At the end of the year he received a 10 percent increase in salary. What is his salary this year? _____

88. XYZ company's profits this year are $2,500,000. Its profit rate on sales (in ratio terms) is 0.10. What are its sales this year? _____

99. If Janice has 12 quarters, 3 dimes, 6 nickels and 7 pennies, how much money does she have? _____

110. Take 62 percent of $12,000. The result is: _____

111. 12,000 x .03 x 2/3 = ? _____

112. On the first of January the local bank agrees to lend you $20,000 for college tuition, room, and board. They charge you 6% interest per year payable on a monthly basis. How much interest must you pay at the end of January? _____

The Impact of Process vs. Outcome Feedback on Student Performance and Perceptions

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ABSTRACT

Much has been written in higher education assessing the value of feedback. This article seeks to explore how altering the feedback message might influence student learning and perceptions of learning. Feedback was provided on in-class quizzes in either the process portion or outcome portion of the quiz. Not only did process-oriented feedback have a more positive impact on student performance on quizzes than outcome-oriented feedback, it also was perceived more favorably by students both in terms of its usefulness and its impact on their learning in the class. However, the quiz feedback students received did not seem to generalize to a similar type of analysis question on other types of assessment instruments. This exploratory study suggests further research is warranted regarding the types of feedback provided, the type of assignment/assessment and the type of thinking required.

Introduction

Feedback is an essential component of learning, growth and development. Feedback provides individuals with information about their behavior or performance so they know what needs to be changed in order to improve. In cybernetics systems theory (Frandsen & Millis, 1993), feedback facilitates self-regulation because it identifies a gap between current performance and desired performance. Once the gap is identified, the individual can take action to close or reduce the gap. Thus, whether the feedback is used by employees, students, athletes, or artists, it is a mechanism to enhance learning and/or performance.

The role of feedback in traditional educational contexts has been studied extensively. Despite all that has been learned about the feedback process in general (e.g. Taylor, Fisher & Ilgen, 1984; Ilgen, Fisher & Taylor, 1979; Ilgen & Davis, 2000; Kluger & DeNisi, 1996) and the evidence that feedback enhances student learning in particular (Black & Wiliam, 1998; Hattie & Timperley, 2007), educators still struggle with how to most effectively use feedback to enhance student learning. Potential obstacles include the substantial time requirements associated with providing detailed feedback, uncertainty about what type of feedback will have the most value, and a lack of control over whether the feedback is utilized, either effectively or at all, by the student. In this paper, we will describe a feedback intervention used in teaching fundamental critical-thinking skills in an upper-level college economics class. Although the results are exploratory in nature, they suggest that feedback focusing on the student's thought process may have a more positive impact on learning than feedback focused on the final answer (e.g., Brookhart 2008).

Literature Review

Factors Influencing Feedback Effectiveness

Ilgen, Fisher and Taylor (1979) conceptualized the feedback process as a special case of the more general communication process. Looking at feedback from this per-

spective they argued that the factors influencing feedback effectiveness fit into three broad categories: the feedback source, the feedback recipient and the feedback message. Although their focus was on understanding the use of feedback in performance-oriented organizations, their description of the feedback process applies equally well to feedback in educational contexts. Pokorny and Pickford (2010) help to make that application to education stating, "Effective feedback is positioned as a process of ongoing engagement through the provision of opportunities for self-assessment and dialogue, placing the focus of the process in the classroom and on the delivery of the curriculum (p. 22)." If we examine the prior research on using feedback to enhance student learning, we can see that most of the research either examines the feedback message, which is typically, although not always, delivered by the instructor or the feedback recipient, which, in educational settings, is the student. This study addresses aspects of both the feedback message and the feedback recipient.

The Feedback Message

The feedback message focuses primarily on the content of the information provided to students about their performance. Some of the prior research investigating the feedback message has examined the nature of the feedback comments provided to students. For example, in a descriptive study, Mutch (2003) content analyzed the feedback comments that instructors provided and identified several different ways that these comments could be categorized (e.g. in terms of what was commented upon, the tone of the comment and whether the comment was positive or negative). Other research has compared the effectiveness of different types of feedback. Chase and Houmanfar (2009) compared the effectiveness of what they termed "basic" feedback, where students were simply told that their answer was either correct or incorrect, and "elaborate" feedback where students were also provided with information about why the answer was incorrect. As expected, students demonstrated more learning when provided with elaborate feedback than basic feedback. Black and Wiliam (1998) distinguished between descriptive and evaluative (i.e., grades) feedback and found descriptive comments to be more useful. Lipnevich & Smith (2009) found that providing students with a tentative grade along with comments resulted in lower performance than just providing comments.

These studies tend to focus on providing the feedback message to students at an end point, after an assignment is completed, to assess how well they have done on the assignment, and this feedback is largely directed at content outcomes, including whether or not the learning objective was achieved and involves providing a grade. In contrast to this typical feedback focus, Orlando (2015) and Halvorson (2014) recommend focusing feedback on the process used to reach the final product so that one might call upon that feedback/process to use in future situations. This is because the process is more under the person's control than the outcome and because ultimately, changes in the process are necessary in order to have a better product or outcome. Process-oriented feedback, according to Sadler (1983) is beneficial because it focuses on "growth rather than on grading" as a way to enhance learning (p.60). The recommendation to focus feedback on the process is also consistent with a substantial body of research which finds that feedback showing students how to reach the answer is more effective than feedback about whether the answer provided is correct or incorrect (Kluger & DeNisi, 1996). Our research examines this recommendation empirically.

In an educational context, one way to provide process-oriented feedback is to give students feedback on the thinking process they use in reaching their final answer. This contrasts with outcome-oriented feedback which is directed toward the answer provided by the student. Our research extends the feedback literature by developing an intervention that compares the typical method of providing the feedback message by evaluating the answer, and an atypical method of providing the feedback message by commenting on the critical-thinking process students use to arrive at the answer. Hence, the first research question is:

R1: Will providing feedback to students about the thinking process they used in developing their answer on an assessment improve classroom performance more so than providing feedback to students on the outcome or answer portion of the assessment?

The Feedback Recipient: Student Perceptions of Feedback

As noted above, when investigating the impact of feedback on student performance and learning it is also important to consider the feedback recipient, in this case, the student. Their perception of the feedback they receive will have a significant impact on if and how they respond to the feedback (e.g. Pokorny & Pickford, 2010; Weaver, 2006). Perhaps not surprisingly, research finds that students often do not actually use the feedback they receive (e.g. Glover & Brown, 2006; MacLellan, 2001; Sinclair & Cleland, 2007). This may be partially due to student perceptions that the feedback is not useful (Jonsson, 2012) or that it doesn't enhance their learning. Poulos and Mahony (2008) also emphasize the importance of considering student perceptions when assessing feedback effectiveness. They conducted student focus groups and then did a thematic analysis of the resulting transcripts. Their analysis identified a number of different themes which influence student perceptions of feedback effectiveness. These themes included the timeliness and delivery of the feedback, the significance of the feedback in terms of being useful and contributing to learning, and the importance of basing feedback on grading criteria and of receiving comments in addition to the grade. Their research demonstrates that determining what makes feedback effective is very complex and not necessarily uniform across all students.

Nevertheless, the prior research makes it clear that when evaluating the effectiveness of any feedback intervention, student perceptions of the feedback should be considered. If students don't understand the feedback, don't perceive it to be helpful or don't view it as enhancing their learning, they are unlikely to use the feedback to make changes, which will reduce the impact of the feedback on their performance. Consequently, in addition to looking at the effect of process vs. outcome feedback on student classroom performance, this study seeks to explore and compare student perceptions of these two types of feedback. Specifically, we examine student perceptions of the usefulness of process versus outcome feedback as well as their perceptions that learning occurred as a result of the feedback. Hence the final two research questions are:

R2: Will providing feedback to students about the thinking process they used in developing their answer on an assessment enhance student perception of the usefulness of the feedback more so than providing feedback to students on the outcome or answer portion of the assessment?

R3: Will providing feedback to students about the thinking process they used in developing their answer on an assessment improve their perception of learning more so than providing feedback to students on the outcome or answer portion of the assessment?

We further extend the feedback research by conducting a longitudinal study. Our study takes place over an entire semester and involves giving the students feedback at nine different points in the semester and assessing their learning over that time period.

Method

Sample and Context Description

The subjects for this exploratory study were 48 students (X males and Y females,) in two sections of a 300-level economics elective. All students had completed an introductory principles of microeconomics course as well as an introductory principles of macroeconomics course. The same economics professor taught both sections of the course. Class activities, exams, texts, materials, pace, etc. were the same between the classes. Both classes met two times a week for 75 minutes in the afternoon.

T-tests comparing students in the two sections showed that the two sections did not differ in terms of their gender, major and college. Although students in Section 1 had a higher cumulative GPA and had completed more credits (both cumulative and in the semester in which the study was conducted) compared to the students in Section 2, these differences were not statistically significant (see Table 1).

In terms of content and structure, this course utilized a set of tools and basic framework of analysis to understand various aspects of the employee-employer relationship. The aim was to help students apply basic

Table 1
Descriptive Statistics: Academic Experience

	Section 1 (Outcome-oriented feedback) N=25	Section 2 (Process –oriented Feedback) N=23	Difference in Means (p-value)
Cumulative GPA–Prior Semesters (4.0 scale)	3.305	3.117	-0.188 (0.134)
GPA–Semester of Study (4.0 scale)	3.098	3.000	-0.098 (0.429)
Cumulative Number of Credits–Prior Semesters	101.792	95.478	-6.314 (0.351)
Number of Credits–Semester of Study	18.750	15.609	-3.141 (0.557)
*** Significant at 1%, ** Significant at 5%, * Significant at 10%			

economic analysis to a wide range of strategic personnel problems encountered in the workplace. Emphasis was placed on using this analysis to draw logical conclusions and develop specific managerial recommendations. In other words, the focus was on developing students' critical-thinking skills instead of memorization of certain facts and figures. For each topic studied, the general methodology followed in this course was as follows: (1) introduce the relevant microeconomic theory in class and derive general principles; (2) apply these general principles to current human resource practices using recent newspaper, magazine, and journal articles; and (3) illustrate these general principles using real-world situations from full-length cases. Since this course was also designated as a writing-intensive course, a second objective of the course was to improve students' written communication skills.

Intervention Description

A significant component of the course was a series of nine assigned cases. Combining grades received on case quizzes, participation in case discussions, and case reports, these cases represented 50% of a student's course grade. Thus, students had a strong incentive to carefully read and analyze these cases. Prior to each case discussion, students were given a one-question, essay-based quiz in class. Students in both sections were given similar questions, although not identical in order to prevent the later section from having an advantage over the earlier section. In both sections, students were instructed to spend five minutes brainstorming and organizing their thoughts in the box located at the top of the quiz. During this time, students were not allowed to write in the answer box located at the bottom of the quiz. After five minutes of brainstorming, students were directed by the instructor to write their answer. They were reminded that their score would be based not only on the content and organization of their answer but also on grammar and punctuation. Students were given five minutes to write their answer. Before the quiz was turned in, students were required to proofread it for accuracy and completeness. See Appendix for a sample quiz.

One of the goals associated with the quizzes was to develop students' ability to identify both the positive and negative economic repercussions of pursuing a particular managerial strategy. Doing so would help them to provide a more balanced view of a situation and take into account different points of view. With this goal in mind, the quizzes were divided into three groups:

1. Group I: Quiz 1- Quiz 3
2. Group II: Quiz 4-Quiz 6
3. Group III: Quiz 7-Quiz 9

Group I and Group III quizzes required students to use these desired analysis skills. In other words, there was not a correct answer given the ambiguity in the case. Instead, students were graded on their ability to look at the issue from multiple perspectives. In contrast, Group II quizzes required students to simply describe a particular aspect of the organization highlighted in the case. Of interest in grouping the quizzes in this manner was whether or not improvements in critical-thinking skills early in the semester would be sustained after the change in quiz focus from analysis to description. In addition, a similar type of analysis-based question was included on the midterm exam in order to see whether or not improvements in critical-thinking skills would be sustained after a change in the assessment instrument from quiz to exam.

The quizzes in both sections followed the same pattern, as described above, and answers were graded on the same 5-point scale. However, to assess whether the type of feedback improved outcome, the instructor varied the written comments on the students' quizzes (R1). In particular, students in Section 1 received feedback solely on their answer (i.e. outcome feedback treatment), while students in Section 2 received feedback solely on their brainstorming process (i.e. process feedback treatment).

Measures

The primary dependent variable for R1 was student performance on the nine quizzes as well as their overall performance. Overall performance was assessed by performance on the midterm, performance on the final exam as well as final grade in the class. To examine R2 and R3, at the end of the semester, students were asked to assess the usefulness of the feedback received during the semester (R2) as well as the impact of the quiz feedback on their perceived learning in the class (R3). Note that both feedback usefulness and perceived learning were assessed by 3 items (see Table 4). All items were measured using a 5-point rating scale, with the "1" being "strongly disagree" and "5" being "strongly agree." Additionally, students' perceived effort was measured in order to determine if there were differences in effort or motivation between the two sections. Perceived effort was measured with 3 items, using a 5-point rating scale with "1" being "no/none" and "5" being "a lot". Finally, students were asked for their perception of the main focus of the feedback on the quizzes. This measure was included to determine if students understood the nature of the feedback they received and thus, served as a manipulation check.

Results

Manipulation Check

To determine if our feedback manipulation was successful, students were asked to indicate their extent of agreement with the following statement: "The feedback I received on my in-class quizzes was focused on how I analyzed/processed the information I read." If our manipulation was successful, students who received process feedback should agree with this statement to a greater extent than students who received outcome feedback. As shown in Table 4, this is exactly what we found.

Research Question 1

The first research question examined the impact of process vs. outcome feedback on student learning. We first examined learning as measured by overall performance. T-tests comparing the two sections on performance on the midterm exam, final exam and course grade revealed that despite differences in quiz-related feedback, both sections performed similarly on these instruments (see Table 2).

Given that the difference in feedback between the two sections was confined to the case quizzes, we also examined student performance on the quizzes themselves. These results are summarized in Table 3. For quizzes in

Table 2
Performance on Exams and Overall Course

	Section 1 Outcome-oriented Feedback	Section 2 Process-oriented Feedback	Difference in Means (p-value)
Mid-term Exam Analysis Question	4.200	3.957	-0.243 (0.723)
Mid-term Exam	75.520	73.565	-1.955 (0.413)
Final Exam	67.680	67.739	0.059 (0.984)
Overall Course Average	80.628	80.128	-0.500 (0.763)

*** Significant at 1%, ** Significant at 5%, * Significant at 10%

Table 3
Mean Performance on Quizzes

		Section 1 (Outcome-oriented Feedback)	Section 2 (Process-Oriented Feedback)	Difference in Means (p-value)
Group I	**Quiz 1**	3.636	3.524	-0.112 (0.620)
	Quiz 2	3.818	4.130	0.312 (0.112)
	Quiz 3	3.978	4.368	0.390*(0.062)
	Difference: Quiz 3-Quiz 1	0.292	0.696	0.404* (0.061)
Group II	**Quiz 4**	4.239	4.273	0.034 (0.832)
	Quiz 5	4.659	4.452	-0.207* (0.100)
	Quiz 6	4.560	4.543	-0.017 (0.812)
	Difference: Quiz 6-Quiz 4	0.313	0.261	-0.052 (0.755)
Group III	**Quiz 7**	4.011	4.381	0.370 (0.110)
	Quiz 8	4.359	4.438	0.079 (0.655)
	Quiz 9	4.182	4.638	0.456** (0.024)
	Difference: Quiz 9-Quiz7	0.208	0.143	-0.065 (0.766)
All	**Difference: Quiz 9-Quiz 1**	0.580	0.989	0.409* (0.062)

*** Significant at 1%, ** Significant at 5%, * Significant at 10%

Group I and Group III, we found that the section receiving process feedback performed better than the section receiving outcome feedback on all quizzes except Quiz 1. This difference was statistically significant for Quiz 3 and Quiz 9.

Additional insight into the impact of process vs. outcome feedback on performance can be gained by examining the pattern of mean quiz scores over the course of the semester. As described above, the quizzes were divided into three groups, with Group I and Group III quizzes containing an analysis-based question and Group 2 containing a description-based question. Figure 1 depicts mean quiz scores for Group I (Quiz 1 – Quiz 3), Group II (Quiz 4 – Quiz 6), and Group III (Quiz 7-Quiz 9).

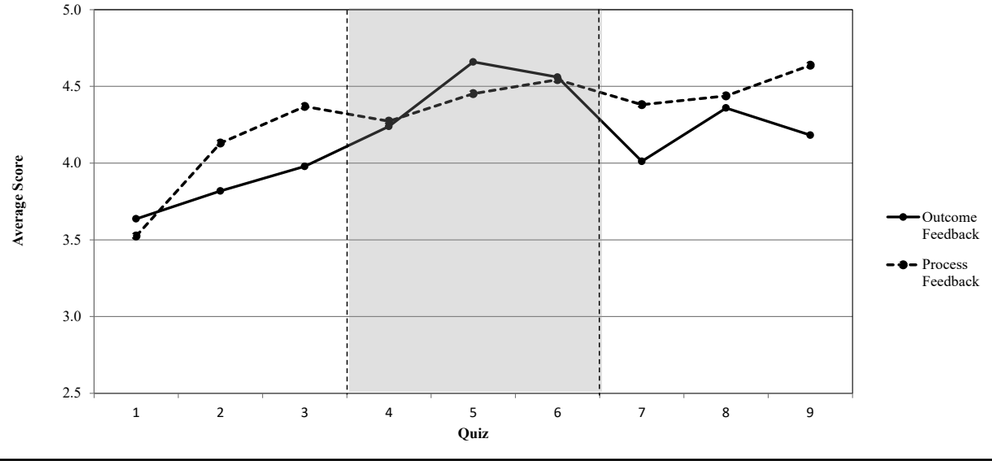
When we look at the change in quiz scores within Group I, we see that students receiving process feedback improved significantly more than students receiving outcome feedback. More specifically, within Group I, although students in both sections improved between Quiz 1 and Quiz 2, the rate of improvement was greater in the section which received process-oriented feedback. Moreover, when we look at the performance difference between Quiz 1 and Quiz 3 we find that students receiving process-oriented feedback improved significantly more than students receiving outcome-oriented feedback.

When the focus of the quiz shifted from analysis to description in Group II, the gains realized by students in the section receiving process-oriented feedback over their peers in the outcome-oriented feedback section dissipated. Our results showed that students in the outcome-oriented feedback section performed similarly to students in the process-oriented section for Quiz 4 and Quiz 6; on Quiz 5, the group receiving outcome feedback performed significantly better than the group receiving process feedback. These results suggest that the outcome-oriented feedback might be more relevant or useful than the process-focused feedback for the less ambiguous, description-oriented, quiz questions.

When students once again were given analysis-based quizzes (Group III quizzes), our results suggest that there was greater retention of previous feedback for students who had received process-oriented feedback. In particular, comparing Quiz 6 and Quiz 7, there was a noticeable drop in the performance of students receiving outcome-based feedback. Students receiving process-oriented feedback did not experience the same sharp decline; in fact, after a slight decline on Quiz 7, their performance continued to increase. Looking at the difference in performance between Quiz 7 and Quiz 9 shows that again students receiving process-oriented feedback improved significantly more than students receiving outcome-oriented feedback. Further, looking at the change in quiz scores across the entire semester (i.e., comparing performance on Quiz 1 and Quiz 9) shows that the section receiving process-oriented feedback improved significantly more than the section receiving outcome feedback.

Although we cannot rule out the possibility that these performance differences were due to pre-existing differences between the two sections, the fact that the two sections did not differ in reported effort or motivation (see Table 4), in their cumulative or semester GPA or in the number of credits completed prior to taking the course suggests that the performance differences on the quizzes is more likely due to the nature of the feedback received rather than to other factors.

Figure 1
Quiz Scores



Research Questions 2 and 3

The second and third research questions focused on student perceptions of how useful the feedback was and its impact on their learning. T-tests comparing the two sections provided some evidence that students who received process-oriented feedback on quizzes perceived that feedback to be more useful in terms of improving their performance in the class than students receiving outcome-oriented feedback on quizzes. The lack of differences between the two sections in terms of perceived usefulness of feedback received on other assessment instruments is consistent with the fact that feedback manipulation only occurred on the quizzes. Students receiving process-oriented feedback also perceived that the quiz feedback had a greater impact on their learning in the class than students who received outcome-oriented feedback (see Table 4). Specifically, although there was no difference between the two sections in terms of perceived impact of the course on writing skills, the section receiving process-oriented feedback reported a greater improvement in their ability to analyze or process what they had read as well a greater awareness of how to use feedback to improve their answers compared to students in the section receiving outcome-oriented feedback.

Table 4
Student Perceptions of Feedback Usefulness and Learning

	Section 1 Outcome-oriented Feedback	Section 2 Process-oriented Feedback	Difference in Means (p-value)
Perception of Feedback Usefulness			
The feedback I received on my in-class quizzes positively impacted my performance in this class.	3.667	4.350	0.683** 0.023)
The feedback I received on my case reports positively impacted my performance on this class.	4.333	4.100	-0.233 (0.352)
The feedback I received on my mid-term exam positively impacted my performance in this class.	3.524	3.750	0.226 (0.462)
Perception of Learning			
After taking this course, I am better at analyzing/processing what I read.	4.048	4.450	0.402** (0.025)
After taking this course, I am better at explaining my thoughts in a written format.	4.095	4.263	0.168 (0.341)
After taking this course, I am more aware of how I use feedback to improve my answers to questions.	3.810	4.368	0.558*** (0.003)
Perception of Effort			
I made _____ effort to improve my writing capabilities in this class	4.095	4.300	0.205 (0.2448)
I made ____ effort to improve my understanding of theory in this class.	3.762	4.100	0.338 (0.135)
I made ____ effort to improve my understanding of personnel applications in this class.	4.048	4.200	0.152 (0.555)
Perception of Type of Feedback			
The feedback I received on my in-class quizzes was focused on how I analyzed/processed the information I read.	3.333	4.200	0.867*** (0.005)
***** Significant at 1%, ** Significant at 5%, * Significant at 10%**			

DISCUSSION

The purpose of this study was to compare the effectiveness of two different types of feedback – feedback focused on the student's thinking process prior to generating an answer (process-oriented feedback) and feedback focused on the student's answer (outcome-oriented feedback). We compared the impact of these two types of feedback on student performance as well as their perception of the usefulness of the feedback and its impact on their learning in the class. Although this was an exploratory study, our results suggest that process feedback may be more beneficial than outcome feedback for more complex analysis-based assignments. Specifically we found that while both types of feedback resulted in performance improvement on quizzes, students receiving process-oriented feedback had significantly greater improvement than students receiving outcome-oriented feedback. They improved more within both groups of analysis quizzes (Group I and Group III) as well as across the entire semester when comparing performance on the first quiz with performance on the ninth quiz. Process-oriented feedback focusing on the student's brainstorming/thinking process may be more beneficial than outcome-oriented feedback because it addresses the more fundamental steps a student needs to take in order to produce a better outcome. Students may more easily perceive the value of this feedback, which would increase the likelihood that they will apply it to subsequent quizzes. When students receive feedback only on the outcome (their answer), they may not be able to translate that information into what they need to change in order to improve their answer on a subsequent quiz, and thus, perceive it as having less value in improving their performance. Furthermore, feedback addressing their answer may have resulted in students focusing only on their grade and not attempting to understand and apply the feedback to the next quiz.

It is noteworthy that the quiz feedback students received did not seem to generalize to a similar type of analysis question on the midterm exam or to the case reports which also required this type of analysis. Students who received process feedback on the quizzes performed the same on the case reports as students receiving outcome feedback and actually performed less well, although not significantly, on the parallel question on the midterm exam. In fact, neither class appeared to be able to transfer learning from the quizzes to either the exams or the case reports. It is not clear why students were unable to apply their learning from the quizzes to other forms of evaluation in the class. It is possible that students did not recognize the similarity between the quiz questions and the exam question and case reports or that they did not realize that they could apply this method of analysis to problem solving in other contexts. Support for this possibility comes from a conversation the first author had with a student in the class who was trying to decide whether to accept a job offer. When it was pointed out to the student that she could apply the same method of analysis used on the quizzes to this situation, the student appeared surprised – she apparently did not automatically see that the situations were similar and thus, did not realize she could apply something she had learned in the class to her personal situation. Helping students to see how they can apply learning from one context to another context would be beneficial. Future research could investigate whether providing students with a prompt that highlights the similarity between an exam question and the previous quiz questions might be sufficient to trigger application of thinking strategies practiced and learned on the quizzes to the exam.

It is interesting that students receiving outcome-oriented feedback actually performed better on the descriptive quiz questions than the students receiving process feedback. Because these questions were less ambiguous, were factual in nature, and thus, were either correct or incorrect, feedback focused on the outcome (answer provided) seemed more beneficial than feedback focused on the process (thinking process). This finding is suggestive that different types of feedback might have more or less value depending on the nature of the assignment and the type of thinking required. Future research might examine this issue by varying the nature of the feedback provided to students on assignments that focus on different levels of thinking in Bloom's taxonomy (Bloom, Englehart, Furst, Hill, Krathwohl, 1956; Anderson & Krathwohl, 2001).

Not only did process-oriented feedback have a more positive impact on student performance than outcome-oriented feedback, it also was perceived more favorably by students both in terms of its usefulness and its impact on their learning in the class. This may be because it showed students what they needed to change in order to perform better instead of simply highlighting what was incorrect with the answer they provided. Furthermore, these students were able to see a more substantial improvement in their performance on the quizzes throughout the semester as they presumably applied, and then benefitted from, the feedback. This would likely have resulted in stronger perceptions that the feedback was enhancing their learning in the class.

CONCLUSION

Taken together, our results suggest instructors may be able to influence both student learning as well as students' perception of their skill development simply by changing the type of feedback they provide to students. They also

generate some additional questions worth investigating further. In particular, is it necessary to require separate brainstorming and feedback in order to obtain the performance improvements that we observed in this study? It may not always be possible or even desirable to require students to brainstorm prior to writing their answer as was done in this study. If students are told that they are being provided feedback on their thinking process and that the purpose of the feedback is to help them improve on *subsequent* assignments, would that accomplish the same thing as having separate brainstorming-related feedback even if that feedback was associated with their answer? Future research could address this question.

As noted above, future research should also address approaches that instructors might use to help students recognize that they can apply thinking strategies practiced in one assignment to other related, but not necessarily identical, assignments. Also important is helping students to recognize the opportunities to utilize the methods of analysis presented for academic materials to non-academic situations. These skills and methods of analysis should enhance effectiveness in work-related contexts but if students do not apply them to these contexts, their value is lost.

Because this study was exploratory in nature and had a small sample, it is not clear if the findings will generalize to other samples and settings. However, our results suggest that further study is warranted. If we better understand what type of feedback is most appropriate for what types of assignments and for what purposes (e.g. for improving what types of thinking skills), we can provide students with feedback that will have more value – both as perceived by students and in terms of impact on student performance and learning.

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Appendix
Sample Case Quiz

Stephen Connor, research director at RSH, is faced with the challenge of replacing a star semiconductor analyst, Peter Thompson. Each of the five potential candidates possesses certain critical skills, experiences and relationships and lacks others.

- Would you recommend hiring Sonia Meetha? Why or why not?
- Brainstorm and Organize Thoughts (must fit in the box below):
- Answer (must fit in the box below):

The Effect of Individual Motivation and Cognitive Ability on Student Performance Outcomes in a Distance Education Environment

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ABSTRACT

The authors explored the effects of general mental ability and motivation (operationalized as conscientiousness) on performance in an online distance education course. The results supported the hypotheses that both higher levels of motivation and higher general mental ability are positively associated with academic performance in a distance learning environment, while low levels of either motivation or general mental ability were associated with lower levels of performance. The results also support the presence of a significant interaction effect between motivation and general mental ability in terms of their relation to performance. High levels of either motivation or general mental ability alone with low levels of the other factor did not produce high levels of performance, demonstrating the importance of simultaneously considering both factors. Theoretical and practical implications of the results are discussed.

Distance education refers to institution-based, formal education provided to geographically diverse students through interactive telecommunications systems. Institutions that have an educational mission as all or part of their purpose have been quick to utilize distance education technologies as these technologies offer an effective way to both expand the student population base and take advantage of technological capabilities to more efficiently address the needs of current student populations.

Academic institutions, especially, are increasingly using distance education to provide academic courses. By 2007, 3.9 million students were taking at least one online class (Doyle, 2009). A single massive open online course (MOOC), Norvig and Thrun's AI class, has been shown to enroll 160,000 students (Carr, 2012). Driving this increase is the convergence of several factors which make distance education an increasingly effective method to deal with several practical problems and opportunities.

First, in many areas of the world, there is a both a growth of the university-age undergraduate population, and a growth in the need for education of older populations who must continue life-long learning in order to adapt to changing educational needs in the workplace. Governments and other organizations are reluctant to invest the capital expenditures required to build new conventional campuses and educational facilities, preferring to attempt to "do more with less" by encouraging distance education as a way to deal with increasing educational needs over a more geographically dispersed or divergent population (Oblinger, Barone, & Hawkins, 2001).

Second, education consumers are increasingly shopping for courses that best accommodate their learning styles and schedules when pursuing higher-education degrees or skill training (Johnstone, Ewell, & Paulson, 2002; Paulson, 2002; Carnevale, 2000). Today's customers of education, raised on the instant availability of the digital communication and accustomed to accomplishing work on their schedule because of this availability, increasingly are demanding that at least some, if not all, of their educational sources be flexible and delivered in formats other than traditional classroom settings.

Third, these trends are facilitated by rapidly improving technology that provides for a continuously improved and more effective distributed learning environment (Oblinger et al., 2001). Major organizations are investing very heavily in differing distance education technologies and systems, lending validity to the fact that although the technology of distance education may not have reached the stage of standardization, the use of distance education is likely a permanent change in the educational landscape and not a fad whose implications can be ignored.

Fourth, distance education is attracting a new subpopulation of higher-education learners – those who are "generally older, have completed more college credit hours and more degree programs, and have a higher all-college GPA than their traditional counterparts" (Diaz, 2002, pp. 1-2).

Finally, in addition to its use in the higher-education sector, distance education also has strong implications for education and training in private, public, and military organizations (De Lorenzo, 2005; Schreiber & Berge, 1998). The combination of all of the above factors points to an increase in the range of applications of distance education in the future, and increasing organizational concern with the efficacy of distance education efforts.

Distance Education Effectiveness

Successful outcomes of distance educational experiences depend on a number of factors, including both institutional (e.g., the user-friendliness of technology and quality of content) and individual (i.e., ability and motivation) characteristics. The growth of distance education as a major distribution channel for lifelong learning services targeted toward working adults offers an opportunity to identify both characteristics of successful distribution systems, and equally important, identification of methods of student classification to determine which potential students are more likely to be successful in the distance education environment. Identification of characteristics of successful student populations will help ensure that distance education learning techniques are used where most pedagogically appropriate, efficient, and effective.

There is a large amount of prior research, especially from scholars engaged in work in educational systems and new technology, on various aspects of distance education. A great majority of this research, as would be expected from a growing field with a lack of widely accepted standards, is more concerned with the technical aspects of delivering distance education, and less with determining what populations might best utilize distance education (De Lorenzo, 2005). Distance education literature also has historically suffered from a lack of standardization of term definition and usage. Distance education is a field in which many different disciplines come together to be used in combination to achieve a desired end that cannot be accomplished by any single discipline; therefore, this lack of standardization is not unexpected. Part of the purpose of this paper is to address this aforementioned situation with respect to student performance outcomes.

There is also a substantial and increasing need to better identify those students who "fit" into distance education courses, so that appropriate student populations are exposed to the most appropriate pedagogical methodologies for their characteristics. For example, at the institution of two of the authors, an urban research university, the College of Business Administration has a goal of offering 30% of class sections each semester in a distance education format. Anecdotal evidence suggests that students enroll in these classes for a wide variety of reasons, with a correspondingly wide variation in success rates, yet there is currently no system to classify students in any fashion to determine either their suitability for the method used in the class or how they might be better counseled to enhance their probability of successful outcomes using the distance education method. Our university is not unique in this aspect, as classification of students to help ensure success in certain learning environments is the exception rather than the norm at most institutions. Students self-select when taking MOOCs which can have dropout rates as high as 95% (Carr, 2012). An understanding of what students belong in what type of course is critical harnessing the potential of these environments.

There is arguably a strong need for research in the areas of student classification, measurement for classification, and performance outcomes in distance education settings. As would be expected, the distance education literature generally has discussed the concepts of ability and motivation to succeed as important to performance outcomes. However, the applicability of this research is less clear than it should be due to the previously mentioned lack of standardization in terminology and measurement (De Lorenzo, 2005).

The research described in this paper addresses these weaknesses by using accepted terms and standardized measures from the behavioral literature for both ability and motivation. We do this in order to define a coherent line of research that can be focused on individual student characteristics and the relationship of those characteristics to educational outcomes. To be of the most practical use, these characteristics should be easily measurable, commonly available in educational settings, and useful to meaningfully discriminate among student population members in order to ensure the most efficacious use of resources dedicated to distance learning.

Ability and Motivation as Antecedents of Performance

Both ability and motivation have been hypothesized to positively effect performance. In particular, Maier (1955) proposed that ability and motivation have both main effects and interaction effects. Most empirical research has focused on main effects, however, Perry et al. (2010) found evidence of interaction effects when studying predictors of customer service performance. This study considers both the main effects of ability and motivation as well as their interaction effects.

Ability

Scholars have typically associated task skills and task knowledge with general mental ability (GMA; Viswesvaran, 2002). Motowidlo et al. (1997) defined task knowledge – including both declarative and procedural facets – as "knowledge of facts and principles related to functions of the organization's technical core... [and] knowledge of procedures, judgmental heuristics, and rules for processing information and making decisions about matters related to the technical core" (p. 80). Moreover, they argued that task knowledge primarily stems from GMA, as those higher in mental ability have greater capacity for insight as well as higher capacities for information processing, attending to important stimuli and excluding unimportant stimuli, and using knowledge compared to those lower in mental ability. They perform better because they learn more efficiently and more effectively, both of which result in the acquisition of more task knowledge.

Researchers have employed a number of measures of GMA, but the measures generally fall into one of two categories: standardized academic entrance exam scores (e.g., CSAT; Sackett et al., 1998) and standardized intelligence tests (e.g., Wonderlic Personnel Test; Mount, Barrick, & Strauss, 1999). An extensive literature search indicates that GMA is the one of most important individual difference predictors of job performance across jobs (e.g., Schmidt & Hunter, 1998). Schmidt and Hunter's meta-analytic examination of 19 common job performance predictors indicated a validity coefficient of .51 for GMA. Further, most of the other predictors (e.g., assessment centers, job experience) contributed little to no explanation of performance variance beyond that accounted for by GMA.

Consistent with prior research, we expect GMA to positively impact performance in a distance education course because those with a higher GMA remember more and apply their knowledge more effectively than those with a lower GMA.

Hypothesis 1: GMA scores are positively related to performance in a distance education course.

Motivation

Campbell (1976) suggested that motivation could be characterized as the choice to initiate effort on a certain task (direction), the choice to expend a determined amount of effort (intensity), and the choice to continue expending that amount of effort (duration). Researchers have used the personality construct of conscientiousness as a proxy for motivation because highly conscientious individuals are likely to display high levels of all three aspects of motivation due to their organized, achievement-oriented, and persistent nature (Mount et al., 1999).

Schmidt and Hunter (1992) labeled conscientiousness as the most important trait-based motivation variable in the field, and empirical research suggests that it is the strongest individual difference predictor of job performance, with the exception of GMA (e.g., Behling, 1998; Hogan, Rybicki, Motowidlo, & Borman, 1998). Additionally, Schmidt and Hunter's (1998) results indicated that conscientiousness significantly contributes to the predictive validity of overall job performance beyond GMA. Schmidt and Hunter (1998) also reported similar results for integrity tests and structured interviews, both of which have large conscientiousness components. Although other

researchers have found positive effects of motivation on distance education outcomes, they relied on measures that were specific to the motivation for the particular learning activity rather than persistent characteristics of the learner (Wang et al., 2008). General learner characteristics can help understand learner behavior throughout their learning life across learning experiences. Wang et al. (2008) did not measure ability. Some researcher investigates the effect of distance education design on student motivation, but does not consider the students initial motivation and therefore gives little evidence to which student populations might be most successful and which may be at risk. For example, Liao (2006) shows a positive relationship between a flow educational experience and outcomes, the research does not show which students are likely to experience high levels of flow and ultimately learning success. Simpson (2008) argues the need for better theories of learner support which should be predicted on understanding of theories of learner motivation rather than just outcome experiences with one set of tools. Therefore, this study focusses on the learner motivation independent of tools use.

Goldberg (1993) suggested that conscientiousness is reflected by such characteristics as dependability and thoroughness versus carelessness and negligence. "Conscientiousness describes socially prescribed impulse control that facilitates task- and goal-directed behavior, such as thinking before acting, delaying gratification, following norms and rules, and planning, organizing and prioritizing tasks" (John & Srivastava, 1999, p. 121). Conscientiousness predicts task performance; because high-conscientiousness workers tend to be efficient, thorough, responsible, organized, and reliable (McCrae & John, 1992). They are likely to persevere and more effectively engage in self-discipline (Colquitt & Simmering, 1998), be more proactive and effective in goal-setting (Barrick, Mount, & Strauss, 1993; Gellatly, 1996), and exert more effort (Mount & Barrick, 1995) than low-conscientiousness workers. These task habits are likely to influence performance levels of effectiveness in fulfilling distance education course requirements. Accordingly, we propose:

Hypothesis 2: Conscientiousness is positively related to performance in a distance education course.

Ability x Motivation

Are the joint effects of ability and motivation on performance of an additive or interactive nature? If the former, then both motivation and ability are significantly related to performance in a distance education course, and their effects are independent and complementary. If the latter, then increments in ability have different relationships with performance at different levels of motivation and increments of motivation have different relationships with performance at different levels of ability. Stated alternatively, the higher the ability, the greater the impact of motivation on performance and the higher the level of motivation, the greater the impact of ability on performance.

Motivation theorists (e.g., Campbell, 1976; Heider, 1958; Maier, 1955) have long hypothesized that performance-related work outcomes are an interactive function of motivation and ability, P = f(M x A). This perspective suggests that greater ability has greater effect at higher levels of motivation and that high levels of motivation have greater effects for more able individuals. In other words, capable individuals who make little effort because they are unmotivated will perform poorly and individuals who lack the ability to perform well will perform poorly even though they are motivated.

Kipnis (1962) demonstrated interactions between ability and persistence explaining supervisory ratings of the job performance of military personnel. O'Reilly and Chatman (1994) reported that the positive relationships between ability (i.e., business school entrance exam scores) and four important early career outcomes – job offers, salary, salary increases, promotion – among MBA graduates were stronger for those with higher levels of conscientiousness.

We suggest that the relationship of ability and motivation with performance is consistent with Maier's (1955) hypothesis when ability, motivation, and performance are measured. We expect that GMA results in greater performance in a distance education course among individuals who are dependable, hard-working, thorough, and efficient and that high levels of motivation enhance performance more among more able individuals. Thus, consistent with Maier (1955), we hypothesized that ability and conscientiousness interact to predict performance in a distance education course:

Hypothesis 3: The relationship between GMA and performance in a distance education course strengthens as conscientiousness increases and the relationship between conscientiousness and performance strengthens as GMA increases.

Method

Sample

The participants consisted of a total of 96 undergraduate business school students enrolled in a management course offered online by a public university in the United States.

Measures

GMA. We assessed GMA using the overall score of the American College Test (ACT), a college entrance exam. The ACT is a valid predictor of performance in college, as measured by grade-point average (Schmitt et al., 2007).

Conscientiousness. We used the 10-item version of the Conscientiousness scale of Goldberg's (1999) Big Five factor markers in the International Personality Item Pool (IPIP). Students rated the items using 5-point scale (1 = "Very Inaccurate" to 5 = "Very Accurate").

Course performance. Students completed four timed, multiple-choice exams, which were scored automatically by an online course system. Students were not permitted to take more than 60 minutes to complete each exam. Exam items were randomly generated, such that students would be asked to respond to different combinations and presentations of items. We summed the points earned on the four exam scores as our index of course performance.

RESULTS

Table 1 presents the means, standard deviations, reliability estimates, and correlations for the variables. As shown there, both ACT scores (r = .29, p < .05) and conscientiousness (r = .22, p < .05) were significantly and positively correlated with total test points. These results are consistent with meta-analyses investigating the relationship between ability and performance (Schmidt & Hunter, 1998) and the relationship between the Big Five model of personality and performance (Barrick & Mount, 1991). Further, consistent with prior research (Mount et al., 1999), the relationship between ability and conscientiousness was trivial (r = .04, ns).

We tested the two main effects hypotheses using multiple regression analyses. Table 2 presents the results of the regression analyses. The regression model including both ACT and Conscientiousness as predictor variables was significant (F(2, 93) = 6.99, p < .001). Further, the significant beta weights for each variable supported both Hypothesis 1, which proposed a positive relationship between ACT scores and exam scores, as well as Hypothesis 2, which proposed a positive relationship between conscientiousness and exam scores.

Table 1
Descriptive Statistics: Means, Standard Deviations, and Correlations for Study Variables

Variable (N = 96)	M (SD)	1	2	3
ACT	20.4 (3.62)	---		
Conscientiousness	3.97 (.43)	.04	---	
Test Scores	574.58 (35.23)	.29*	.22*	---

*p<.05

We tested the interaction hypothesis using hierarchical regression. First, we centered the predictor variables. Second, we added the GMA x Conscientiousness cross-product term to the main effects model. Third, we tested the change in R2 between the model with only the main effects included and the model with both the main effects and the interaction term included. The test of R2 change indicated support for our third hypothesis, which proposed an interactive effect between GMA and Conscientiousness scores on exam scores (F(1, 92) = 4.11, p < .05).

In order to precisely identify the manner in which the ACT-performance relationship was affected by conscientiousness, we applied Bauer and Curran's (2005) extension of the Johnson-Neyman (J-N) technique to estimate regions of significance. Regions of significance indicate the levels of conscientiousness at which the group mean difference is significant. They provide an inferential test for any possible simple slope (Bauer & Curran, 2005). This

Table 2
Hierarchical Regression Analysis (N = 96)

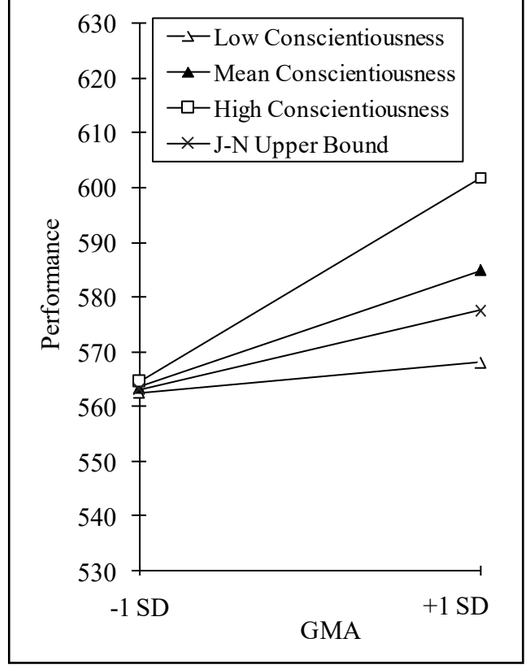
Dependent Variable:	*B*	β	R^2	*F*	ΔR^2
Step 1					
ACT	2.77**	.29			
Conscientiousness	17.46*	.21	.13	6.99***	
Step 2					
ACT	-17.45	-1.80			
Conscientiousness	-83.81	-1.01			
Interaction	5.14*	2.46	.17	6.18***	.04*

*p<.05,**p<.01, ***p<.001

yielded 95% (non-simultaneous) regions of significance defined by a lower bound of -27.38 and an upper bound of -0.19. The minimum and maximum values of (mean-centered) conscientiousness were -.43 and .43. The upper region fell within the observed range of conscientiousness scores. As the lower region did not, we did not represent or interpret it further.

Figure 1 is a graphic representation of the results of our application of Bauer and Curran's (2005) extension of the J-N technique to Cohen et al.'s (2003) suggested protocol for identifying the forms of interactions. It contains a plot of the equations at low, average, and high levels of conscientiousness scores (-1, 0, and 1 standard deviations from the mean). As shown in Figure 1, the ACT-performance relationship was non-existent among workers at low (simple slope: $t = .56$, ns) levels of conscientiousness. In contrast, the relationship was positive among workers at average (simple slope: $t = 3.16$, $p < .01$) and high levels of conscientiousness (simple slope: $t = 3.45$, $p < .01$). Congruent with the simple slopes analysis, the region of significance was between the average level of conscientiousness and one standard deviation below the mean of conscientiousness. Thus, ACT scores were unrelated to performance only among the individuals relatively low in conscientiousness. Conscientiousness was unrelated to performance among individuals with low ACT scores.

Figure 1
Interaction of GMA and Conscientiousness on Academic Performance



Discussion

We proposed that both GMA and conscientiousness are related to performance in a distance education course. The results were consistent with our predictions. We also proposed that the joint effects of GMA and conscientiousness (i.e., ability and conscientiousness) are interactive rather than additive. The results indicated that as conscientiousness increased, the effect of GMA on performance increased. Consistent with the interactive hypothesis, the GMA-performance relationship held for all but individuals relatively low in conscientiousness.

We offer four possible strengths of the current study. First, we used two well-known measures – the ACT measuring GMA and the IPIP measuring Conscientiousness – to test the interactive hypothesis. Second, our criterion measure was objectively scored. Although it was likely far from the ideal, scores did not reflect subjective interpretation that might affect variation in scoring across the participants. Third, the criterion measure reflected performance across four trials, which may provide a better assessment of performance than a single trial. Finally, our hypothesis was based on two constructs – GMA and Conscientiousness – that were theoretically relevant to the performance criterion.

Limitations and Future Research

First, replication is needed because we had only one sample. Second, our sample consisted of 96 undergraduate business students. Although anecdotal evidence indicated that many or most of these individuals had part-time or full-time jobs in the private, public, or military sectors, the generalizability of the results to other populations is not known. Similarly, the course content and our performance criterion may not be representative of distance education courses in settings outside of higher education. Third, we operationalized GMA in terms of the ACT score and motivation in terms of conscientiousness. Other GMA measures may have been more appropriate and/or would yield different relationships

Equating motivation with conscientiousness permitted us to assess motivation in terms of individual characteristics, but motivation operationalized as a situational characteristic (e.g., supervisors monitoring course progress) is likely to provide an alternative approach to testing the interactive hypothesis. The distance education research literature in the educational field tends to define motivation as a situational characteristic, not an individual characteristic. It would seem this would be a fertile area for research to determine the relatedness of the two methods of defining motivation with regard to performance in a distance education context.

Conclusion

Performance in a distance education course may represent a unique aspect of performance. Maximum performance reflects capabilities or what students "can do," whereas typical performance reflects what students "will do" (e.g., Kanfer & Ackerman, 2005). A student fulfilling distance education course requirements faces a highly independent set of tasks. Thus, the application of ability and motivation of the student may be more important in the distance education environment than other learning environments.

As we noted previously, the emergence of distance education as a distribution channel for lifelong learning services targeted toward large segments of the education-consuming population offers an opportunity to identify which students are likely to be successful. Not all individuals are predisposed to perform well in distance education courses. Unlike most education and training situations, the distance education context is one of considerable independence and few proximal situational influences.

Implications for educators or managers are two-fold. The first is the need to identify which students or employees would benefit most from distance education. The second is to identify which students or employees taking such courses would benefit from organizational assistance (i.e., formal study groups, mentors assigned, etc.). The present study is a preliminary step in addressing these issues. We found that high-ability, highly conscientious individuals performed at the highest levels. Individuals lower in ability and conscientiousness may be likely to benefit from various forms of assistance in order to enhance the effectiveness of their distance education performance and experience. Practically, this may mean that additional criteria other than student choice should be used to determine who should be taught with distance learning methodology, and that potential students should be counseled as to additional factors they should consider when deciding whether to enroll in a class taught with distance education methodology.

Since the use of distance education is increasing, more subject areas and more student populations will likely be touched by distance education technology making ever more important to understand the situations that will challenge distance education effectiveness and what techniques can be used to improve effectiveness. In situations where either or both GMA and motivation are low, research should consider how distance education can be reinvented in ways that better support those weaknesses and what will be effective under the two situations. Further, can promising techniques such as tools that inspire flow be systematically adapted to students of differing ability and motivational characteristics.

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