Developing a Computer Ethics Course for Online Learners

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***Abstract* – Online learning is still a very contentious topic throughout the halls of academia. Advocates state that students who complete online courses learn as much as those in a face-to-face environment; earn equivalent grades; and, are equally satisfied. However, other researchers note that online students are less likely to complete their courses thereby negating the positive impact. Yet, online education is continuing its upward growth and in higher education, new degree programs and courses are being added on a regular basis. The Babson Survey Group reported that in 2011, online course enrollment hit an all-time high with more than 6.1 million students. The reported also stated that approximately thirty-one percent of all higher education students now take at least one course online. With the cost of education rising and employers looking for students with more depth in the subject area, there remains a debate regarding how to best deliver the educational experience to students. The aim of this paper is to present the development and results of a pilot study involving an online computer ethics course at a two-year institution. The paper positions the course within the context of the college's computer science curriculum, describes the rationale for course development and presents the next steps toward making the course a requirement for computer science majors.**

Keywords – computer ethics; learning content management system; online learning; undergraduate computer science

I. INTRODUCTION

The United States Department of Commerce, Economics and Statistics Administration in its July 2011 report stated that science, technology, engineering, and mathematics (STEM) occupations are projected to grow by 17.0 percent between 2008 and 2018, compared to 9.8 percent growth for non-STEM occupations [1]. Additionally, STEM workers command higher wages, earning 26 percent more than their non-STEM counterparts. Moreover, STEM degree holders enjoy higher salaries, regardless of whether they are working in STEM or not [1]. By 2018, the bulk of STEM jobs will be in Computing (71%) followed by traditional Engineering (16%), Physical Sciences (7%), Life Sciences (4%) and Mathematics (2%) [2]. These statistics provide an impetus for more students to choose STEM areas as fields of study; however, the number of students choosing STEM disciplines, inclusive of computer science is steadily decreasing.

According to The New York Times' Christopher Drew, studies note that approximately 40 percent of students who choose to purse a STEM area either switch their major in college or do not graduate at all [3]. This statistic, as stated by Drew, is twice the combined attrition rate of all other majors [3]. A great deal of research has been conducted on the reasons as to why students choose not to study STEM. It has been suggested that societal stereotypes, environmental and cultural factors, a lack of visible role models, different interests and experiences, and academic un-preparedness are some of the reasons [4] – [7]. While these reasons are well-documented, more research is now being conducted on what happens to students during the first two years of college which deters them from pursing their goals of becoming a scientist, engineer, mathematician or computer scientist.

One article posits that there has been a dramatic shift in the way in which students learn [8]. It suggests that most high school classes are small in nature allowing a teacher to work with approximately thirty students at any given time. This stands in stark contrast of the large lecture halls consisting of 200 students that a new college student might face. In this type of environment, most professors cannot offer individual attention to all students enrolled in the course, often leaving some students to teach themselves, which in high school they have not learned how to do [9]. Therefore, the paradigm of how to best offer course content to students and especially STEM majors is continuously being studied.

In the report entitled Distance Education at Degree Granting Postsecondary Institutions 2000-2001, from the National Center on Education Statistics, noted that during the 2000-2001 academic year, 56 percent (2,320) of all 2-year and 4-year Title IV-eligible, degree-granting institutions offered distance education courses for any level or audience. Moreover, there were an estimated 3,077,000 students enrolled in all distance education courses offered by 2-year and 4-year institutions during the 2000-2001 academic year [10]. Since that report, it has been noted that online course enrollment in the United States hit an all-time high in 2010 with more than 6.1 million students and according to the report from the Babson Survey Group, this number will only increase [11]. The report also stated that approximately thirty-one percent of higher education students now take at least one course online and that academic leaders believe that students are satisfied with this type of content delivery method [11].

This paper focuses on the development of an online course in computer ethics for a two-year institution. The paper describes the reason for course development and presents the next steps toward making the course a

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requirement for computer science majors. Also presented are results from the pilot offering of the course. The paper is organized into the following sections. Section II provides the rationale for the course which introduces the Complete College plan. Sections III and IV introduce the course and the pilot study. Sections V and VI present the results and discussion from the pilot study. Section VII presents next steps and concluding thoughts.

II. COMPLETE COLLEGE PLAN

A. Complete College America

In response to the concern that the U.S. is lagging behind other countries in its production of college-degree holders, Complete College America emerged in 2009 as a national non-profit organization whose mission is to work with states to increase the number of Americans with career certificates or college degrees [12]. Since its inception, 34 states, including the District of Columbia have become Alliance members and are now participating in working to significantly increase the number of students who are successfully completing college.

To become a member of the Alliance, the state's governor in partnership with its colleges and universities pledge and work together to meet the mission of Complete College America [12]. More specifically, when a state becomes an Alliance member it makes college completion a top priority and commits to do the following [12]:

- Set completion goals
- Collect and report common measures of progress
- Develop action plans and move key policy levers

B. Complete College Georgia

The state, Georgia, in which the course was developed and piloted is an Alliance member and has adopted the mission of Complete College America. Georgia notes that in order to improve its economy that another 27% of its citizens must join the already 34% of the states' population who currently hold an associate's degree or higher [12]. To meet this goal, not only must the colleges and universities enroll more students, but they must retain the ones presently enrolled and remove barriers that impact student success. To improve low completion rates, colleges and technical schools have committed to [13]:

- Build and sustain effective teaching
- Explore and expand the use of effective models
- Promote and increase distance education
- Focus on adult and military outreach
- Implement STEM initiatives

C. Georgia Perimeter College

Georgia Perimeter College (GPC) is a two-year institution located in the Atlanta-metro area, part of the 33-member schools of the University System of Georgia (USG). GPC offers Associate degrees in Arts, Sciences and Applied Sciences [14]. GPC typically hosts the largest freshman and sophomore enrollments in Georgia, making it the top producer of transfer students to 4-year institutions within the state. It has five campus locations and services approximately 22,000 students. Roughly 10 percent of the student body takes all their classes online [14]. The number of students choosing one of the STEM disciplines is roughly 10 percent [15].

To help meet the goals of Complete College Georgia, the Academic Advisory Committee on the Computing Disciplines (AACCD) determined that two-year institutions needed to offer at least one additional computer science course that could be transferred to a 4-year institution in order to make transferring students more competitive and that would give students additional depth in the discipline. The AACCD is an advisory committee of the Board of Regents (BOR) of the USG. Advisory committees are formed around the courses of the core curriculum, and the degrees and major offered by BOR institutions. As part of their responsibilities, the advisory committees study the curricula and programs of instruction in the discipline or disciplines within the purview of the committee; make reports and recommendations concerning the improvement of instruction and the curriculum; and, make recommendations to the Academic Affairs System Office concerning new programs proposed by USG institutions [17].

In response to the charge from the AACCD, the GPC's computer science curriculum committee proactively engaged in selecting an additional course that: 1) is required by transferring institutions and can easily be transferred; 2) provides students with additional depth in the discipline; and, 3) can be taught by existing faculty. A survey of surrounding 4-year institutions was conducted and it was determined that a course in computer ethics would meet the criteria. Also in the survey, it was determined that computer ethics could be offered as early as the second year for students, unlike make of the other computer science courses, thereby making it a viable option for a 2-year institution. Moreover, it was a course that could be offered online to a large population of students that a traditional face-to-face course may not be able to do in its initial offering.

III. COURSE DEVELOPMENT

A. Course Description

CSCI 2900-099 - Ethical and Social Issues in Computing, is a three hour course dedicated to the study of social, ethical, and legal effects of computing on society and its users. Ethical concepts, professional codes of ethics, and the influence of computing on individuals, organizations, and the global economy will be addressed. Students will utilize critical thinking and problem solving skills to analyze and debate case studies on topics some of which include privacy; intellectual property; computer crimes; system failures and implications; and, the impact of technology on society [18].

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Prerequisites for the course are sophomore standing and CSCI 1301- *Principles of Computer Science* I with a "C" or better, or permission of the Instructor and Department Chair. It was decided that CSCI 1301 would be the course prerequisite because it emphasizes structured, top-down development and testing of computer programs. At the conclusion of the course, students would be able to utilize critical thinking and analytical skills to successfully analyze, develop and implement programs in a modern programming language.

The course utilized the College's Desire 2 Learn (D2L) learning management system as its online portal. This allowed the instructor to disseminate information, engage students in discussions and perform student assessments.

B. Topics Covered

The topics covered in the CSCI 2900-099 include [18]:

- Basic concepts and historical overview of computer ethics
- Introduction to issues and themes in ethical computing
    - Privacy
    - Freedom of Speech
    - Intellectual Property
    - Computer and Network Crime
    - Evaluating and Controlling Technology
    - Error, Failures and Risks
- Professional ethics and responsibilities

C. Learning Outcomes

By the end of the course, a student should be able to [l8]:

1. Explain and evaluate the ramifications of technological advances brought by the advent of the computer on individuals, organizations and society
2. Identify ethical and legal issues related to computer use
3. Develop solutions based on the computer professional code of ethics
4. Effectively and succinctly communicate through speech, writing, and presentation the themes of the course

D. Student Assessments

Since this was designed to be a sophomore level course, it was decided that student assessments would include the following: debate presentations, class participation, one programming assignment, a term paper, two exams and one final exam.

IV. PILOT STUDY

A. Participants

The course was designed for and utilized by students who have chosen computer science as a major. During the pilot study, summer 2014, the course enrollment was twenty-two students with nineteen students completing the course. Participants ranged in age from 20 to 48 years with the median age being 28. All students had sophomore standing and had completed the prerequisite of CSCI 1301. Students also self-reported that they either had full-time or part-time jobs, which was one of the reasons for enrolling in an online course.

B. Class Participation

Class participation accounted for 2 percent of the total course grade. Each week on the discussion board the instructor would post a question related to the course topic and it was expected that students would submit a posted response to the question and debate presentation prepared by classmates. The discussion board was designed for students to express their opinions, ideas about the material presented, to ask questions and answer the questions of fellow classmates. As part of the post, students were also expected to provide:

- A brief summary of the topic
- The presentation that best describes your position on the topic (provide the reason why)
- Point(s) from the presentation(s) with which you either agreed or disagreed

C. Class Debates

One goal of the course is to help students identify ethical and legal issues related to computer use so that they can develop solutions based on the computer professional code of ethics. Therefore, five case scenarios were assigned on various course-related topics and students were expected to present arguments and solutions.

The guidelines for class debates on case scenarios stated that each student would be assigned a part of the topic and was expected to prepare a presentation that would be posted by the assigned due date. Based on the student's assigned part, each was required do the following on which they would also be assessed:

- Analyze the situation.
- Discuss how the use of this technology impacts your given role.
- Use analogies and similar cases where possible.
- Identify possible risks or consequences.
- Present your opinion of the situation (even if it differs from your given role).

The presentation should be no less than ten (10) minutes and no more than fifteen (15) minutes. The debate presentation counted for ten percent of the total course grade. The presentation should include at least three (3) references from which the information was gathered. Students were encouraged to be creative with technology beyond the use of PowerPoint to promote interaction and advanced technology use. Students were assessed on their use of technology, style and delivery of the content. Sample topics for class debates are presented in Table 1.

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TABLE 1. DEBATE OVERVIEW

Debate	*Course Topic*	*Debate Topic*
#1	Privacy	Surveillance and Expectation of Privacy: Google Street View
# 2	Intellectual Property	The Fight for the TV Airways: Aereo Technology
#3	Crime	Identity Theft and Credit Card Fraud: The Target Corp. Scandal
#4	Evaluating and Controlling Technology	Electronic commerce: Amazon.com
#5	Errors, Failures and Risks	The Health Care Industry's use of Technology and Therac-25

D. Programming Assignment

The programming assignment which counted for five percent of the total course grade was designed to engage students' critical thinking and problem solving skills while also focusing on the course content of ethics. Consequently, it was decided to utilize content students were introduced to in the required course, *CSCI 1300 – Introduction to Computer Science*. This breadth-first course introduces students to a variety of topics with one being information security inclusive of a brief overview of encryption algorithms. Using this introduction, it was decided that students would implement a version of the shift cipher. The task was to work with any character on the keyboard, allow the user to determine the shift, make some changes to the input, then display the new code on the screen. Students were given a shift algorithm and asked to develop the program using either C++ or Java. Students were told that the assignment makes use of basic elements that they learned in CSCI 1300 and CSCI 1301 which included, but not limited to:

- Input/output statements
- Arithmetic operators
- Assignment statements
- Relational and logical operators
- Control structures
- Data structures

E. Term Paper

To allow students to develop a better understanding of the field, the opportunity to research current topics related to ethical issues in computing and to also foster better writing skills, a term paper was assigned. The task was to choose and watch one of the instructor-selected Twilight Zone episodes. The episodes are based on an ethical/societal computing issue discussed during the course. Students were informed that the term paper should summarize the topic that is being presented; then use supporting references to analyze, evaluate, interpret and summarize the information they have uncovered. The episodes that were chosen from which the students could select were: I Sing the Body Electric, The Old Man in the Cave and The Brain Center at Mr. Whipples. Students could watch the episodes for free on hulu.com for free. The term paper accounted for eight percent of the total course grade.

F. Exams

There were two online exams given. Each consisted of twenty-eight questions that were either true/false or multiple choice. Additionally, there were two essay questions. Students were given two hours to complete each exam from the time they started until the time they ended. They were also informed that they would only have one attempt per question. The final exam followed the same pattern as the two course exams; however, there were additional essay questions. Additionally, students were required by the institution to come to one of the campuses to take the final exam. The final counted for twenty-five percent of the total course grade and the course exams accounted for fifty percent of the total course grade. These percentages are determined by the computer science curriculum committee and are required for all computer sciences courses taught.

V. RESULTS

This section presents the results of student assessments, as well as an anonymous online survey that students were asked to complete at the end of the course.

A. Student Performance

In a face-to-face course, class participation is often noted by student interaction and class involvement. However, in an online course, class participation is a little harder to gauge which is why posting to the discussion board was utilized. To ascertain if students understood the required reading material as well as viewed their classmates' presentation, the instructor monitored the discussion posts. Figure 1 shows the number of students participating in the posts. Figure 2 shows the number of students participating by discussion post.

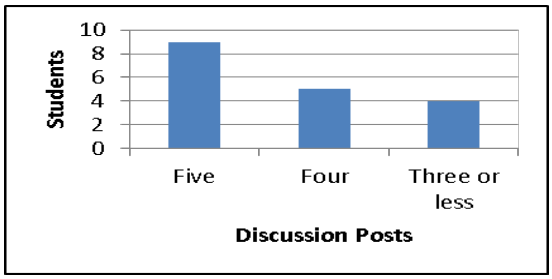

Figure 1. Students participating in posts

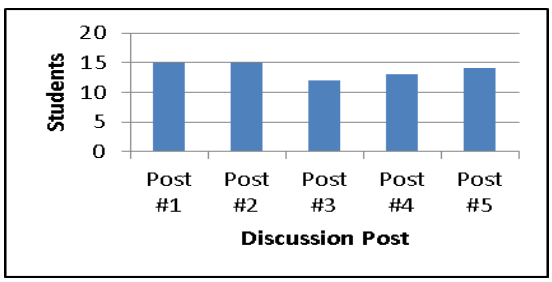

Figure 2. Students participating by post

Figure 3 shows the results of student performance on the class debates and term paper.

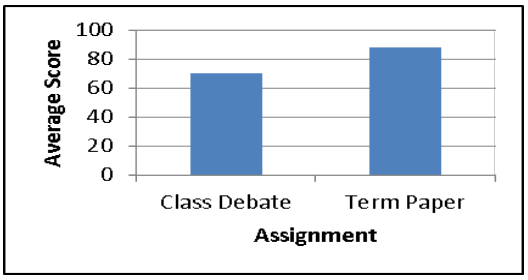

Figure 3. Average score on selected assignments

B. *Student Survey*

An online anonymous survey consisting of ten questions was created to get a better understanding of students' perception of the newly created online course. Presented are some of the results from the ten questions that the students were asked to complete.

Figure 4 shows the results of the students' perception on the ease of participating in class through using the discussion board.

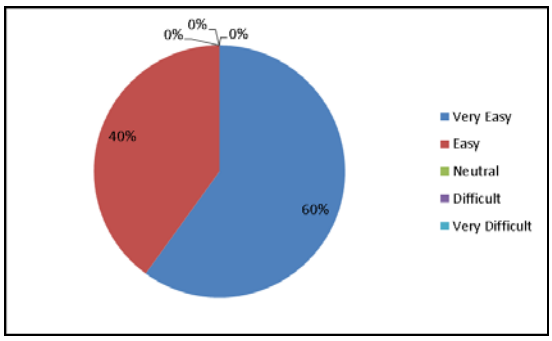

Figure 4. Participation using discussion forum

Figure 5 presents the results on students' perception on the ease of researching and writing the term paper.

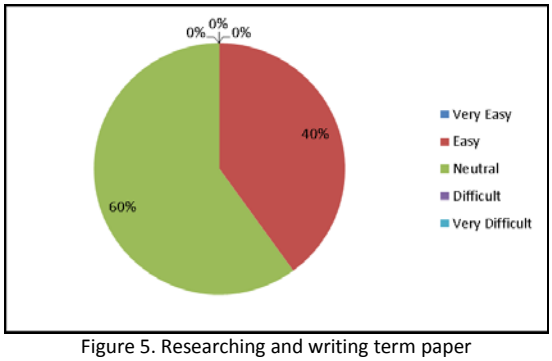

Figure 5. Researching and writing term paper

Figure 6 presents the results when students were asked in comparison to other computer science courses about the amount of time they spent on the newly developed online course.

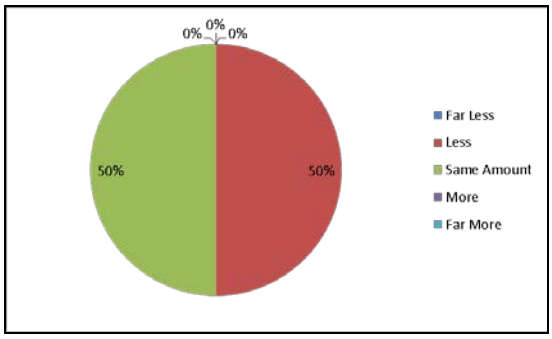

Figure 6. Time compared to other CS courses

Figure 7 presents the results when students were asked if they enrolled in the course again the type of delivery mode they would choose.

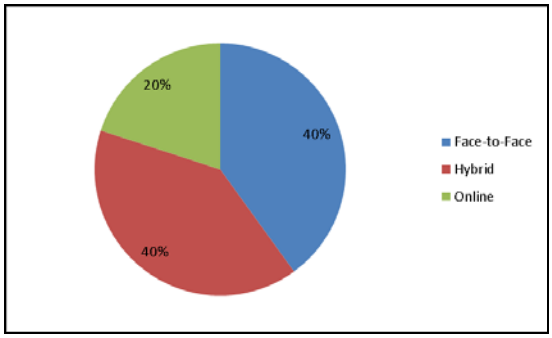

Figure 7. Delivery method

The next section provides an overview of the results presented, followed by concluding thoughts.

VI. Discussion

The results revealed that students participated in the discussion posts on a regular basis and utilized them as a way to establish their contribution to the course just as if they were in a face-to-face class. The results also revealed that the two assignments that one does not typically find in a computer science course, class debates and a term paper, were well-received by students which resulted in high passing scores on both assignments.

The anonymous online survey results revealed that students thought that the course was well-developed, that the amount of work was appropriate, and that the time they spent was comparable to other computer science courses that they had previously taken; hence the responses shown in figures 5 and 6. This led the instructor to believe that the thoughtfulness in which the course was designed was comparable to courses that had been previously designed and taught face-to-face. However, one unexpected result was the response to the question related to deliver mode. Students were asked if they had to enroll in the course again, which delivery method they most likely choose. The results revealed that only twenty percent would choose the online method again. The author finds this result to be one for

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future investigation because when polled, fifty percent of the class stated that they had taken the majority of the courses online because they enjoyed the flexibility of online learning. Moreover, many of the students self-reported that they either had full-time or part-time jobs, which was one of the reasons for enrolling in an online course. Therefore, the author thought that a larger percentage of the students would agree again to take the course online.

VII. CONCLUSION

In summary, the purpose of this paper was to describe the development of an online computer ethics course and present the results from a pilot study of its initial offering. The paper described the uniqueness of offering the course at the two-year college level, which is not typically done. Additionally, the paper described how material was conveyed in an online learning environment.

Future work includes making this course a requirement for computer science majors. This includes preparing and presenting a proposal for the college curriculum committee. Once approved, the proposal is presented to the Faculty Senate, and after review and approval, forwarded to the President for review and approval. However, prior to moving forward with requiring this course for computer science majors, some challenges must be addressed.

The first challenge noted by the author was the use of D2L and its compatibility with some of the software that the students used. Many of the students used open source software to complete their debate presentations. This software was not compatible with D2L often yielding no sound or picture, thereby making it difficult for the instructor to grade and for peers to adequately view the presentation. Another challenge was communication. Since this was the author's first time teaching an online course, the traditional method of office hours was not an option. While the author did establish "virtual" office hours, because of students' varying work schedules, many did not attend and instead attempted to communicate with the instructor outside of "normal working" hours. The author is rethinking the concept of office hours for the next course offering. It is anticipated that the course will again be offered in summer 2015.

In closing, as online learning continues to grow, so does the debate on how best to offer online learners a rich educational experience. By looking carefully at the course offering, the subject content and thoughtfulness in preparation of course material, we may find our answer and the answer of how to increase the number of students choosing a STEM discipline as a major.

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