Volume 10, Issue 4
August 2012
ISSN: 1545-679X

INFORMATION SYSTEMS EDUCATION JOURNAL

In this issue:

The **Information Systems Education Journal** (ISEDJ) is a double-blind peer-reviewed academic journal published by **EDSIG**, the Education Special Interest Group of AITP, the Association of Information Technology Professionals (Chicago, Illinois). Publishing frequency is six times per year. The first year of publication is 2003.

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A Case Study: Applying Critical Thinking Skills to Computer Science and Technology

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Abstract

A majority of incoming college freshmen and sophomores have not applied their critical thinking skills as part of their learning process. This paper investigates how students acquire their critical thinking skills while facing the copyright, fair use, and internet security challenges in this contemporary digital society. The findings show that 90 percent of students were not able to apply their critical thinking skills with valid reasoning when they made a decision based on the case scenarios.

Keywords: Copyright, Fair Use, Critical Thinking Skills, Computing Education, Higher Education

1. Introduction

Where have all the computer science educators in K-12 education gone? According to the executive summary, Running on Empty: The Failure to Teach K-12 Computer Science in the Digital Age, "computer science education is being pushed out of the K-12 education system in the U.S. In the past five years there has been a marked decline in the number of introductory and Advanced Placement computer science courses being taught in secondary schools. (ACM, 2011, P. 1)" Not only are they being pushed out, but in Texas they are non-existent. Looking at the Official State Board of Education Administrative Rules Regarding Graduation Requirements, Chapter 74. Curriculum Requirements, Subchapter F. Graduation Requirements, Beginning with School Year 2007-2008, there are absolutely no requirements for any computer science courses in the core curriculum required to graduate. The Recommended High School Program requires at least 26 credits. The Core Courses consist of 4 English credits, 4 Mathematics credits, 4 Science Credits (Biology, Chemistry, Physics only), 3 ½ credits for Social Studies, Economics ½ credit, 2 credits for Languages other than English, 1 credit for Physical education, Speech ½ credit, 1 credit of Fine arts, 5 ½ credits of Electives (TEA, 2011).

All of this is good with one blatant exception. They are not being taught anything about the one medium that drives our economy and world - Computers! Most of them are quick to tell you that they know how to do e-mail, write on Facebook, etc. Try to find one that knows the

difference between a microprocessor and a motherboard. They don't know how computers came to be such an integral part of our everyday lives. Students are not schooled in the history of computers, computer languages, hardware, software, databases, networks, algorithms, graphics, information retrieval, network security, etc. When they get to college and are faced with having to take a computer course, some panic and actually tell the instructor that they are "computer illiterate" and don't understand anything about computers. The colleges and universities are then stuck with the ominous task of doing what the high schools should have done, teach beginning computer classes that cover not only the basics of computing, but also cover such topics as copyright, ethics, and internet security. As far as the students are concerned, if it is on the web, it's free and they should be able to do what they want with the information. Who ever heard of copyright laws or fair use? Then the concern arises, how do the student apply their critical thinking skills to make a decision of to download or not to download while facing seemingly free and safe resources on the screen?

2. Literature Review

The following subsequences define the terminologies used in this paper including copyright, fair use, critical thinking skills, and internet security.

Copyright

In Title 17 of the United Stated Code, the ownership of copyright is defined as "copyright in a work protected under this title vests initially in the author or authors of the work (Copyright, 2011, p.2)." In other words, copyright law is meant to give a particular work's creator control over its copying and distribution for an extended period of time (Berti, 2009). Campidoglio, Frattolillo, and Landolfi (2009) stated that "copyright protection is usually considered as a basic requirement by authors and web content vendors, whereas it is perceived as a use restriction by web users (p. 522)." Sadly to say, Berti (2009) observed that most copyright infringement today is committed by young adults and teenagers who seem to be unaware that they are violating author rights. A common thought from the copyright infringement cases was "If I can get it for free, why I should pay for it?"

Yang and Zheng (2004) stated that copyright protection depends largely on communicative technological innovations which should urge the traditional copyright protection to be upgraded with technological progress, because of failing to protect digital copyrights. In order to reward author creativity and stimulate innovation while safeguarding web users' interests, Campidoglio, Frattolillo, and Landolfi (2009) suggested that some forms of prevention measurements might need to be addressed to deter illegal sharing or reproduction of standards. Berti (2009) agrees that the current copyright laws are outdates which were written for an analog world instead of the digital one in which we live today. In this paper, we will summarize our suggestions based on our findings and reinforce the needs of copyright laws awareness in this digital society.

Fair Use

Fair use is defined as "the right to reproduce or to authorize others to reproduce the work in copies or phonorecords (P.1)." Section 107 of the United States Code lists the various purposes of a particular work which may be considered fair, such as "criticism, comment, news reporting, teaching, scholarship, and research (P. 1)." However, the doctrine of fair use in the US is not very clear which simply provides the factors to let the users consider whether fair use of an original work exists (Berti, 2009; Campidoglio, Frattolillo, & Landolfi, 2009). Campidoglio, Frattolillo, and Landolfi (2009) stated that fair use "has been repeatedly invoked to prevent copyright owners from misusing their copyrights in order to stifle legitimate marketplace competition (p. 524)." Therefore, fair use can be considered a limitation upon a copyright holder's exclusive rights which permits the public to use a copyrighted work for limited purposes.

Internet Security

From the educational perspective, information security and safety in our digital society has become a main concern; especially, how university students' computing behaviors enhance or depreciate the safety and security of information in their domain (Lomo-David & Shannon, 2009). Crowley (2003) stated that a growing awareness that society is increasingly dependent upon information systems which have proven vulnerable. Thereafter, the corporation and educational digital communication infrastructure to the Internet should be the

frontline of the protection. Brodie, Karat, and Feng (2005) indicated that institutions understand the challenges that privacy poses but they do not employ new technology for privacy enforcement. Thereafter, the awareness program should be enforced with the privacy policies combined with password, forms of authentication, and/or biometric techniques for data protection.

Critical Thinking Skills

Ennis (1985) defined critical thinking as "reasonable, reflective thinking that is focused on deciding what to believe or do (p.46)." Ennis stated that the educators must go beyond Bloom's taxonomy to consider specific dispositions and abilities characteristic of critical thinkers who will decide on what to believe or do as the most practical higher-order thinking activity.

Woo & Wang (2009) suggested that the meaning of critical thinking often depends on values and culture which may be interpreted as "argumentative" or "being critical of others". Thus, from a pedagogic perspective, critical thinking skills can be learned by a given situation which is influenced by the level of questions asked (King, 1990). Jalongo, Twiest, and Gerlach (1999) observed that the critical thinking evolves with the following stages:

- Apply: The students use knowledge and understanding to complete a practical task.
- Analyze: While working on a practical task, the students break things down into their component parts.
- Synthesize: The students then will be able to combine and integrate various sources of information.
- Evaluate: At the end of the task completion, the students will be able to assess the value, merit, or worth of something.

For the context of this research, the case study was applied to implement the stages of critical thinking skills. The following section will detail the methodology and instrument design.

3. Methodology

Populations

The students who took the Introduction to Computers' courses were invited to participate in this research at the beginning of the fall semester in 2010. A total of 117 students participated in the survey, but eight of the collected samples were not completed. Therefore, 109 were valid for further analysis. Gall, Gall, and Borg (2003) suggested that the minimal total sample sizes for different hypothesis tests, a total of 42 samples are needed to provide a medium effect size at the .05 level of significance for the correlation coefficient tests. With 109 valid samples for this research, it fulfilled the minimum requirement for conducting the reliability analysis tests. The SPSS version 17.0 was utilized for testing the descriptive analysis and correlation tests.

Instrument

This research adopted the format from the National Science Foundation, Critical Thinking Assessment Test design (CAT). The CAT assessment (2011) was designed to investigate the students' critical thinking and reasoning skills by giving them the case studies scenarios. The CAT instrument provided by the National Science Foundation's CCLI (Course, Curriculum, and Laboratory Improvement) Program assesses the following critical thinking skills: (a) Evaluating Information, (b) Creative Thinking, (c) Learning and Problem Solving, and (d) Communication.

The context of this study will focus on two of the measuring groups which including (a) Evaluating Information and (B) Learning and Problem Solving.

There were two parts of the case studies designed to investigate the levels of our students' knowledge and critical thinking skills in copyright laws, fair use, and internet security. Part One of the survey given to the class prior to the discussion on copyright consisted of a scenario and questions analyzing the scenario. The scenario consisted of a technology specialist working for a school district that allowed teachers to use online collections for their multimedia projects in his lab. However, many wanted it on the network and the question became "Should he put it on the school districts network?" The Copyright statement and the Permitted Use statements are examples from one free download website and one commercial company. A Copyright statement presented stating that the website furnishing the media owned almost none of the content but it could be freely used. No warranty regarding the

copyright status was given. The Permitted Use statement granted the user a non-exclusive, non-transferable, non-sub licensable, limited and revocable right to access, use and display the site on any computer or electronic display device. The site could not be used for any other purpose and all copyrights, trademarks and other proprietary notice will be retained as the same as the original.

The students were given four questions to answer concerning the scenario in Part One. The first question consisted of whether or not the information should be uploaded to the district's network. The options were Yes, No, and Not Sure. The second question was to clarify their reasoning of why they chose the certain option. The third question sought to test their understanding of the fair use concept. The third question was "Is it fair use?" The options were Yes, No, and Not Sure. The fourth question was to provide reasoning for their decision in question 3.

Part Two of the test was about Internet Crime and Internet Security. An e-mail was used that one of the authors received in an attempt to gather private information. Most people have received them in the past. The e-mail consisted of a warning code to Webmail Account Users stating that your e-mail account will expire in 3 days. In order to keep your Inbox, you must reply to this e-mail with username and password along with some other information.

The first question asked if the e-mail was legitimate. The possible answers were Yes, No, and Not Sure. The second question was to provide reasons as to why the e-mail was legitimate or not. The last question was to consider the fact that the e-mail was a scam. The students were to identify the main item(s) that led them to believe that it could be a scam.

Grading

Each sample was graded by at least two graders. If the score was not identical, the third grader will review the answer and assign an appropriate score to seek for an average score from those three graders.

The scores were weighted with certain points based on the students' responses. Table 1 listed the suggested answers for each point. If the student answered Yes for question 1 and 3, the graders were to skip question 2 and 4. Those that answered Yes to question 1 and 3 were considered to not have any valid reasons for their decision. Only those that answered in the negative were considered as having valid reasons.

Table 1. Scoring Guide

Question	Point/s
(Part One) 1	0: Yes/Not Sure 1: No
2	Maximum of 3 points **Copyright** (Up to 2 points: 1 point for each line provided) Line 4: owns almost none of the content Line 5: almost all may be Line 8: probably do not need to Line 10: is believed to be accurate…. Line 10: does not provide any warranty Line 12: should make your own determination **Permitted Use** (1 point) Line 3: Which you are a user… Line 4: No other use of the Site and the information … is authorized
3	0: Yes/Not Sure 1: No
4	Maximum of 3 points **Copyright** (Up to 1 points: any line provided below) Line 4: owns almost none of the content Line 5: almost all may be Line 8: probably do not need to Line 10: is believed to be accurate Line 10: does not provide any warranty Line 12: should make your own determination **Permitted Use** (2 points: one point for each line) Line 3: Which you are a user Line 4: No other use of the Site and the information … is authorized
(Part Two) 5	0: Yes/Not Sure 1: No
6	Maximum of 2 points (one point for each line) Line 1: email address Incorrect grammars Line 10-13: message limitation (20 GB) Line 18 -22: Requesting personal information Line 30: .. activate your account
7	Maximum of 2 points (one point for each line) Line 1: email address Line 10-13: message limitation (20 GB) Line 18 -22: Requesting personal information Line 30: activate your account

4. Findings

Descriptive Results

Part One. For copyright issue, 67.9% of the students rated that this is a legitimate way to handle the data to have the copyrighted materials posted on the school network. This makes one wonder if they actually read the scenario or just skimmed it not completely understanding the question (see Figure 1).

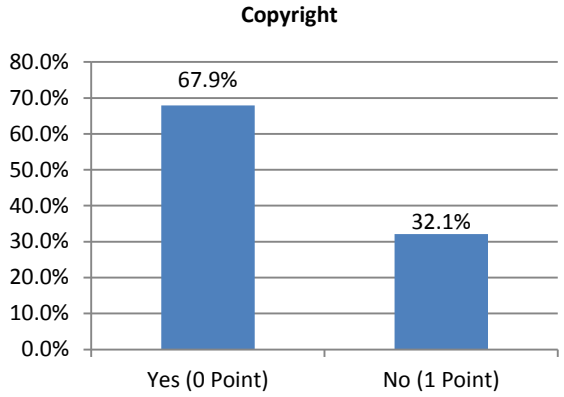

Figure 1. Copyright – Download Files

Less than 1% (.9%) could come up with valid reasons and 11% could provide only partial reasons as to why they felt that the technician should not put the information on the school's network (see Figure 2). Sadly to say, 88.1% of students could not provide valid reason/s to support their decision.

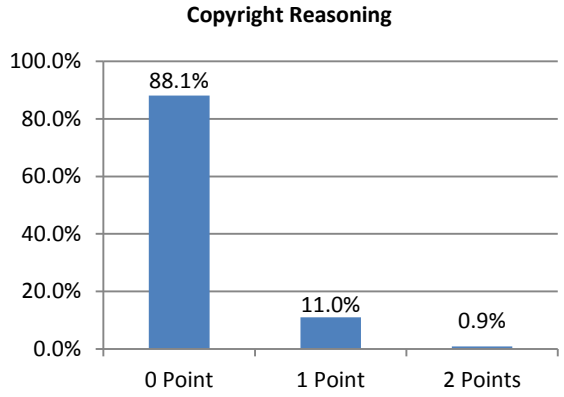

Figure 2. Copyright – Reasoning

For the fair use issue, 83.5% thought that this case met the definition of fair use (see Figure 3). It makes one wonder if students think that because something is available that they can do anything with it they desire. Intellectual property considerations seem to be beyond their comprehension. There were only 6.4% of students who could provide partial reasons of why the Fair use does not apply to this case (see Figure 4).

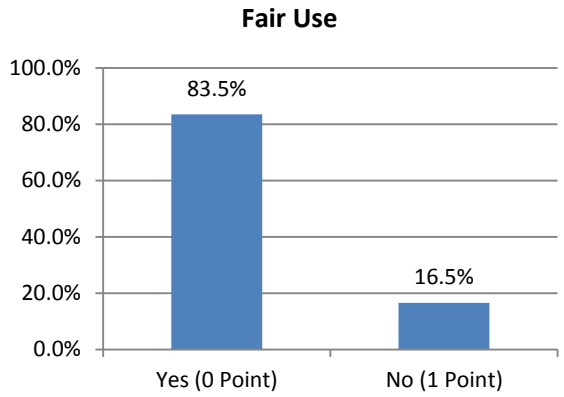

Figure 3. Fair Use – Download Files

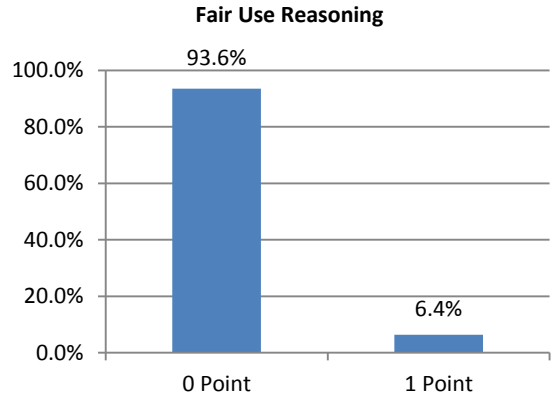

Figure 4. Fair Use – Download Files

Part Two. The email scam case was answered overwhelmingly with an 84.4% of students that believed the email was not legitimate (see Figure 5). However, only 9.2% could come up with valid reasons of how the email was not legitimate (see Figure 6). Out of 109 samples, 17 students (15.6%) felt that it was legitimate and it was ok to provide the personal information through the similar email. That means 17 more people scammed into giving out personal information. How do we stop our students from falling victim to this type of scam and making the e-mail scams be non-profitable? If 100% of the people that receive these types of e-mails would not respond, surely they would just go away? Probably a "pie in the sky" wishful thinking. It will never happen, although it should be our job to try to assure that those

types of scams will become a thing of the past. 66.1% identified such items as the e-mail address flag the legitimate issue (System Administrator [webteam.dept@w.cn]). The majority of the students caught this particular item. 9.2% identified at least 1 other item that made them suspicious.

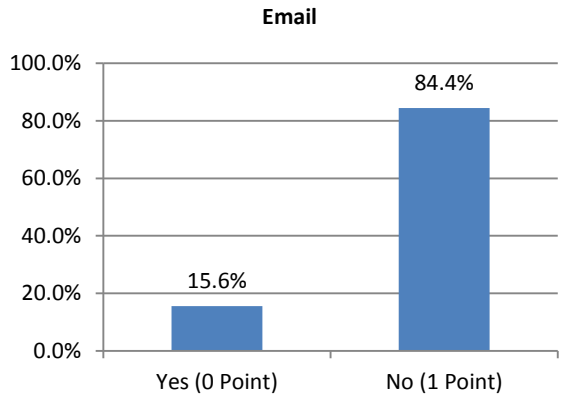

Figure 5. Email – Legitimate

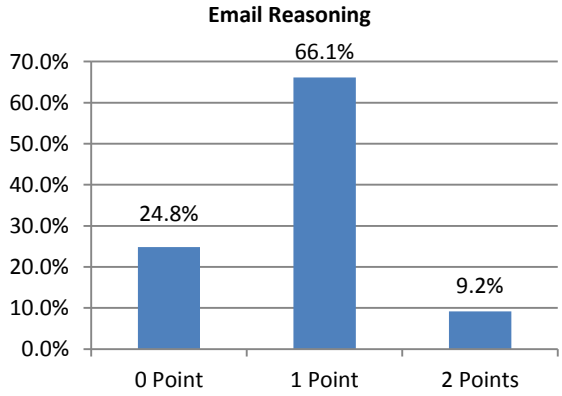

Figure 6. Email Legitimate Reasoning

As to whether the e-mail was a scam, 80.7% identified at least 1 item and 7.3% identified at least 2 things that made them suspicious (see Figure 7). This ranged from e-mail address to message limitation, requesting personal information and the fact that they were to "activate your account". The rest just "thought it sounded fishy".

Correlation with Critical Thinking Skills

From the correlation test results, the findings showed a significant correlation between the decision the students made and the reasons they provided. In other words, the students provided a better reasoning skill while they were making a right decision related to copyright, Fair use, and Internet security issues. Table 2 showed that the Spearman's rho varied from .387 to .474. Field (2003) stated that the Spearman's correlation coefficient is a non-parametric statistic which works by first ranking the data and then applying Pearson's equation to those ranks. The only item did not show the correlation was between the decision they made and believe that whether the email was a scam or not (Spearman's rho = .146.). This item revealed that the students were not protected by the common knowledge of internet security and cybercrime incidents. The results revealed that the students were not able to perform properly in the following areas: (a) evaluating information and (B) learning and problem solving.

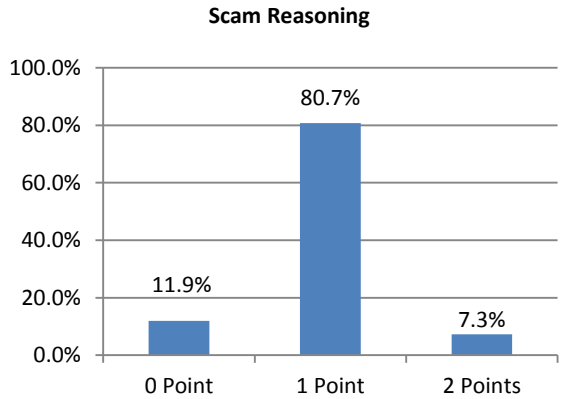

Figure 7. Email Scam Reasoning

Table 2. Critical Thinking Correlations
Note. N=109, ** Significant level: P<.01

Decision	Reasoning	Spearman's rho	Sig. (2-tailed)
Yes/No/ Not Sure	Copyright	.474	.000 **
Yes/No/ Not Sure	Fair Use	.387	.000 **
Yes/No/ Not Sure	Email Legitimate	.414	.000 **
Yes/No/ Not Sure	Email Scam	.146	.132

5. CONCLUSIONS

Reviewing the low scores we received, we wonder how we are failing in our responsibilities to offer the guidance. We haven't provided the students the tools they need to avoid being a

victim to some unscrupulous scammer or ending up in court or jail because of a copyright violation. As usual, the answer probably lies somewhere in the middle. With the thinking of our State Board of Education requirements for graduation from our high schools, we had completely ignored the responsibility of making sure our future business leaders are knowledgeable in the technology available today. Therefore, we will continue to have people falling victim to scammers, ignoring copyright and fair use laws as well as ethics and other subjects so vital today. As Crowley (2003) suggested that this growing awareness should lead to a demand for Information Systems Security training and education. Applying the same hope to resolve in copyright and fair use issues, the practitioners might need to emphasize on the importance of increasing education and awareness, justifying the pricing for distribution, improving digital watermarking, and digital right management technologies (Bertis,2009; Campidoglio, Frattolillo, & Landolfi, 2009).

We are entering the 21st century with 18th century thinking. Granted, budgets have been slashed and everyone has to do more with less. We all know the scenario. However scarce funds happen to be, doing less does not mean doing nothing! That seems to be the approach that the Texas Education Agency has taken in striking all computer science courses from the core curriculum. They have made a decision based on the quality of computer science courses in the high schools. At the present time, most are either non-existent or very poor because of the lack of qualified/certified computer science teachers. It's no wonder that they opted to cut that out of the curriculum. That has to change.

We need state certification programs for computer science teachers just as we have state certification programs for math teachers or reading teachers. Computer science is such an important part of our culture and life that it must be recognized as being as important to a students' education as math, English, history or Social studies. It's no wonder that the United States lags behind many other countries on students' performance in math and science. If we plan on catching up or pulling ahead of the rest of the developed countries in our education system, we need to take a hard look at what is deemed important in the education of our children. Certification programs and requirements for computer science teachers must be designed and implemented in the very near future to ensure that students are being taught computing science concepts and skills to better enable them to compete in the marketplace in the 21st century.

Our state legislatures need to be lobbied to make changes to the educational requirements for graduation if the State Board of Education fails to see the importance of computer science and computer technology education for high school students. It is no longer a luxury as the consequences of inaction on their part are delegating future generations to failure. Scams are increasing daily and many students do not have the resources, knowledge or critical thinking skills to combat this growing threat. Neither do they have the knowledge to differentiate between good websites and fraudulent ones or to be able to discern if something is free or copyrighted. The State Board of Education and our legislature are failing in their duty to provide for the education and welfare of our students.

Certification programs need to be implemented by the universities to guarantee that high school curriculums can include computer science and computer technology requirements for graduation. As it stands now, the requirements cannot be implemented due to the lack of certified teachers to teach computer science and computer technology. This has to change immediately! This is not something that can be put off any longer. Time is of the essence in this situation.

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