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In this issue:

"Cycle of Poverty" in Educational Technology

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"Cycle of Poverty" in Educational Technology

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Abstract

According to many experts, the millennial and post-millennial generations of young people are still in the dark about digital technology. Trends in the International Mathematics and Science Study indicated that U.S. eighth-graders in U.S. public schools with the highest poverty levels had lower average mathematics and science scores compared to their international counterparts in public schools with lower poverty levels. Regarding the status of computer education in a higher education system, this study analyzed 74 students' computer skills - how the students performed in critical thinking and on ethical issues. A mixed method was designed to analyze the central phenomenon of computer education. The findings showed that there is a significant low level of performance in the following areas: Critical thinking skills, Computer literacy, and Ethics. Due to limited resources in computer education, this paper might be used as the significant evidence for supporting computer education in our Teacher Preparation Programs in the USA.

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1. INTRODUCTION

Ask almost any student and he/she will insist they are fairly "computer literate." This millennial generation (MG) overstates their computer skills in the applications of hardware and software (Sanchez, 2003). In their mind digital literacy means that they can do e-mail, social networking (e.g. Facebook), do a shallow search for simple things on Google and do Instant Messenger. That means that they know how to use a computer ("How the new generation," 2007; Kelly & Haber, 2006; Shannon, 2008). Ask the MGs to research something on the internet and then evaluate the information they found as to how factual it is, whether it would be considered reliable, and what criteria did they use to determine the validity of the information found. They will, in all probability, have no idea. Recently, Daniel F. Sullivan, President of St. Lawrence University wrote, "As has been widely reported, the millennial and post-millennial generations of young adults have never known a life without digital technology, but neither are they technologically savvy. Often they don't understand ethical uses of technology or the concept of intellectual property rights. Their critical thinking skills are notoriously weak and their reflective capabilities sorely lacking (Sullivan, 2008)." Oblinger (2003) also stated that the MGs were fascinated by new technologies and therefore, benefited from building their comfort levels working with computers. On the other hand, studying students' learning

outcomes reveals the strengths and weaknesses of the MGs from the computer courses (Carbonara, 2005; Messineo & DeOllos, 2005; Tomei, 2005; Thorsen, 2006).

Reviewing the academic performance of Science, Technology, Engineering, and Mathematics (STEM) in past decades, we see a difficult challenge ahead of us in computer education as well. In 2003, the performance of U.S. 15-year-olds in mathematics literacy and problem solving, as measured by the Program for International Student Assessment (PISA), was lower than the average performance for most Organization for Economic Cooperation and Development (OECD) countries (Digest of Educational Statistics, 2008). The data also indicated that U.S. eighth-graders in U.S. public schools with the highest poverty levels had lower average mathematics and science scores compared to the international counterparts in public schools with lower poverty levels (Trends in International Mathematics and Science Study, 2008). Regarding computer education, in 1989, the United States had one of the lowest ratios of students to computers across all education levels (Education Indicator, 1989). In the 2004 EDUCAUSE survey, e-learning, distributed learning, and course management systems slipped from near the top to near the bottom of the list of concerns of information technology professionals (Spicer, DeBlois, & EDUCAUSE Current Issues Committee, 2004). The data mentioned above guided us to study the development of students' computer skills and how the students performed in critical thinking and on ethical issues.

Research Questions

Two research questions guided this study: (a) what theory explains the level of the students' computer skills? and (b) how do the students perform in critical thinking and on ethical issues? The sub-questions follow the paradigm for developing a theory. The questions explore open and axial coding to answer: What caused the central phenomenon? What outcomes resulted from it? What specific interaction issues have been influential? What are the resulting strategies from the consequences of these outcomes?

Computer Education

Most colleges and universities do not have an education track for computer education (US Department of Education, 2008). A majority of teacher preparation programs provide elementary education and secondary education with specialization tracks for mathematics, history, English, etc. However, *computer education* for either elementary or secondary education is not to be found (U.S. Department of Education, 2008). The computer education which a P-12 school system provided is delivered by teachers who probably took a computer literacy course with Microsoft applications or else none of the computer related courses. At no time were the future teachers ever given any instruction on how to teach their students about computers, much less what to teach. "It is probably no surprise that students are outpacing teachers in their familiarity with and use of technology – for today's students' technology use is as common as breathing (Deluna, 2006, p.62)."

This has led to a huge gap in the education of our teachers in the United States. Our P-12 school students are paying a huge price by not being taught computer literacy prior to college. Those students that do not go to college go through life being on the "outside looking in" because they have no knowledge of a very important part of our society, the "wired world" or the "technology savvy" portion which affects their daily lives. Chisholm, Carey, & Hernandez (2002) stated that an achievement problem existed when a population in higher education was disadvantaged by lack of access to information technology prior to entering the workforce. Deluna (2006) also stated that for many teachers, a lack of personal experience with technology presents an additional challenge which is to incorporate technology-based activities and projects into their curriculum; but teachers must first find the time to learn and understand the terminology necessary for participation in projects or activities.

Using the key term of "computer education" as a search term on the Internet, the list of 1,100,000 matching results showed all kinds of sites stressing computer education for degrees, corporate training, computer resources, research, and service. However, we are not able to locate one site which was devoted to actual teaching student teachers

the issues that they need to know for P-12 education classes which emphasize critical thinking, moral, and ethical issues, etc. The common terms shown in the results are programming, applications, application training, tutorials, etc. There are limited resources related to computer education. This paper might be used as the significant evidence for supporting computer education in our Teacher Preparation Programs in the USA.

Teacher Preparation Programs

A good teacher education program is a must at any university and needs to protect its reputation, identity and values that make it a unique program. Faculty is influential in creating a program that gives rise to a vast array of educational fields and academic experiences that will build on each other and not just be a bunch of individual courses (Carroll, Featherston, Feiman-Nemser, & Rooservelt, 2007). Students should have ideas and engage in intellectual discussions and activities. Carroll et al. (2007) stated that the whole idea of teacher education is that the approach and content of the subjects taught will coincide with pedagogy as well as the children's learning. Students engaged in learning when it has been developed by teachers using technology, is paramount in ways that allow students to reach important standards such as district, state or national (Januszewski & Molenda, 2008). Schools are notorious for lagging behind other sectors of society in the use of technology. Januszewski et al. (2008) emphasized that technology may improve a school's organizational performance by providing the schools with the networking and software designs to allow schools to accommodate the changing environment in which they operate, both at the faculty/staff level as well as the students' needs.

Critical Thinking

By definition, critical thinking applies skills that contribute to information literacy. Critical thinking and information literacy both require making a distinction between assumption and fact, suspending personal opinion and bias in favor of objectivity, and considering issues from multiple perspectives and in adequate depth (Taylor, Arth, Solomon, & Williamson, 2007). It includes possible processes of reflecting upon a tangible or intangible item in order to form a solid judgment that reconciles scientific evidence with common sense. Learning to be a critical thinker does not mean that one will always be right because all of the facts may not be available, certain concepts may be incorrect or an individual's biases may hinder their thought processes. The critical thinker has learned to evaluate all of the information or data available and come to a reasonable conclusion. Without critical thinking skills, an individual is at a disadvantage and may make a wrong decision because of their inability to discern accurate, precise, relevant and logical information.

In contemporary usage "critical" has a certain negative connotation that does not apply in the present case. Though the term "analytical thinking" may seem to convey the idea more accurately, critical thinking clearly involves synthesis, evaluation, and reconstruction of thinking, in addition to analysis. "Without advanced knowledge and skills, students and professionals alike are at a significant disadvantage in their work environments (Taylor, Arth, Solomon, & Williamson, 2007, p.22)."

Digital Technology

The term is used to describe the technology used with various digital devices, i.e. computers, iPods, cell phones, Blackberries, etc. It is not a term that relates to one item or one concept or even one idea, but numerous items, concepts, and ideas. Digital technology is more of a grouping rather than a singular term. Digital relates to discrete values rather than continuous values such as analog. Therefore, any computer, iPod, etc. that uses the digital (binary) value to represent data is considered digital technology (Parsons, & Oja, 2008). Through digital devices, people can obtain knowledge, communicate with the world, and make life easier in a modern technological age (Hefzallah, 2004).

Intellectual Property

This is a term used to denote the writings of an individual/group that are a result of their own ideas, concepts, musings, and thought processes (Parsons, & Oja, 2008). "Intellectual property refers to anything created by the mind, such as literary works (books, poems, essays), artwork (drawings, paintings), inventions, ideas, logos or symbols, names, designs, and images or photographs

(Taylor, Arth, Solomon, & Williamson, 2007, p.179)". Since the material is original and not borrowed or quoted from another writer, then these writings are considered the property of the writer. Since the writings are from the intellect of the individual(s) involved, the term "intellectual property" was coined (WIPO, 2008). Intellectual property is actually what is plagiarized when another uses it without giving the original author credit (US Copyright Office, 2008).

2. METHODOLOGY

To analyze the collected data, a mixed method was designed for this study. For qualitative analysis, a grounded theory was utilized to generate or discover a theory that relates to a particular situation (Creswell, 1998). We followed a standard format to process a systematic analysis with both open and axial coding to develop and portray the theoretical framework of this study. In addition, qualitative data was quantified (Tashakkori & Teddlie, 2003). The data divided between "qualitative" and "quantitative" affords opportunities to use the strengths of some methods to counterbalance the weaknesses of others (Axinn & Pearce, 2006). The Statistical Package for the Social Sciences (SPSS, Version 15.0) was used to analyze the numerical data. A descriptive method was also implemented to determine the degree of responses from the data.

Participants

The survey was conducted during the Spring 2008 semester using 74 students from three introductory computer courses. The students voluntarily completed this survey at the beginning of the semester. The participants range in age from 18 to the 40s and classifications range from freshmen to juniors. The participants' major were from College of Arts and Sciences, College of Criminal Justice, and College of Education. Their computer experience encompasses high school through authentic work experience (other than a summer job).

Instrument

To answer the research questions, ten survey questions were designed. Question one and two were designed to answer the research question of "what theory explains the level of the students' computer skills?". Question three to six were designed to answer the research question of "how do the students perform in the process of critical thinking and on ethical issues?" Question seven to ten were designed to answer the sub-questions, and follow the paradigm for developing a theoretical theory.

1. On a scale of 1 – 10, (1 being no knowledge and 10 being very knowledgeable) how would you rate your knowledge of computers in general? Give a reason for your score.
2. What computer applications do you know how to use? Were you taught computers in either elementary or high school? If so, how do you rate that instruction?
3. How do you rate the information found on the internet? In other words, how much do you trust the information found there?
4. Do you trust certain sites on the internet for factual information more than other sites? If so, give an example of one you would consider accurate and an example of one you would have questions about.
5. Do you spend considerable time on the internet? If so, what do you look at or what sites in particular do you visit?
6. Do you use a computer daily? If so, how much time do you spend on the computer? If you don't use a computer daily, how often do you use a computer and what do you do on the computer when you do use it?
7. What does the term "intellectual property" mean to you? Have you ever heard the term before?
8. Do you understand what constitutes plagiarism? Can you define the term and give an example?
9. What is meant by the term "digital divide"?
10. What does the term "digital technology" mean?

Reliability

It is common that qualitative researchers often use their own specific backgrounds on theoretical assumptions to shape what ap-

proaches are taken and what issues to focus on (Creswell, 1998; Bogdan & Biklen, 2003; Huberman & Miles, 2002). To prevent the bias that may have occurred in this study, Gall, Gall, and Borg (2003) stated that a self-reporting measure is appropriate. It is an instrument which yields numerical scores from which inferences can be made about how individuals differ on various aspects of self. Using the self-report measure prevented bias; we organized and studied the open coding categories to assign the levels of responses. Upon agreement among us of the translated data, the numbers were then imported to SPSS 15.0 to "reduce methodological errors" (Onwuegbuzie & Daniel, 2005). As a result, our findings and conclusions were presented in both textual and numerical values (Onwuegbuzie & Teddlie, 2003).

3. FINDINGS

By utilizing SPSS 15.0 to analyze the data, we determined that the students rated their knowledge of computers with an average of 6.45 out of 10. The frequency report showed that 66.2 percent of students evaluated their computer skills between the scales of five to seven (See Figure 1).

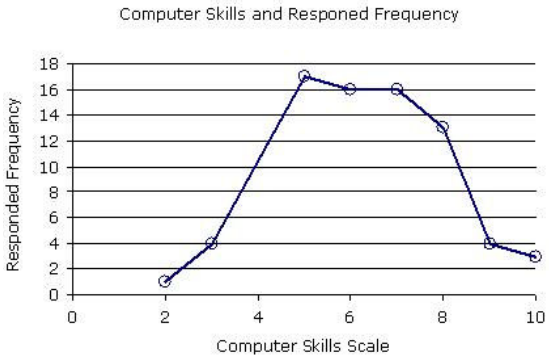

Figure 1. Computer Skills Levels

Five out of 59 responses felt that they knew enough to "get by" or they could "usually figure it out". Five responses stated a negative experience that they "don't like computers", "scared of computers", or "never really do anything on the computer". 28 out of 59 responses (47%) indicated that they only know the "basic of computers" (See Figure 2).

The findings showed that the most common software they knew is Microsoft Office Applications: Word, Excel, and PowerPoint (See Figure 3). Surprisingly, there were 5 responses indicating they only learned typing in a class using computers. 42 responses indicated that they had a computer course in high school, 12 responses were in middle school, and 16 at elementary level. They rated the instruction on an average of 4.18 out of 10.

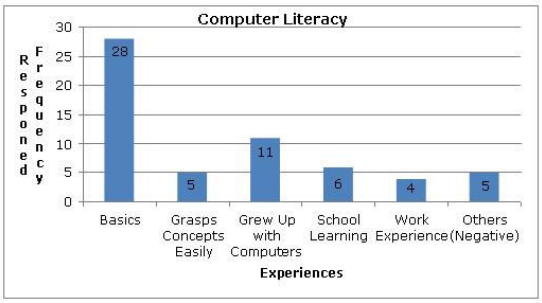

Figure 2. Computer Literacy

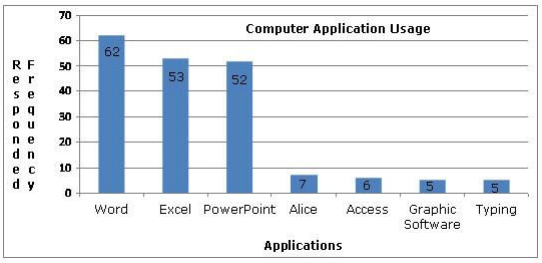

Figure 3. Computer Application Usage

The findings from question three and four showed that 18 out of the total 74 (24%) indicated that they trusted the information on the internet. 28 out of 74 (38%) said that certain sites were not trustworthy but in general it was felt that the majority of the information on the internet is reliable.18 out of 74 (24%) said that either they "don't trust media" or they believe that the internet is "not a reliable source". On a scale of 1-10, the students rated the information having an average validity of 6.9 out of 10.

We found that many students trusted certain sites as 100% accurate which include WebMD, Wikipedia, Yahoo, Accurate-library, Google, gamepolitics.com, espn.com, CNN.com, Webind, etc. They consider the following web domain is trustworthy as .gov, .edu, and .org. One response stated "…I usually go by if it sounds right." Sites such as MySpace and Facebook were not trusted and some thought Wikipedia could not be trusted either. Wikipedia seems to be on

both lists: a few students mentioned that Wikipedia could be trusted because people could change it if it were wrong, while one student mistrusted the site for the same reason that the other student trusted it.

The findings from question five and six were to follow up how the students spend time on the internet, and what sites in particular they visit frequently. These findings showed that 30 out of 65 (46%) students felt that they spent a lot of time on the computer. Facebook, MySpace, and e-mail were the top sites that most students admitted to looking at for long periods of time other than the school website. When asked if considerable time is spent on the internet, most felt that they spent a great deal of time on the computer on a daily basis. The average amount of time overall is 3.8 hours daily, but there were ranges from 10 hours (work related) to .5 hours. Most just "surfed the net" while a few indicated that they used it for homework.

Question seven to ten started getting into what they really knew about the common terms in informational ethics and critical thinking process. The term "intellectual property" was a complete mystery to 62 out of 74 students (84 percent). Twelve of the students had an idea of what it meant, but not one single student actually knew what the term implied. For the understanding of the term – "plagiarism", we found that it had the most positive correlation results compared to the other terms. Out of 74 students, only seven had no idea what the term "plagiarism" meant. Of the ones that wrote an answer they all had the general idea even if they did not know exactly. The example of "where you use someone else's words as your own and don't give credit" was typical of the answers.

To define the term "digital divide", there were only eleven students that responded. The rest of the students (85 percent) openly admitted not ever having heard the term. This question resulted in 1 student having a fair amount of knowledge of the term "digital divide" and 1 student making a rather "educated guess". The rest of the nine responses defined the term in words such as "the divide between the young and old people caused by computers."

To define the term "digital technology", 48 students (65 percent) answered that "I have no clue". Only 1 person actually even made a stab at it as others thought it was "technology that's digital" or "applications on a computer" or "technology that only exist on a network". "Anything to do with computers" was also a favorite.

4. RESULTS

What theory explains the level of the students' computer skills?

The findings showed that when the students evaluated their computer skills with 6 or 7 out of 10, they also stated that they only know the basic Microsoft Office programs. Whether the students overrated their computer skills in this study is not available to verify. Based on the results, 57 percent of the students had computer courses in high school and had an average instruction rate of 4.18 out of 10 which explained one of the reasons why a significant digital divide still exists after a decade of promoting computing implementation in our educational system (Shannon, 2007). As Messineo and DeOllos (2005) stated in the study of "Are we assuming too much? Exploring students' perceptions of their computer competence" that students viewed their computer competencies differently depending on whether they are using the technology for personal or course-related tasks. While the expressed levels of experience and comforts are high for some forms of technology, exposure and confidence with more advanced applications are sometimes lacking. The theory established by this study is that the college students' computer competency levels lag far behind what the public perceived.

How do the students perform in critical thinking and on ethical issues?

We found that more than 65 percent of the surveyed population did not have the basic knowledge of computer concepts. The findings showed that the students spend most of their spare time looking at Facebook, MySpace and reading e-mail. It may also question their intellectual prowess in that they trust most of what they read on the internet. Is this a fair assumption on our part? The argument here is no, it is not a fair assumption. There is nothing wrong with their intellectual capacity, just that they have not

been taught a minimum competency level of:

1. Critical thinking skills
2. Computer literacy
3. Ethics

Without knowing anything about these three items, it is no wonder that students today have such a poor grasp of the available technology. It is no wonder that Facebook, MySpace, e-mail and games are all that they can grasp as concepts. They are relatively easy to learn and it is entertaining to them.

What caused the central phenomenon? What outcomes resulted from it?

We should begin with high school or even middle and elementary school to build up the students' computer skills. We need to better educate our students that are becoming teachers in the public schools in ways that will prepare them to teach their students not only the actual technology (such as Microsoft Office) but also the concepts such as critical thinking, computer literacy and ethics. If students can come into college with some background using computers for something other than to write a letter using Word, doing e-mail or surfing the web, then as college educators we can use the one-semester the state gives us to teach them the advanced methods of computer technology, advanced critical thinking techniques and advanced computer literacy topics. We as college educators are being forced to do the job that the public schools should be doing, leaving our students not much better off than they were in high school.

In 2000, the National Council for Accreditation of Teacher Education (NCATE) adopted standards put forth by the Association for Educational Communications and Technology (AECT) that establish guidelines or procedures for the evaluation and accreditation of programs that will be used in preparing specialists in educational technology and school media (NCATE, 2008). Attitudes, behaviors, dispositions and in general, expectations have not driven academic programs in the past to provide documentation or provide any measurement that would define exactly what ethical practice should entail (Januszewski & Molenda, 2008). AECT and other professional organizations should initiate conversations, meetings and other activities that would lead to a definition for the phrase of "ethical practice", critical thinking, and computer literacy which is measurable and can become standards for computer education for faculty and/or students.

What specific interaction issues have been influential?

Based on the 2007 Progress Report of Closing the Gaps by 2015 from Texas Higher Education Coordination Board (THECB), undergraduate degrees and certificates in technology (computer science, engineering, math, and physical science) have steadily declined since FY 2003 in Texas (THECB, 2008). On the other hand, the U.S. Department of Labor reported employment in professional, scientific, and technical services will grow by 28.4 percent. This is expected to add 1.9 million new jobs by 2014 (US Department of Labor, 2008). Many researchers have been scrutinizing this widening gap between the shrinking number of future technology employees and the lush growth of job vacancies. Rettenmayer, Berry, and Ellis (2007) surprisingly found that the guidance counselors and high school teachers were the least influential in students' choices of their majors in college. Should the information and computing faculty develop awareness and educational programs on their behalf to influence more students to major in information and computing fields, if high school teachers and guidance counselors are unaware of technology career opportunities?

A computer education track in some form should be available to our future candidate teachers so that they can get certified (accredited) to teach computer technology in the public schools. After all, there is certification for math, special education, reading, etc. so why not computer education? This would allow extra courses in the core curriculum for certification in computer education. In other words, we need to teach the teachers how to teach the students the concepts of computers.

What are the resulting strategies related to the consequences of these outcomes?

First of all, as educators, we need to be able to have the time to teach the students the important concepts of critical thinking, computer literacy, and ethics. If we do not teach them these skills, then how are they going to learn them? The Texas Higher Education Coordination Board has passed a law mandating that a baccalaureate degree must consist of at least 120 semester credit hours and not more than 139 credit hours to obtain a Bachelor's degree (THECB, 2008). Moreover, the state of Colorado even has a more restrictive law that requires Bachelor's degrees to be no more than 120 credit hours (Colorado, 2008); although teacher education is allowed up to 126 credit hours (Colorado, 2008). The higher education institutions have to cut their core hours to accommodate this law. This has to be one of the most antiquated and controversial laws ever. At this point in our history when other countries are outranking us in math and science, we need to be expanding our core curriculum, not cutting it.

Time is definitely not on our side. Time in the classroom is being wasted having to teach students things that they either already know how to do or things that could be taught in an on-line environment. For instance, teaching the Microsoft Office applications in the classroom might not have to take place. With various on-line teaching programs available, there is no reason to have to take valuable classroom time teaching the basics. They can learn this on their own at any convenient time. Classroom time should be devoted to things such as technology innovations, ethics, computer literacy, critical thinking skills, computer security and current problems involving computer privacy.

5. CONCLUSION

This study focused on the students' computer skill levels and their critical thinking levels in a higher education system. The results did not show a positive outcome as what we would like to have in a higher education level. Moreover, the resources from our secondary school system are not showing positive outcomes either. As a nation, we are already behind many other countries in math and science as was noted in 2003 (International Association for the Evaluation of Educational Achievement [IEA], 2008). We cannot afford to also be behind in computer education. As the International Association for the Evaluation of Educational Achievement stated opportunities provided outside school were a major factor influencing student learning about computers. Consider the poorest students, they have fewer opportunities to learn computing skills at home, away from school. At all selected school levels in 20 countries; students' computer-related knowledge was weakly associated with the opportunities that students had to acquire that knowledge within schools (IEA, 2008).

We, as educators, need to urge elected officials who structure the educational environment to expand computer education in our public schools and universities. Instead of cutting the curriculum to appease parents we need to be expanding the horizons and making sure our students are not falling behind. If we do not close the technological gap soon, the U.S. will find itself sinking to a second-class country instead of a world leader.

Future research will be needed to conduct a larger scale of assessment in computer skills, critical thinking skills, and ethical issues. Furthermore, the research will be invaluable to review the accredited universities with teacher preparation programs to (a) analyze the existing curriculum designs, (b) assess the teacher candidates' computer skills, critical thinking skills, and ethical issues.

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