Reframing Computer Education in P-16 System

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Abstract

The national technology plan from the U.S. Department of Education in 2004 showed that teachers have more resources available through technology than ever before, but many teachers have not received sufficient training in the effective use of technology to enhance the students' learning. A mixed method was designed to evaluate the current Computer Education system from the view of 17 Technology Specialists in Texas P -12 systems. There were three research questions which guided this study: To what rating/level a typical teacher was evaluated in (a) their computer literacy levels; (b) implementing instructional technology into his/her classroom; and (c) valuing Computer Education to be included in the teacher preparation program? The finding showed that a typical teacher's average computer literacy level was evaluated as below average. A typical teacher who implemented instructional technology into his/her classroom was evaluated with a value of below expected usages. The findings also showed that there is a strong emphasis on the importance of computer education which is suggested to be included in the teacher preparation program. To avoid any bias occurred from the participants' backgrounds; the results showed that there is not a significantly different outcome between (a) the sizes of schools where the participants work; (b) the participants' teaching years; and (c) the subjects the participants teach. Following the suggestions of the courses to be offered from the computer education, the top four courses were proposed from the most to the least value: Multimedia Educational Application, Fundamental Computer Courses, Operating System, and Web Design. Due to the limited resources in computer education, this study might enhance the value of creating a computer education track to promote the efficiency of educational technology in P – 16 systems.

Keywords:

Computer Education, Educational Technology, Teacher Preparation Program

Introduction

The public mistakenly concludes that since the new generation grows up with digital devices they easily learn, and comfortably use technology ("How the new generation," 2007; Kelly & Haber, 2006; Shannon, 2008). As a result, many higher education institutions had dropped the introductory computer courses from the required core course list due to the recent regulation from the Southern Association of Colleges and Schools (SACS) which mandates the minimal total credit hours of 120 to fulfill the requirement of a bachelor degree (SACS, 2008). Many higher education institutions already witness the new graduate students and future teacher candidates are still incompetent in computer literacy even before the curriculum was redesigned to meet SACS's standards (Shannon, 2007). Cooper (2007) also stated that there is ample evidence to suggest that there is still a need for computer skills, concepts, and critical thinking developments at the university level.

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). A widening gap between the shrinking number of future technology employees and the lush growth of job vacancies attracted several researchers. Many researchers tried to understand the students' trends and needs, and tried to establish the recruitment and retention plans for the undergraduate degrees and certificates in technology. From 2000-2005, the percentage of ACT-tested students who reported that they were interested in majoring in computer and information science has been dropping steadily from 4.5 percent to 2.9 percent (ACT, 2005). Howles (2007) found that most students applied to Computer Science (CS) because of their love of computers, but a fair percentage of students (13 – 17.5%) enter the major of CS with no programming experience and limited computer use. Moreover, it is surprising to find out that the guidance counselors and high school teachers were the least influential in students' choices of their majors (Rettenmayer, Berry, & Ellis, 2007). We ask: should the information and the computing faculty take on the role of gatekeeper for these students? By developing educational programs on behalf of technology students, perhaps more students will major in the information and computing fields.

The International Computing Education Research (ICER) Northwest Workshop in 2006 identified five strategic goals to address the universal influences in multidisciplinary domains of knowledge of computing applications (Cushing, Bryant, Orr, Spengler, Tuttle, & Yasuhara, 2006). Two of the five ICER goals were related to computer education. One ICER goal was to attract more people to the field by mounting a vigorous campaign to change the image of computing. ICER suggested different solutions such as convening focus groups to get a better sense of what students want, increasing outreach to high-school students, teachers, and counselors, and making outreach materials available to faculty. The other ICER goal stated that universities could eliminate structural barriers to interdisciplinary collaboration and provide greater institutional rewards for teaching and curriculum development.

The national technology plan showed that teachers have more resources available through technology than ever before, but many teachers have not received sufficient training in the effective use of technology to enhance the students' learning (U.S. Department of Education, 2008). Legislation and corresponding regulations have forced teacher education programs to respond hastily to national, state, and local expectations for the training of teachers (Crouse & Kasbohm, 2004). Therefore, accredited teacher education programs are increasingly important. Crouse and Kasbohm stated that teacher education programs are expected to incorporate standards-based, data-driven instruction that will produce teacher education candidates who are both qualitatively and quantitatively superior to past candidates.

Purpose of the Study

The purpose of this study was to evaluate the existing computer education from the view of the Technology Specialists to determine to what degree it is for a typical teacher's computer literacy skill and for implementing educational technology in his/her classroom. In addition, this study sought to determine how the Technology Specialists value the Computer Education to be included in the teacher preparation program. Due to the limited resources in Computer Education, the significance of this study was to enhance the value for creating a Computer Education degree plan for teacher preparation program to guide the educational technology in place.

Research Questions

Three research questions guided this study. For a typical teacher, how do technology specialists: (1) evaluate the computer literacy skill levels; (2) evaluate the usages of implementing instructional technology into classrooms; and (3) value the computer education to be included in the teacher preparation program? The sub-questions follow the paradigm for exploring open coding and were designed to answer: What computer courses do the educators value the most? What specific issues have been influential?

Methodology

A mixed method was designed for this study to collect the data in two forms: (a) Likert scale rating of 1 to 5 which 1 is the least and 5 is the highest value; and (b) open questions for the participants to share their experiences and thoughts. Axinn and Pearce stated that the data divided between "qualitative" and "quantitative" affords opportunities to use the strengths of some methods to counterbalance the weaknesses of others (2006).
For quantitative analysis, the Statistical Package for the Social Sciences (SPSS, Version 15.0) was utilized to analyze the numerical data. A descriptive method, One-Sample *t* test, and analysis of variance (ANOVA) were tested between the variables to determine the degree of responses and correlation value (Creighton, 2007; Field,

2000). For qualitative analysis, a grounded theory was implemented to generate or discover a theory that relates to a particular situation (Creswell, 1998). An open coding was created to develop and portray the theoretical framework of this study. In addition, qualitative data was quantified to interpret the findings (Tashakkori & Teddlie, 2003).

18 Technology Specialists were invited to conduct this online survey. There were 17 participants voluntarily completed the survey questions. A human subject protection form was approved for this study. A consent letter was sent out through email to obtain the permission for utilizing the data for publication. This study was limited to 17 schools/districts in 100 mile-radius around Huntsville, Texas area. The results of this study cannot be generalized to the entire P-16 systems in Texas or the U.S.; rather, the results were limited to P-16 systems which are similar in context of population, wealth, and enrollment.

Instruments

There were 21 questions designed with an online format to answer the research questions in the following categories: Background Information (Question 1 to 4); Teacher's Computer Skill Evaluations (Question 5 and 6); Computer Education Proposed Courses (Question 7 to 15); Job Tasks (Question 16 to 20); and an overall question for computer education (Question 21) (see Table1).

Table 1: **Research Questions**

Question	Question Statement
1	How many years have you been an educator in P-12 school system?
2	What subject/s have you taught in P-12 school system?
3	How many years have you been the Technology Specialist?
4	How many students are there in your school?
5	Estimate a typical teacher's ICT literacy level in your school.
6	Estimate a typical teacher implementing instructional technology into his/her classroom
7	To what rating do you believe that the fundamental ICT courses should be included in Teacher Preparation Program?
8	To what level do you expect the following course must be included in Teacher Preparation Program? **Computer Operating Systems**
9	To what level do you expect the following course must be included in Teacher Preparation Program? **Data Base Management**
10	To what level do you expect the following course must be included in Teacher Preparation Program? **Data Structures**
11	To what level do you expect the following course must be included in Teacher Preparation Program? **Multimedia Educational Application**
12	To what level do you expect the following course must be included in Teacher Preparation Program? **Networking**
13	To what level do you expect the following course must be included in Teacher Preparation Program? **Programming**
14	To what level do you expect the following course must be included in Teacher Preparation Program? **Web Design**
15	What other courses do you expect to be included in teacher preparation program for computing education? Please write your response.
16	To what range of hours on a weekly basis do your coworkers ask for support in the following areas? **Hardware** (Input, Output, Process, Memory)
17	To what range of hours on a weekly basis do your coworkers ask for support in the following areas? **Software** (Microsoft Office, Multimedia Software)
18	To what range of hours on a weekly basis do your coworkers ask for support in the following areas? **Networking**
19	To what range of hours on a weekly basis do your coworkers ask for support in the following areas? **Educational Application**
20	To what range of hours on a weekly basis and in what other computing areas do your coworkers ask for support? Please write your response.

21	How much do you value the computing education to be included in the teacher preparation program? Please write your response.

Reliability

Based on a statistical power of .5(*N*) with correlation coefficient (*r*) at an alpha level of .05, and a large effect size, a sample consisting of a minimum of 15 individuals was needed (Gall, Gall, & Borg, 2003). There were 17 individuals participated in this study which exceeded the needed samples for a reliable outcome for both qualitative and quantitative analysis. It is common that qualitative researchers often use their own specific backgrounds on theoretical assumptions to shape what approaches 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, an open coding system was organized to analyze the responses. Following after the coding system, the number counts of each category were then imported to SPSS 15.0 to "reduce methodological errors" (Onwuegbuzie & Daniel, 2005). As a result, the findings and conclusions were presented in both textual and numerical values (Onwuegbuzie & Teddlie, 2003).

Findings

By using an ANOVA test, the result showed that there is not a significantly different outcome between (a) the sizes of schools where the participants work; (b) the participants' teaching years; and (c) the subjects the participants teach. The following sections provide the answers for each research question.

How do technology specialists evaluate the computer literacy skill levels of a typical teacher?

As defined by Carbonara (2005), the term of computer literacy is the ability to use hardware and software efficiently and effectively including a broader scope of ability to identify, evaluate, and use information. Moreover, the National Educational Technology Standards (NETS) for teachers state that the performance indicators for teachers are: (a) Facilitate and inspire student learning and creativity; (b) Design and develop digital-age learning experiences and assessments; (c) Model digital-age work and learning; (d) Promote and model digital citizenship and responsibility; and (e) Engage in professional growth and leadership (ISTE, 2008).

Based on a Likert scale of 1 to 5 rating which 1 is the least and 5 is the highest value, the findings showed that a typical teacher's average computer literacy level was 2.82 which was a statistically significant result, below the average expected score (3) from the view of technology specialists ($p<.01$).

How do the technology specialists evaluate the usages of implementing instructional technology into classroom from a typical teacher?

A typical teacher implemented instructional technology into his/her classroom evaluated at a level of 2.65, of which 47.1% of responses were evaluated at 2 and 41.2% had a score of 3. This finding showed that the teachers are still not ready to utilize the various technological methods to enhance the students' learning in their classroom.

Comparing the computer literacy levels and the teachers' implementing instructional technology levels, there was a significant difference ($t=18.306$, $p<.01$) between these two variables. The computer literacy mean level is higher than implementing instructional technology mean level. The findings showed there might be some vital conditions to cause this result that will be worthwhile for further research (See Figure 1).

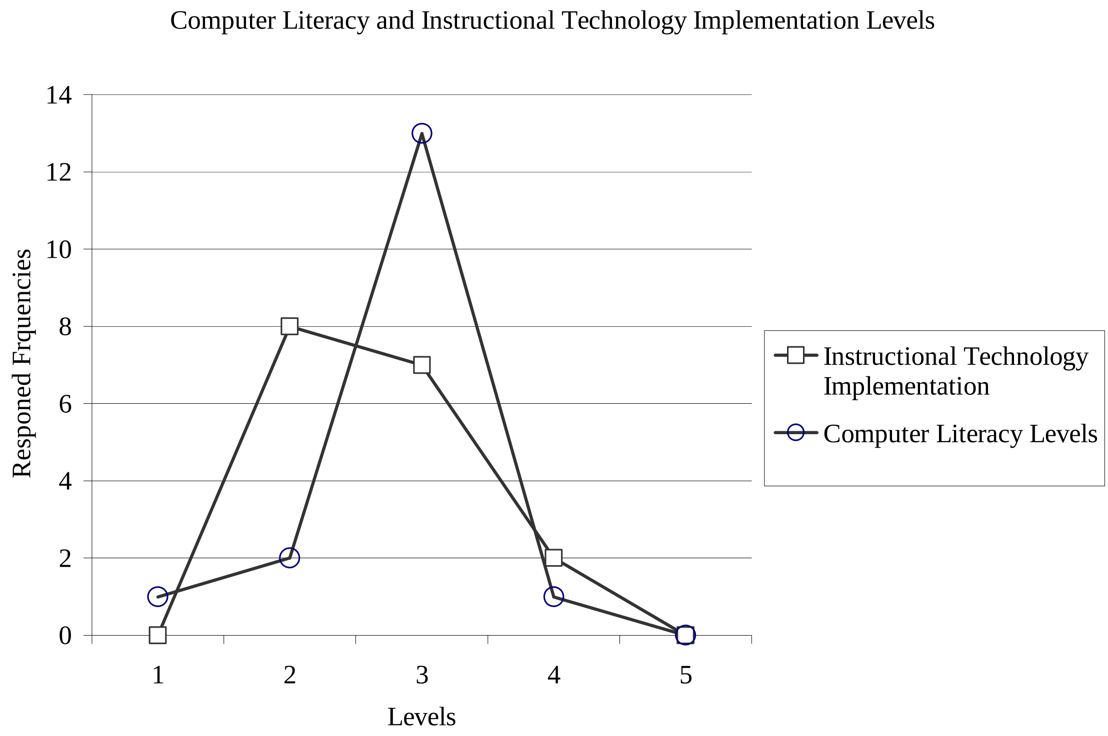

Figure 1: Computer Literacy and Instructional Technology Implementation Levels

How do the educators value the computer education to be included in the teacher preparation program?

The findings showed that there is a significantly strong support for the computer education to be included in the teacher preparation program. The codes were created and quantified the frequencies as the following: *Imperative* (41.2%), *Important* (23.5%), *Beneficial (23.5%)*, and *Valuable* (11.8%).

The following responses were the typical input under the code of *Important*:

> "I believe it is as highly important as pedagogy and core content."
>
> "Computing education is highly important as teachers need to understand the applications and techniques they are expected to teach and how these applications can be used in context…"

Under the code of *Imperative*, the participants stated:

> "It is imperative that all teachers have basic computing skills that can be utilized within the instructional delivery as well as being able to use the technology in a way that furthers the students understanding and develops their skills."
>
> "The value of computing education for our future workforce is pertinent…."

Under the code of *Beneficial*, many stated similarly as the following statement:

> "I think it would be very beneficial for students in the teacher preparation program… I see many teachers struggling with the use of technology in the classroom…"

What computer courses do educators value the most?

By giving the suggestions of the courses to be offered from the computer education, the top four courses were recommended from the most to the least value: Multimedia Educational Application, Fundamental Computer Courses, Operating System, and Web Design (See Table 2). The findings showed that 28.6% of responses emphasized that technology integrating should be included into core curricular subjects of preparing the students for their future workforce, or future education. The other 28.6% of responses stated that an introductory course should provide the basic applications such as, Microsoft Office, terminology, and troubleshooting. 42.8% of responses suggested that the multimedia educational application should include Podcasting, Smartboards, Starboard, and Data Loggers.

Table 2: The Suggested Courses for Computer Education

Proposed Courses	Mean Value	Standard Deviation
Multimedia Educational Application	4.82	.529
Fundamental Computer Courses	4.76	.562
Computer Operating System	3.71	1.160
Web Design	3.59	1.176
Networking	3.41	1.064
Data Base Management	3.06	1.088
Data Structure	2.88	.993
Programming	1.94	.827

To analyze whether the value of each suggested computer courses was affected by the hours of the participants' job tasks; an ANOVA test was used to determine whether there were significant correlations between the variables. The categories of job tasks were listed as the following: Hardware, Software, Networking Troubles, and Educational Application issues. The finding showed that the top two longest tasks are Software Issues and Educational Application Issues that occupied around 5.5 hours per week to assist the teachers (See Table 3). After tested with ANOVA between the job tasks and the proposed computer courses, the findings showed that there was not a significant difference between the variables. The participants did not value the level of each proposed computer course based on the items of their job tasks.

Table 3: Technology Specialists' Job Tasks

Job Tasks	Mean Hours	Standard Deviation
Hardware Issues	2.73	1.074
Software Issues	5.52	1.091
Networking Troubles	1.94	.686
Educational Application Issues	5.42	1.312

Some other job tasks were also coded: *printer, General Troubleshooting, Projector and Laptop, Microsoft Office Software, Training,* and *Research*. 27% of the participants stated that they have been assisting their teachers in Microsoft Office software, and 28% of the participants spent time helping general troubleshooting.

From the responses of the job tasks the participants provided, there is a deep frustration expressed from the participants. Many teachers are still struggling with using PowerPoint and Excel software with which it was assumed that all educators and students should be quite competent in today's society. Moreover, to recover this technological incompetency issue, many participants had to spend some extra time to create in-house training courses to assist their teachers. One response stated that:

"I have been surprised at how little many educators know about technology…"

What specific issues have been influential?

Technology training that specifically addresses the integration of technology into the curriculum has the strongest positive impact on teacher attitudes toward instructional technology (Casey, 2000). Casey stated that a significant number of teachers either use instructional technology inappropriately, or not at all, because little attention is paid to helping teachers transition into applying technology. This study reflected that a proper designed teacher preparation program might be the primary key to bridge the transition for teachers and students.

In addition, this study echoes the needs for supporting the goals from ICER's strategic goals from the Northwest Workshop in which the higher education institutions might increase outreaching to high-school students, teachers, and counselors by reviewing their existing programs and materials available to the students and faculty. Furthermore, an interdisciplinary collaboration for teaching and curriculum development will be needed to shorten the disproportionate gap between the number of future technology employees and the growth of job vacancies.

Conclusions

From the view of Technology Specialists, the findings showed that the existing teacher preparation programs do not provide sufficient support to implement technology for strengthening the future candidate educators' technological competency. Howles (2006) stated that Computer Science educators must expect that students will be entering programs with limited or no programming experience and slight access to technology. Well structured introductory classes with multiple entry points for students with or without experience and adequate support and tutoring services are necessary for these students, to bridge them to success (Howles). With the same goals, I believe that this discipline should also be applied to multidisciplinary departments across campus, especially the teacher preparation program. These programs produce our future educators and train counselors to guide and influence our future students by introducing them to the different aspects of the world of information and technology which is beyond web browsing, emailing, and game playing. Educators will be able to deliver the "love of computing" at a higher level for the students if a proper higher level of computer courses is in place within the teacher preparation program.

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