Spring 2013

Teachers' Perceptions on the Availability and Quality Of Computer Science and Technology in Schools

Pauline H. Lake
Trinity College, plake09@yahoo.com

Teachers' Perceptions on the Availability and Quality Of Computer Science and Technology in Schools

Pauline Lake
Educational Studies Program Senior Project
Trinity College
December 2012

Abstract:

As our world becomes more technologically advanced and the availability of jobs in the Computer Science (CS) field increases, it is important that U.S. students are provided with a CS education and experience technology integration in their classrooms. My research examined the availability and quality of CS and technology in schools based on the perceptions of K-12 teachers in the Hartford area. Through analysis of online survey responses and follow-up interviews, I identified that teachers' perceived the availability and quality of CS and technology in schools to be influenced by factors, such as funding disparities, teacher inexperience, and lack of administrative and technical support. Based on these findings, I argue that many teachers have a misconception about CS. I also argue that teachers' perceptions are disconnected when comparing their current school to other schools. If we wish to have our students develop the essentials skill to be fully functioning members of our technologically advanced society, I recommend that K-12 teachers are provided with more administrative and technical support and better Professional Development training that involves the foundation of basic CS principles.

Introduction

As our world becomes more technologically advanced and the availability of jobs in the Computer Science field increases, it is important that U.S. students are provided with a Computer Science education and access to technology. In schools, access to technology is most prevalent through the use of computers. In 2009, 97% of teachers reported having one or more computers located in the classroom every day (National Center for Education Statistics, 2010). Currently, students use these computers to learn job related skills including typing, using software such as Microsoft Office, and using the Internet. But, students also need to learn about abstraction, computation, and problem solving (Computer Science). However, the National Science Foundation (NSF) states that there is a lack of computing in K-12 schools (National Science Foundation, 2012). This implies that K-12 schools are not offering Computer Science courses, such as programming, and access to technology resources for their students. If this is the case, then there must be a reason for K-12 schools not offering access to Computer Science and technology. If this is not the case, then Computer Science and technology courses *are* available in schools. If the latter happens to be true, then "lack" *could* refer to a number of different things including staffing, training, hardware resources, and pedagogical resistance. But, what exactly does lack mean and what influences the availability and quality of Computer Science and technology in schools?

There are a number of factors that *may* be contributing to the amount of Computer Science and technology in schools. This includes, funding disparities, the lack of qualified Computer Science teachers, including teachers who lack technology skills, and educators not understanding the significance of problem solving and technology skills for

their students. My research asks: *How do teachers perceive the availability of Computer Science and technology in schools? Based on teachers' perceptions, what factors affect the amount of Computer Science and technology that is offered in schools?* I analyzed teachers' perceptions on the amount of Computer Science and technology that was available in their schools and any barriers to technology that they believe existed, in an attempt to find out what affects the availability and quality of Computer Science and technology in schools.

If students are not exposed to Computer Science and technology in K-12 schools, this could influence their career field choice and interests in post-secondary schools. According to Figure 1 (Appendix C) from the Computing Research Association's annual Taulbee survey, there was a decline in the number of Computer Science majors from 2000-2007. It wasn't until 2007 that the number of Computer Science majors started to slowly increase (Harsha, 2012). But despite this increase, the NSF has acknowledged that student interest in Computer Science majors has fallen below the projected number of job openings in the Computer Science field. As part of acknowledging this decline, the NSF introduced a nationwide project called Computing Education for the 21st Century (CE21) which aims to increase the number of Computer Science college majors and to prepare students for the current workforce (National Science Foundation, 2012). In order for the goals of CE21 to be met, students must be interested in Computer Science and they must have access to a Computer Science education before the post-secondary level. Student access to a Computer Science education prior to college means that K-12 schools must provide students with Computer Science courses and technology resources.

Teachers perceive some schools to have fewer Computer Science courses and less technology resources than other schools. However, teachers' perceptions are disconnected when they compare their current school to other schools. Based on teachers' perceptions, I argue that the availability and quality of Computer Science and technology in schools is influenced by funding, teachers' inexperience, and lack of administrative and technical support. Many teachers are willing to include Computer Science and technology in their classrooms, but are limited by internet restrictions and student home access. In addition, many teachers who currently include technology in their classroom instruction do so for the purposes of having a teaching aid and to build students' technology skills, because they have a misconception about Computer Science.

Literature Review

Every day, our world is becoming more technologically advanced. As new technologies are released, it becomes increasingly harder for individuals to keep up. But, with the increase in technology also comes an increase in the number of jobs in Computing fields, including web design, software development, and technical support. However, today's students, the future generation of workers, are not being trained for these jobs. In addition, students, although fascinated by technology, are not majoring in Computer Science when they reach the college level and they are overall not interested in employment that involves Computer Science programming and the use of technology.

My research examines the availability and quality Computer Science and technology in schools, based on teachers' perceptions. Since the factors that affect Computer Science and technology in schools may very well be the same factors that

influence the technological divide, this literature review is split into two parts: The technological divide and perceptions on Computer Science and technology in schools.

The Technological Divide:

The technological divide occurs when there is a difference in technology skills among individuals. In addition to skill level, the technological divide can also include unequal access to technology. The technological divide also impacts who uses technology and how they use it. Specifically, in Hartford, CT there is a disparity among residents with access to technology and a disparity among those who use computers. In 2004, the AETNA Center for Families & Kellogg Project Community Resident Survey was distributed to families in Hartford. The survey revealed that only 37% of the households surveyed owned a computer and only 22% of households had Internet access. In addition, 78% of Hartford's residents indicated that they needed more computer training (Hughes, 2005). It is this technological divide that affects students' interest levels and abilities directly by influencing the amount of Computing and technology education that they receive. But, how is this technological divide constructed in schools? Multiple researchers have focused on the external factors that construct the technological divide (Anderson & Ronnkvist, 1999; Clarke and Zagarell, 2012; Warschauer, 2007).

One common argument among researchers is that funding and access to technology influence the amount of technology in schools. In a study funded by the NSF, Anderson and Ronnkvist (1999) issued a nationwide survey to administrators and technology coordinators in 655 elementary and secondary U.S. schools. The purpose of their survey was to determine if the 1995 report made by the Presidential Panel on Education Technology remained true. In the report, the panel concluded that the

technology equipment available in U.S. schools was of limited quality. Anderson and Ronnkvist found that computers in the schools had limited functionality and memory capacity. In addition, Anderson and Ronnkvist found that schools seemed to keep up with the constant technological advancement by having new technologies that emerged. However, access to the Internet varied among the schools, as well as the usage of internet. Anderson and Ronnkvist argued that the digital divide caused disparities along social, economic, and geographic boundaries. According to Anderson and Ronnkvist, these disparities lead to differences in funding among the schools.

Similarly, Clarke and Zagarell (2008) argued that "a variety of factors may be at play in reference to the technological divide" when it comes to the amount of technology in schools. According to Clarke and Zagarell, funding disparities and inexperience of teachers and administrators are two of the most influential factors. The connection that Clarke and Zagarell make between teachers and administrators and the technological divide is an important one since teachers and administrators ultimately control what goes on in the classrooms. If teachers and administrators do not have a proper Computer Science and technology background, they will permit less Computer Science and technology to be used in the classroom. I further their argument by saying that teachers and administers who do not believe Computer Science and technology education are important for students will also not permit Computer Science and technology use in the classroom.

The technological divide, sometimes referred to as the digital divide, was also examined in a study by Warschauer (2007) through a pilot program called Project Fresa. Project Fresa was a yearlong project involving primarily Latino students from an

elementary school in Oxnard, California. The project was designed to foster critical thinking through technology and allowed students to build their language and critical thinking skills through conducting research on strawberry farm workers and sending letters by e-mail to various local officials. The goal of Project Fresa was to target the technological divide that, Warschauer argued, existed as differences in students' school access, students' home access, school use, gender gaps, and generational gaps. The success of the program was believed to have come from combining all of these differences into one project and allowing the students to work with teachers who had more experience with computers than they did. Warschauer looked at each of the above differences as individual divides. By doing so Warschauer's research is limited because it does not examine the possible intertwining relationships between these differences. My research aims to find possible factors and how they influence the availability and quality of Computer Science and technology in schools. This may include finding relationships between factors. Certainly, research on the impact of external factors is important. However, the internal factors, the problems faced inside of schools, are also an important piece in understanding Computer Science and technology in schools.

Although their article discusses the effect of external factors, Clarke and Zagarell (2012) state that "the only way to bridge the technological divide is to understand which problems teachers face and how those program affect their attitude toward technology." My research aims to further this statement by collecting my data directly from teachers. More importantly, focusing on the perceptions of teachers helps to determine if internal factors, such as personal beliefs and opinions, in addition to external factors, influence the availability and quality of Computer Science and technology in schools.

Perceptions and Beliefs on Technology in Schools:

Past research on technology in schools has focused on the perceptions of teachers and students. Li (2007) conducted a study that used both quantitative and qualitative methods, interviews with 15 teachers and surveys with 575 students. Participants in the study consisted of high school Math and Science teachers from both urban and rural areas and their students. Results from Li's interviews and surveys revealed that while students perceived technology as useful and effective in their learning, teachers perceived technology to be unhelpful in teaching practices and no teacher in the study mentioned using technology to help students prepare for the workplace. Li argues that teachers are fully aware of their students love for technology, but may be ignoring their students' views. If this is true, then teachers may be ignoring students' views because of their own personal beliefs of technology. Or perhaps inexperienced teachers are not ignoring their students' views on technology, but are instead fearful of using technology in the classroom due to their level of inexperience.

Other research has involved only studying the perceptions of teachers. For example, Niederhauser and Perkmen (2008) surveyed 92 pre-service teachers about their individual confidence levels with technology, interest levels regarding technology, and intentions on using technology in their future classrooms. Niederhauser and Perkmen argued that "teachers' intrapersonal beliefs [are] central to our understanding of their predisposition to integrate technology into their classroom." Teachers' beliefs and opinions are important because they help decide whether or not Computer Science and technology make it into the classrooms. However, unlike Niederhauser and Perkmen's research, my research involves gathering the perceptions of current teachers and asking

them about their views on Computer Science and technology in their schools compared to other schools.

Similar to Niederhauser and Perkmen (2008), Inan and Lowther (2010) also studied the perceptions of teachers by way of a survey. Inan and Lowther surveyed 1,382 Tennessee teachers about their perceptions on factors that influence technology integration. Through analysis of the survey responses, the researchers created a path model that found both direct and indirect factors of technology integration. The path model showed relationships between each of the factors. Overall research has generally focused on the amount of technology in schools and teachers' perceptions on integrating technology into the classroom. However, literature on Computer Science in schools was not found because Computer Science has not yet been incorporated into K-12 pedagogy nationally. Computer Science education for K-12 is a fairly new initiative that is supported by the National Science Foundation. My research is unique because in addition to asking about technology in schools, it examines Computer Science in schools. My research seeks to determine how teachers' perceive Computer Science and technology in both their schools, as well as, in other schools. Through analyzing teachers' perceptions, my research aims to identify the factors that most influence the availability and quality of Computer Science and technology in schools.

Methodology

For my research, I used a primarily quantitative approach to gather primary information. First, I created an online survey using a quantitative tool called Qualtrics. In the survey, I included questions that allowed participants to identify the amount of Computer Science courses and availability of technology at their schools, as well as at

other schools. I also asked the teachers about their level of experience with Computer Science and technology, including whether or not they use technology in their schools (See Appendix A). The primary purpose of the survey was to determine which factor(s) most affect the availability of Computer Science and technology in the participants' schools. Due to limited research time, approximately three months, distribution of a survey was the best way to collect my data.

I distributed the survey via e-mail, to approximately 400 teachers in Hartford, CT and surrounding towns. E-mails were retrieved from public websites with the Hartford Public Schools' website as my starting point. I also included the e-mails of teachers I met at a local STEM conference in September. Participation in the survey was voluntary and anonymous. Completion of the survey took approximately 15 minutes. After survey responses were submitted, I downloaded the data from Qualtrics and used SPSS and PSPP to conduct a data analysis.

Of those e-mailed, 58 teachers completed the survey. Of the 58 respondents, 42 taught in Hartford Public Schools and 8 taught in surrounding towns (See Table 2 in Appendix B). Most of the respondents currently worked in magnet schools with 34 indicating they worked in magnet schools, 16 in public schools, and 2 in private schools. 33 of the teachers were female, 18 were male, and 7 did not indicate their gender. 31 teachers had 10 or more years of teaching experience and only 10 teachers had been at their current schools for their entire teaching career (See Tables 1 and 2 in Appendix B). In addition, all subject areas were represented among the participants. Thus, my sample represented a wide range of teachers in the Hartford area and provided me with responses from teachers of various backgrounds.

In addition to the survey, I conducted follow-up interviews with two of the 58 survey participants. These teachers indicated on their survey that they were interested in participating in a 20-30 minute follow-up interview and contacted me via e-mail to schedule an interview time (Appendix A – Question 37). When scheduling an interview time, I asked that the teachers select a time after school because I did not want to interfere with their school day. Although every survey participant had the opportunity to participate in a follow-up interview, most declined the opportunity for unknown reasons. Others, besides the two teachers I interviewed, indicated that they were interested but either did not contact me or did not confirm an interview time.

The first teacher I interviewed was Mr. Wright[1]. Mr. Wright is a Physics teacher at a Hartford magnet high school. He has eight years of teaching experience and has taught at the same school for his entire teaching career. Mrs. Smith, the second teacher I interviewed, is a Kindergarten teacher at another Hartford magnet elementary school. Like Mr. Wright, Mrs. Smith also has eight years of teaching experience. However, Mrs. Smith has taught at several schools including a Hartford Public School (non-magnet) and a private school in Connecticut.

Both interviews were tape recorded and transcribed for analysis. The interview questions were taken from the survey and asked in a more open-ended format. For example, each interview began with "Tell me about you and your experience as a teacher." Based on the interviewee's response, I asked a follow up question, based on one of the survey questions. Through the interviews, I hoped to put all of survey responses into context and provide the teachers a chance to give more detailed responses. I also wanted to learn more about how the teachers may or may not be using technology in their

[1] This name and all other names are pseudonyms.

classrooms. After analyzing the interview transcriptions, I looked for common themes between the survey responses and the interviews.

Context and Reflexivity

As a dual major in Computer Science and Educational Studies, I have spent most of my college career advocating for technology integration. I have also gained teaching experience through creating and teaching an introductory Computer Science program. For the context of my research, I used two distinct definitions of Computer Science and technology. The following definitions are based on my expertise and experience with Computer Science and education.

Computer Science: A field that focuses on problem-solving skills that are developed through the use of computers and computer programming. This also includes knowledge of abstraction, computation, and algorithms.

Technology: Any device or tool, such as computers (both hardware and software, such as Microsoft Office), cell phones, projectors, Smart Boards, etc., that make everyday life easier.

Findings

Availability and Quality of Computer Science and Technology:

This section gives an overview of how teachers in the Hartford area perceive the availability and quality of Computer Science and Technology in both their current schools and in other local locals.

My research found that Hartford area K-12 schools provide students' with access to technology resources, but very few Computer Science courses are offered. When asked "how many computer labs are in you school," 74% of the respondents indicated that their

schools had one to four computer labs. Considering that 94% of the respondents indicated that their schools had less than 1,000 students, one to four computers labs in each school indicates that students are sharing computers (See Tables 1 and 2 in Appendix B). In addition to the low number of computer labs available in the schools, teachers also indicated that more technology courses were offered than Computer Science courses. This included 38% of teachers reporting that their school had no Computer Science courses at all and 34% teachers reporting that their school offered only one to four Computer Science courses each year. This can be compared to 36% teachers reporting that their schools offered five or more technology courses each year (See Table 3 in Appendix B). The teachers' survey responses clearly illustrated that their school offered students access to computers and that their schools offered more technology courses than Computer Science courses.

The teachers were also asked "How do you feel about the amount of Computer Science and technology in your school compared to other local schools?" When answering, the teachers could choose one of three options: My school has less than, the same amount, or more than other schools. 41% perceived their current school to have more Computer Science and technology than other schools (See Table 4 in Appendix B).

Preconceptions of Computer Science and Technology:

Defining CS

Immediately upon starting the survey, teachers were asked to define Computer Science. The first question on the survey states "Please describe, in your own words, what "Computer Science" means to you" (See Appendix A). While some teachers did give a correct definition, there were many teachers who incorrectly defined Computer

Science. The most frequent answer included "computer technology" in which teachers described Computer Science as being the study of learning computer technology or the use of computers to enhance work. Others stated that Computer Science was "learning with the use of computers" or "another support to use in the classroom."

Usefulness

Through both the survey responses and the interviews, it was clear the teachers' perceived Computer Science and technology as important to helping their students succeed. When asked "Do you think that Computer Science and technology courses are useful for students? Please explain." 92% of the teachers said yes. One teacher said, "Yes, we are preparing them for employment in the 21st century." While another teacher said, "Yes. Technology is used on a daily basis. In order to keep up with finding solutions to real world problems, we have to use technology (computers). Future careers and jobs demand a working knowledge of new technology." There was a consensus among the teachers that knowledge of Computer Science and technology helps prepare students for the real world, including for employment after school and the necessary technology skills that are needed to be functioning members of today's technologically advanced society.

Barriers:

The following are barriers that the teachers' perceived to be influencing the availability and quality of Computer Science and technology in their currents schools and in other local schools.

Funding

Research reports funding as one of the leading factors in the technological divide (Anderson & Ronnkvist, 1999; Clarke & Zagarell, 2008). Therefore, it is no surprise that teachers also perceived funding to be an issue. 75% said funding "very much" influenced the availability and quality of technology in their current schools, while 80% said funding "very much" influenced the availability and quality of Computer Science. Interestingly, 48% of the teachers said funding had "some" influence on technology in other schools, while 60% said funding "very much" influenced Computer Science in other schools. In both cases, the teachers' perceived funding to be influential to technology in schools, but more influential on Computer Science in schools.

Student Home Access

Mrs. Smith reported that when she arrived at her school, the Kindergarten students had not yet developed basic technology skills, such as using a mouse and a keyboard, and that some of her students did not have access to computers at home. Similarly, Mr. Wright also stated that he had a blog for posting homework assignments and announcements, but at times it became an issue, because some of his students did not have access to technology at home. Others, he reported, were much more fortunate and came to class with their laptops. Mr. Wright also stated, "If I were in South Windsor, the majority of them would have [home access]." By this Mr. Wright implies that the city of Hartford lacks access to technology when compared to surrounding towns. Mrs. Smith and Mr. Wright were among the 50% of teachers who perceived student home access to have at least some influence on technology at their school. They were also among the

53% who perceived student home access to have at least some influence on Computer Science at their school.

Technical Support

Mrs. Smith reported that her school had one technical support person. However, this person was the Computer Science/Technology teacher. She described him as approachable and willing to help, but help was limited to times when he was not teaching his classes. Mr. Wright also reported having one technical support person in his school that made getting help a slow process. Mr. Wright also added that when it came time to get help with a particular technology, calling product support for that technology was more helpful. With having just one technical support person at each of their schools, Mr. Wright and Mrs. Smith provided insight on why 67% of teachers said that technical support very much affected the availability and quality of technology at their school. In addition, 64% of teachers also perceived technical support to be very much affecting Computer Science at their schools.

Administrator Approval

My research found that the teachers perceived support from their administrators to be an important factor in the availability and quality of Computer Science and technology in schools. When asked how much influential administrator approval was for technology at their current school, 44% said “very much” and 34% said “some.” Through the interviews, two main themes emerged regarding administrator’s approval: Professional Development and internet restrictions.

Professional Development

Both interviewees mentioned Professional Developments (PDs).[2] Both teachers felt that their administrator did a good job of setting up PDs that focused on basic technology skills, such as how to use a Smart Board, which was helpful for teachers with very little technology experience. Both Mr. Wright and Mrs. Smith felt that the PDs were helpful for the inexperienced teachers. However, Mr. Wright, who considered himself "competent with technology," felt that the PDs were "boring" and did not focus on skills beyond basic use. Mrs. Smith, who referred to herself as "the go-to person" for technical questions, praised her principal for his efforts to provide help with technology to the inexperienced teachers, but also reported that the PDs were very basic. She ended by saying, "I feel like there also needs to be that next level of Professional Development for people who already know what they're doing."

Internet Restrictions

When I questioned the teachers, in the interviews, about barriers to technology in the classroom, there was a consensus that internet restrictions were a problem. These restrictions were established by the administration to keep students from viewing inappropriate material on the Internet and to avoid copyright issues that might occur when using material from certain sites, such as YouTube. However, the restrictions often stopped the teachers from showing educational material. As a Physics teacher, Mr. Wright expressed frustration with the internet restrictions because they did not allow him to spontaneously show his students videos of real life Physics:

[2] Professional developments are workshops set up by the administrator to help teachers improve/develop skills. Topics are generally chosen on a need-based assessment and administrators usually have teachers complete a survey indicating what they would like the focus of the PDs to be.

> "They block EVERYTHING here … Yeah, there's crap out there, but it's an INVALUABLE resource to say "What does an air bag crash look like?" I can [pull up] a video. But, they won't let us at. So, if there's something to complain about, it's this ridiculous notion that "oh they're posting copyrighted material and we're gonna get into trouble" Who's gonna sue a school district for showing a video? … So if there's a problem with the district, that's it. The filters, the block."

Mr. Wright went on to say that the internet restrictions did not stop the students, they only stopped the teachers.

Similarly, Mrs. Smith expressed concern with not being able to show her Kindergarten students visuals on how to do certain assignments:

> "I don't wanna say they limit you, but there's definitely intentional things put on the school property, you know, that you could use or not use. I know even trying to pull up … SchoolTube videos, that would show the kids what a doll out of a recycled soda bottle would look like … And, I had a really hard time, even trying to pull up the videos, just because of the internet blocking certain things."

Both teachers clearly expressed frustration with internet restrictions. In both interviews, the teachers reflected on a time when they wanted to show their students a video that pertained to the class. 86% of survey respondents, including both Mr. Wright and Mrs. Smith, believed using the web enhanced classroom instruction. But, unfortunately, internet restrictions limit what they can use the Internet for.

Teacher Experience/Training

The finding on administrator's approval especially intriguing when compared to the survey responses for the question "How much do you feel teacher experience/training affect the availability and quality of technology in your school?" On this question, 46% of the teachers answered "very much." Also, when asked if teacher experience/training affected the availability and quality of Computer Science in their school, 54% of the teachers said "very much." This perception was accurate because many teachers reported

having little to no Computer Science experience. This included 79% of teachers who had taken less than four Computer Science courses and 56% of teachers had no experience with programming languages (See Table 1 in Appendix B).

Discussion

Overall, teachers perceive some schools to have fewer Computer Science courses and less technology resources than other schools. This is not only evident in the teachers' responses to question 12 on the survey, but also in their perceptions of how much a particular factor influenced technology and Computer Science in their school compared to other schools. In addition, when comparing their current school to other schools, teachers' perceptions are disconnected. Recall that 41% stated that they felt their school had more technology and Computer Science than other schools. However, the majority of teachers' indicated that their schools had only one to four computer labs and little or no Computer Science courses. If there are few computer labs in each school and virtually no Computer Science being offered, how can this mean that teachers' current schools have more Computer Science and technology than other schools? If this were true, then other schools would not have any Computer Science and technology at all.

Teachers also perceived some factors to be more influential at other schools more than at their current school. One factor that stood out was funding. With the majority of the teachers being from magnet schools, it comes as no surprise that they would indicate funding to be more of an issue at other schools than at their own school. This is because in Hartford, magnet schools are funded separately than traditional public schools and ultimately receive more funding.

Based on teachers' perceptions, I also argue that the availability and quality of Computer Science and technology in schools is influenced teachers' inexperience and lack of administrative and technical support. Teachers' inexperience included having very little to no Computer Science experience. This inexperience could be because Computer Science pedagogy is fairly new. However, teacher inexperience could also be related to the lack of administrative and technical support the teachers receive in schools. If administrators are not offering accessible technical support then teachers will become discouraged with trying to integrate technology into their classroom. In addition, administrators are responsible for the Professional Development training that teachers receive. Therefore, administrators should be held accountable for making Professional Developments on basic Computer Science principles a priority for teachers. If teachers see that their administrators approve on learning Computer Science and that their administrators are advocating for the development of Computer Science skills in students, then teachers will be more likely to take the initiative to learn more about Computer Science and its significance.

Many teachers are willing to include Computer Science and technology in their classrooms, but are limited by internet restrictions and student home access. Teachers have indicated that they perceive Computer Science and technology skills as useful for their students. Some even went as far as saying that such skills were necessary for students to keep up with the workforce and helped students to be functioning members of society. And 100% of the teachers that answered the question "Do you, or have you ever, used technology in your classroom instruction?" responded "yes." This indicates that teachers are willing to use Computer Science and technology. The dilemma is when they

try to do so and are stopped by internet restrictions on particular sites that the teachers find educational, but administrators and the district find inappropriate to use. Also, some teachers are forced to use less technology in assignments because their students make not have home access to technology and/or have not developed enough skills to use technology the way the teacher hopes they can.

In addition, many teachers who currently include technology in their classroom instruction do so for the purposes of having a teaching aid and to build students' technology skills. With teachers reporting more technology courses than Computer Science courses in their schools, it is evident that the technology in schools is being used for students to learn basic computer skills and for use of software, such as Microsoft Office. Not using the available technology for teaching students Computer Science material means that students are losing out on the opportunity to learn high-thinking skills, such as abstraction and computation. I argue that Computer Science is not being offered because many teachers have a misconception about Computer Science. In other words, teachers do not understand the meaning and significance of Computer Science. This is because many teachers do not have a Computer Science background and have never experienced technology beyond basic everyday use. Teachers' inexperience is also related to administrators and Professional Developments continuing to focus on basic technology skills.

Limitations

Due to limited research time, approximately three months, my research does not examine the comparisons among teachers' perceptions in neighboring towns. Although some respondents were from outside of Hartford, there was not a representative sample to

make accurate comparisons and conclusions to teachers' perceptions in the city of Hartford. If future research is conducted on this topic, I would recommend conducting more interviews with teachers, as well as, distributing surveys to more teachers in surrounding towns. In addition, I recommend conducting more research on this topic with administrators. As seen here, administrator's approval is important for determining what teachers can and cannot do in their classrooms. It is important that their perceptions also be examined.

Recommendations

My research found that teachers need more support, both inside and outside the classroom. This includes a need for more technical support and having trained staff to help with technical problems that occur throughout the school day. In addition, teachers need more Computer Science experience and professional developments that go beyond basic use of technology. This can be done by having administrators create professional developments on learning the meaning of Computer Science, its significance, and basic Computer Science principles. Doing so would need not to involve intensive programming, but simple exercises, such as with binary flashcards, and dialogue between educators with and without Computer Science experience. Another important, but simple, Professional Development to have is one that distinguishes between Computer Science and technology.

Another recommendation is to have more Computer Science teachers in schools. Hire at least one teacher that is designated to teaching only Computer Science courses. The skills that students learn through Computer Science are valuable and our students need the skills to be successful in our world that is driven so much by technology.

As both an educator and a computer scientist, I recommend my Computer Science senior project, the Computer-Technology Helper, to teachers. The Computer-Technology Helper is a digital repository in which both Computer Science educators and non-Computer Science educators can upload, view, edit and collaborate on teaching materials that are specifically related to Computer Science and technology. By using the Computer-Technology Helper, teachers need not be concerned by internet restrictions on certain sites, because all the teaching materials, including videos, would be stored on the Computer-Technology Helper website. In addition, teachers could gain support from other teachers, whether in their school or in other schools, and work collaboratively on Computer Science and technology teaching materials.

Conclusion

There is a low interest in Computer Science when children are at a young age because children are not being exposed to Computer Science and technology in school. Teachers perceive the availability and quality of Computer Science and technology in schools to be influenced by factors, such as funding disparities, teacher inexperience, and lack of administrative and technical support. In order to provide our students with access and exposure to Computer Science and technology, our teachers must first be introduced to Computer Science and technology, as well as, understand their significance for developing skills such as abstraction, computation, and problem-solving. Administrators must support their teachers by providing them with appropriate training and technical support, such as incorporating basic Computer Science principles into Professional Developments. If administrators feel that funding prevents them from providing their teachers and students with access to Computer Science and technology, then they should

look to organizations, such as the National Science Foundation, for monetary grants. Educators must realize that it is our duty to work together, to make sure that our students are provided with the necessary skills to be successful in a world driven by Computer Science and technology.

REFERENCES

Anderson, R. & Ronnkvist, A. (1999). The Presence of Computers in American Schools. *Teaching, Learning, and Computing: 1998 National Survey (Report No.2).* Retrieved from http://www.crito.uci.edu/tlc/findings/Computers_in_American_Schools/report2_text_tables.pdf

Clarke, G., Zagarell, J. (2012). "Teacher and Technology: A Technological Divide." *Childhood Education,* 88, 136–9.

Harsha, P. (2012, April 9). "Undergrad Computer Science Enrollments Rise for Fourth Straight Year — CRA Taulbee Report." [Web log post]. Retrieved from http://cra.org/govaffairs/blog/2012/04/undergrad-computer-science-enrollments-rise-for-fourth-straight-year-cra-taulbee-report/

Hughes, J. (2005) "Kellogg Project and Aetna Center for Family Community Resident Survey" (Hartford, CT: Trinity College)

Inan, F., Lowther, D. (2010). Factors affecting technology integration in K-12 classrooms: a path model. *Education Tech Research and Development*, 58, 137-154. doi: 10.1007/s1 1423-009-9132-y

Li, Q. (2007). "Student and Teacher Views About Technology: A Tale of Two Cities?" *Journal of Research on Technology in Education,* 39:4, 377–397.

National Science Foundation. (2012). "Computing Education for the 21st Century (CE21)." http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503582

Niederhauser, D., Perkmen, S. (2008). "Validation of the Intrapersonal Technology Integration Scale: Assessing the Influence of Intrapersonal Factors That Influence Technology Integration." *Computers in the Schools,* 25:1-2, 98–111.

U.S. Department of Education, National Center for Education Statistics. (2010). *Teachers' Use of Educational Technology in U.S. Public Schools: 2009* (NCES 2010-040).

Warschauer, M. (2007). "A Teacher's Place in the Digital Divide." *Yearbook of the National Society for the Study of Education,* 106, 147–166.

Appendix A: Computer Science and Technology in Schools – Online Survey

Greetings!

I am inviting you to take part in a study of how teachers and administrators feel about the availability and quality of Computer Science and technology in Hartford schools (and in surrounding towns). You must be a teacher or an administrator to participate in this survey.
Before you begin:

- The survey will take you approximately 10 minutes and is completely anonymous.
- You may skip over any questions or stop the survey at any time.
- You will not be able to save your responses, so please do not exit the survey until you have finished and submitted your responses.
- Once you have moved on to the next page, you will not be able to go back.

Please click Continue when you are ready to begin the survey.

Thank you for participating!
Pauline Lake
Trinity College '13
pauline.lakealmeida@trincoll.edu

The following questions are about your feelings and beliefs:
Q1 Please describe, in your own words, what "Computer Science" means to you.

Q2 How do you feel about using technology in the classroom?

Q3 What kind of technology, if any, do you feel enhances classroom instruction? (Select all that apply)

- ❑ Computers (1)
- ❑ Projectors (2)
- ❑ Smart Boards (3)
- ❑ Calculators (4)
- ❑ Cell Phones (5)
- ❑ iPads/Tablets (6)
- ❑ Cloud Storage (e.g. Drop box, Google Drive/Docs) (7)
- ❑ World Wide Web (8)
- ❑ Microsoft Office (e.g. Excel, OneNote, PowerPoint, Word) (9)
- ❑ Software (e.g. Classroom management tools for grading and attendance, Games, Photoshop) (10)
- ❑ Other (11) _____
- ❑ None of the above (12)

Q4 For those technologies that you did not select, or if you selected 'None of the above', please explain why.

Your feelings and beliefs continued:

For the purpose of this survey, "Computer Science" is defined as a field that focuses on problem-solving skills that are developed through the use of computers and computer programming.

Q5 How much do you feel that the following factors affect the availability and quality of Computer Science courses in your school?

	Not at all (1)	Very Little (2)	Neutral (3)	Some (4)	Very Much (5)
Administrators' Approval (1)	❍	❍	❍	❍	❍
Availability of technical support in schools (2)	❍	❍	❍	❍	❍
Funding (3)	❍	❍	❍	❍	❍
Standardized Testing (4)	❍	❍	❍	❍	❍
Students' Home Access (5)	❍	❍	❍	❍	❍
Student Interests (6)	❍	❍	❍	❍	❍
Teacher Experience/Training (7)	❍	❍	❍	❍	❍
Teacher Qualification/Certification (8)	❍	❍	❍	❍	❍
Teacher Interests (9)	❍	❍	❍	❍	❍

Q6 How much do you feel that the following factors affect the availability and quality of Computer Science courses in other local schools?

	Not at all (1)	Very Little (2)	Neutral (3)	Some (4)	Very Much (5)
Administrators' Approval (1)	❍	❍	❍	❍	❍
Availability of technical support in schools (2)	❍	❍	❍	❍	❍
Funding (3)	❍	❍	❍	❍	❍
Standardized Testing (4)	❍	❍	❍	❍	❍
Students' Home Access (5)	❍	❍	❍	❍	❍
Student Interests (6)	❍	❍	❍	❍	❍
Teacher Experience/Training (7)	❍	❍	❍	❍	❍
Teacher Qualification/Certification (8)	❍	❍	❍	❍	❍
Teacher Interests (9)	❍	❍	❍	❍	❍

Q7 Comments

For the purpose of this survey, "Technology" refers to any device/tool such as computers (both hardware and software, such as Microsoft Office), cell phones, projectors, SmartBoards, etc.

Q8 How much do you feel that the following factors affect the availability and quality of technology in your school?

	Not at all (1)	Very Little (2)	Neutral (3)	Some (4)	Very Much (5)
Administrators' Approval (1)	❍	❍	❍	❍	❍
Availability of technical support in schools (2)	❍	❍	❍	❍	❍
Funding (3)	❍	❍	❍	❍	❍
Standardized Testing (4)	❍	❍	❍	❍	❍
Students' Home Access (5)	❍	❍	❍	❍	❍
Student Interests (6)	❍	❍	❍	❍	❍
Teacher Experience/Training (7)	❍	❍	❍	❍	❍
Teacher Qualification/Certification (8)	❍	❍	❍	❍	❍
Teacher Interests (9)	❍	❍	❍	❍	❍

Q9 How much do you feel that the following factors affect the availability and quality of technology in other local schools?

	Not at all (1)	Very Little (2)	Neutral (3)	Some (4)	Very Much (5)
Administrators' Approval (1)	❍	❍	❍	❍	❍
Availability of technical support in schools (2)	❍	❍	❍	❍	❍
Funding (3)	❍	❍	❍	❍	❍
Standardized Testing (4)	❍	❍	❍	❍	❍
Students' Home Access (5)	❍	❍	❍	❍	❍
Student Interests (6)	❍	❍	❍	❍	❍
Teacher Experience/Training (7)	❍	❍	❍	❍	❍
Teacher Qualification/Certification (8)	❍	❍	❍	❍	❍
Teacher Interests (9)	❍	❍	❍	❍	❍

Q10 Comments:

Your feelings about Computer Science and technology at your school:

Q11 How do you feel that the technology that is available in your school? Is it adequate? In your response, please consider the number of students in your school, the number of teachers, and how the technology is used.

Q12 How do you feel about the amount of Computer Science and technology in your school compared to other local schools?

- ❍ My school has less Computer Science and technology than other schools. (1)
- ❍ My school has the same amount of Computer Science and technology as other schools. (2)
- ❍ My school has more Computer Science and technology than other schools. (3)

The following questions are about your personal experience:

Q13 Do you, or have you ever, used technology in your classroom instruction?

- ❍ Yes (1)
- ❍ No (2)

Q14 You indicated that you currently use, or have used, technology in your classroom instruction. What technology have you used? Why?

Q15 You indicated that you have never used technology in your classroom instruction. What, if anything, would make you consider using technology in the classroom?

The following questions are about your personal experience:

Q16 Which of the following, if any, would change your approach to teaching? (Select all that apply)

- ☐ Greater access to technology (1)
- ☐ Greater technical support in your school (2)
- ☐ Access to good reasons why technology should be used in the classroom (3)
- ☐ Access to resources on how to integrate technology into the classroom (4)
- ☐ Other (5) _____
- ☐ None of the above (6)

Your experience continued:

Remember that for the purpose of this survey, "Computer Science" is defined as a field that focuses on problem-solving skills that are developed through the use of computers and computer programming. "Technology" refers to any device/tool such as computers (both hardware and software, such as Microsoft Office), cell phones, projectors, Smart Boards, etc.

Q17 How many of the following courses have you taught at your school?

	0 (1)	1-4 (2)	5-9 (3)	10+ (4)
Computer Science (1)	❍	❍	❍	❍
Technology (2)	❍	❍	❍	❍

The following questions are about the school where you are currently employed:

Q18 What type of school do you currently work at? (Select all that apply)
- ❑ Charter (1)
- ❑ Magnet (2)
- ❑ Private (3)
- ❑ Public (4)
- ❑ Technical/Vocational (5)

Q19 What city is your school located in?

Q20 What grade levels are at your school? (Select all that apply)
- ❑ K (1)
- ❑ 1 (2)
- ❑ 2 (3)
- ❑ 3 (4)
- ❑ 4 (5)
- ❑ 5 (6)
- ❑ 6 (7)
- ❑ 7 (8)
- ❑ 8 (9)
- ❑ 9 (10)
- ❑ 10 (11)
- ❑ 11 (12)
- ❑ 12 (13)

Q21 Approximately how many students attend your school?
- ❍ Less than 500 (1)
- ❍ Between 500 and 1000 (2)
- ❍ Between 1000 and 2000 (3)
- ❍ More than 2000 (4)

Questions about the school where you are currently employed continued:

Q22 Tell us how many of each of the following courses are offered at your school each year:

	0 (1)	1-4 (2)	5-9 (3)	10+ (4)	I don't know (5)
Computer Science (1)	❍	❍	❍	❍	❍
Technology (2)	❍	❍	❍	❍	❍

Q23 Do you think that Computer Science and technology courses are useful for students? Please explain.

Questions about the school where you are currently employed continued:

Q24 How many computer labs are in your school?

❍ 0 (1)
❍ 1-4 (2)
❍ 5-9 (3)
❍ 10+ (4)

Q25 What kind of computers are in the labs? Some examples: Dells, Macs, etc.

Q26 Are there computers available to students and teachers in each classroom?

	No (1)	Some (2)	Yes (3)	I don't know (4)
Computers for students (1)	❍	❍	❍	❍
Computers for teachers (2)	❍	❍	❍	❍

Please tell us more about you:

Q27 What is your role at your school? (Select all that apply)

❑ Dean (1)
❑ Assistant/Vice Principal (2)
❑ Principal (3)
❑ Teacher (4)
❑ Teacher's Assistant (5)

Q28 What subject(s) do you teach?

Q29 What is your gender?
- ❍ Male (1)
- ❍ Female (2)

Q30 How long have you been

	<1 year (1)	1-4 years (2)	5-9 years (3)	10+ years (4)
a teacher or administrator (1)	❍	❍	❍	❍
at your current school (2)	❍	❍	❍	❍

Tell us more about you continued:
Q31 How many Computer Science courses have you taken?
- ❍ 0 (1)
- ❍ 1-4 (2)
- ❍ 5-9 (3)
- ❍ 10+ (4)

Q32 Do you have any experience with programming languages?
- ❍ No (1)
- ❍ Yes (2)

Q33 You indicated that you have experience with programming languages, which ones?

Q34 Are you interested in Computer Science? Please explain.

Q35 Are you interested in technology? Please explain.

Q36 Would you consider yourself "technologically savvy"? Please explain.

Thank you for participating in this survey!
Q37 Can you participate in a 20-30 minute follow-up interview?
- ❍ Yes (1)
- ❍ No (2)

Please contact me at pauline.lakealmeida@trincoll.edu to set-up an interview time.

Please click Continue to submit your responses.

Appendix B: Tables 1-4

Table 1: Description of Survey Participants (*N* = 58)

Demographics and Experience	*N*	Percent
Gender		
Female	33	65%
Male	18	35%
Total Years Teaching		
< 1	1	2%
1-4	5	10%
5-9	13	26%
10+	31	62%
Years Teaching at Current School		
< 1	10	20%
1-4	13	25%
5-9	18	35%
10+	10	20%
Number of Computer Science Courses Taken		
0	9	18%
1-4	31	61%
5-9	7	14%
10+	4	8%
Experience with Programming Languages		
No	28	56%
Yes	22	44%

Note: Gender missing 7, total years teaching missing 8, *years teaching at current school missing 7, number of CS courses* taken missing 7, experience with programming languages missing 8

Appendix B: Tables 1-4

Table 2: Description of Survey Participants' Schools (*N* = 58)

School Characteristics	*N*	Percent
Location		
Hartford	42	84%
Windsor	2	4%
Enfield	1	2%
Milford	1	2%
Newtown	1	2%
Tolland	1	2%
West Hartford	1	2%
Type of School		
Magnet	34	65%
Public	16	31%
Private	2	4%
Charter	0	0%
Technical/Vocational	0	0%
Total Student Enrollment		
< 500	25	49%
500-1000	23	45%
1000-2000	2	4%
> 2000	1	2%

Note: Location missing 8, type of school missing 6
total student enrollment missing 7

Appendix B: Tables 1-4

Table 3: Availability of Computer Science and Technology in Schools (*N = 58*)

	N	Percent
Number of Computer Labs		
0	4	8%
1-4	37	74%
5-9	6	12%
10+	3	6%
Number of Computer Science Courses		
0	19	38%
1-4	17	34%
5-9	7	14%
10+	1	2%
I don't know	6	12%
Number of Technology Courses		
0	10	20%
1-4	17	34%
5-9	11	22%
10+	7	14%
I don't know	5	10%
Classroom Computers for Students		
Yes	48	96%
No	2	4%
Classroom Computers for Teachers		
Yes	46	96%
No	2	4%

Note: Number of computer labs missing 8, number of Computer Science courses missing 8, number of technology courses missing 8, classroom computers for teachers missing 10

Appendix B: Tables 1-4

Table 4: Q12 How do you feel about the amount of Computer Science and technology in your school compared to other schools? (*N* = 58)

	N	Percent
My school has less Computer Science and technology than other schools.	12	21%
My school has the same amount of Computer Science and technology as other schools.	16	28%
My school has more Computer Science and technology than other schools.	24	41%

Note: Missing 6

Appendix C – Figure 1