March 16, 2017

Professor Kathryn Hoene
1600 Chester Avenue
Bremerton, Washington 98337-1699

Subject: Completion Report

Dear Professor Kathryn Hoene:

I am quite content to send to you the enclosed report on the education with computers and how it plays into society and education for the future. This report has been worked on since your request made the beginning of this Winter quarter of 2017.

The intent of this report is to deeper analyze and inform readers of how computers are integrated into education as well as how education with computers is vastly adapting and needs to be considered more in earlier stages of learning.

This report looks at the general view of learning with computers, specifically towards computer science and how it is adapting in the United States. This report also aims to take any information from specific areas and look at it in a broader view.

Anyone who is interested in computers and technology and its advancements with education and its future possibilities for careers places in the workforce would benefit from reading this report. The report is written in a way so that it can be read by anyone who wants further information on computers and how they are involved with education and work, but it is also open to any type of audience that is interested, for this report does not require any specific knowledge for the benefit of learning from it.

Sincerely,

Nicholas Messenger

Enclosure: Report (1)

The Education of and with Computers

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ABSTRACT/SUMMARY

Computers have aided human interaction in many ways throughout the years, each generation advancing more than the last. But many do not look into computers and its co-existence with education. There are many paths one can take with furthering their knowledge and skills with computers, but computer education is not well known and not pushed enough in today's time where technology thrives. This report aims to look at all of these things and analyze the importance of learning about and with computers. This report will do this by further analyzing the job market in the computer industry, the availability of learning, how the learning process is achieved, as well as how computers have and will exist in an education standpoint, specifically in the United States.

INTRODUCTION

Computer science and other forms of computer education are out there and being used, but not nearly as much as they could be. Availability is very limited and the government is working to improve that over time, but if things like computer science are to ever fully come into play with regular education, it needs to happen soon in this time of quickly evolving technology. Computer-based jobs are abundant and can lead to very successful business and career opportunities for almost anyone that wishes to go into the path of the computer industry. Learning with computers can be beneficial and rewarding, but with any type of education, there are limits. Looking at availability, teaching techniques, self-efficacy, and acknowledgement of people with disabilities help show how these limits exist. Yet, today computers are abundant and schools as well as government and business leaders look to bring computer education such as computer science into the spotlight. Most people can assume that computers will stay with humans for a long time, so we should all learn to use them as a whole.

DISCUSSION/COLLECTED DATA

Computer Science for All and the Computer-Based Job Market

With computers becoming a normal tool for society in both the workplace and home, the government looks to capitalize on this by allowing a more diverse group of people to learn with computer education. Former President Obama helped push the Computer Science for All initiative which aims to "empower all American students from kindergarten through high school to learn computer science and be equipped with the computational thinking skills they need to be creators in the digital economy, not just consumers, and to be active citizens in our technology-driven world" (Smith, 2016). This will help ensure that students will at least have some knowledge of the computer industry before entering higher levels of education. Knowing what is out there and available, can help one determine where they want to go with their education and career path. Not only would this initiative get more knowledge out there at younger ages, but it would help teach the skills required for the career opportunities related to that knowledge.

There is a large industry and job market around computers and people do not really know it. Those looking for jobs can open another door of opportunity by learning something like computer science since computers are used in many businesses and jobs in today's time. Brown (2016), a writer for The Washington Post, looks at the large job market in the United States and comes to a conclusion that there is "an estimated 500,000 unfilled U.S. jobs [that] require some level of computer-science understanding, yet three-quarters of the nation's public schools do not offer any computer science courses, often sending companies turning to foreign workers for specialized skills." There is a large job market out there but it is not fully available to everyone and it should be since technology is

commonly used and discussed in everyday life. Brown (2016) also finishes that analysis off with a bold statement that "the federal government isn't doing much to help: Virtually no federal funding is dedicated to enhancing computer science offerings in K-12 schools." And while this is partially true, acts and initiatives like CSforAll aim to fix this.

There is progress being made slowly towards making computer science a more regular curriculum in schools, and hopefully it will pick up the pace since the technology and computer-based world is at a constantly quick stride. Guzdial (2016), a professor at the Georgia Institute of Technology, discusses the progress made towards computer science in the United States as well as in other countries:

> The ECEP cohort is making strides toward making high school-level CS curricula available in their states and territories: *Exploring Computer Science*, *Computer Science Principles*, and *Advanced Placement CS Level A*, which are being adopted across the U.S. Alabama was the first state to include *CS Principles* in its state curriculum… It is going to take time to reach *CSforAll*. Most of the ECEP cohort expect to offer CS in 30%–50% of all high schools in their state within the next five years. Puerto Rico is just introducing *Exploring CS* into its first schools this year. In several states, the goal is to have a single CS teacher in 50% of schools within five years, which is insufficient to provide access to CS education for all students (Guzdial 2016).

Like stated earlier and in Guzdial's article, the CSforAll initiative is going to take time to fully evolve and become a full achievement. Bringing computer-based education to schools as a more regular type of education will help students see what is available to them, and this in return could help fill the ever-increasing job market in the computer industry.

Learning and Teaching with Computers and its Importance/Limits

Computer science and computer-based education has its limits and these limits should be addressed, especially if this type of education becomes more prevalent in school systems. While initiatives like CSforAll are trying to bring more availability to computer education as well as make it more well known, there are still limitations such as learning process, student self-efficacy, providing for those with disabilities, and so forth. Guzdial and Morrison (2016), professor at Georgia Institute of Technology and assistant professor at University of Nebraska Omaha, discuss computer science being part of Washington state's STEM education program, where they address the limits to computer education and explain that they should be addressed in the near future:

> While computer science is now part of STEM in the U.S. by fiat, students cannot access computer science classes as easily as mathematics and science education. Many countries are ramping up computing education, so the situation is going to change. As it does, we will have to develop more accurate expectations of how students learn CS, improve our ability to measure learning in computing, develop learning progressions, and create an infrastructure to develop teachers and track progress as we reach the pervasiveness of mathematics and science education (Guzdial, Morrison, 2016).

The push for computer science in school systems is strong, but now that it is becoming a larger topic, it should be focused on in greater detail. Before any big education programs become large, the limitations should be addressed and handled before things can blow out of proportion. Creating a large program for computer science is great, but not if there are

limitations still not addressed. Like Guzdial and Morrison (2016) discuss in their article, access is still not as open, and the teaching system is still not ready.

Another factor to look at is the student to teacher relationship and student self-efficacy. In Wiggins, et al. (2016) analysis and studies of self-efficacy throughout tests inside and outside of school systems, the professors address learning and the importance of emphasis on self-efficacy:

> As the computer science education community moves toward adaptive support for individual learners, it is crucial for intelligent learning environments to consider not only students' knowledge and skill, but also motivational factors driven by affect. Self-efficacy, students' beliefs in their own abilities, may have deep and far-reaching implications for computer science learning. Students' level of self-efficacy may, in particular, influence the types of adaptive support that are most effective (Wiggins, et al., 2016).

Not only is availability and access important limitations to address with computer education, but so is the learning process itself. Before computer science becomes a more regular field of study in K-12 schools, it should be absolutely concrete with its learning structure and should focus on the student and their own learning and self-reflection/self-efficacy. If this is not established, then the whole education program is not as successful and leads to a waste of resources and hurts students, teachers, and the governmental support for the program as well.

Another type of limitation that is very important to address is access to those with disabilities. While access to everyone in general is very important, no access to those with disabilities does not make it access to "all". Ladner and Israel (2016), professor at

University of Washington and assistant professor at University of Illinois, address this in conjunction with access in general:

> In addition to availability and relevance, accessibility and specialized instructional approaches are needed. Curricula, including programming tools, must be accessible, and teachers must include students with disabilities in their classes. Students with disabilities comprise nearly 15% of K–12 students, and have a wide variety of disabilities. Most are taught alongside peers in general education settings and can learn the basics of computer science and attend college (Ladner 2016).

School systems always try to provide for anyone with disabilities, whether it is someone to help someone who is deaf learn with sign language, or providing access ramps for those who are in wheelchairs or have limited mobility. Education and learning with computers should be the same. Most computers now have options for accessibility to help those who are blind or hard of hearing to access computers. This will need to be adapted even further to fit the types of activities involved with higher level learning with computers such as computer science. Like Ladner (2016) discusses, a fair number of students in K-12 schools have disabilities, and this should not be ignored, for someone with a disability could lead to huge successes in the future.

Limitations to computer-based education are definitely prevalent and should be addressed so that everyone can have access to education and learning. If this is addressed on top of the push for more education in K-12 schools, this can make computer education very successful and look good in general. With today's technology, it won't be as hard to provide for those with disabilities or limitations and this will allow for more people to learn

with and about computers, leading to more successful students and future leaders in the computer and technology industries.

The Past, Present, and Future of Computer Usage and Computer Education

Computers have been used for tools and aid with tasks for many generations and will only continue to further aid us in our everyday lives and everyday work and activities. While we can't predict the far future, we can make assumptions and educated guesses. For example, in the near future of about 20 years or so, it is safe to assume that much will change with the rapid growth of technology. Technology will cost much less, especially for older technology. The word "electricity" is hardly used today and in the near future, the word "computer" will most likely have the same outcome. Technology will continue to adapt and help humans, allowing for computers and mankind to work in tandem. One could have glasses that could allow for instantaneous translation of language or facial recognition to help one during social interactions (Hoske, 2013). The future looks bright for computers and technology and to be where we are today, we have to realize that there was rapid changes, growth, and work towards the advancement of computers, technology, and education in both.

In Levy and Murnane's (2004) book on computers and the future job market, there is great discussion on networking and learning with computers in the past:

> In October 1997 John Morgridge officially introduced the Cisco Networking Academy program. In that month, sixty-four high schools in seven states were teaching the first semester of the Academy curriculum. Over the next six years the program grew extremely rapidly, not only in high schools, but in community

> colleges, in community-based organizations, and in a variety of other settings in the United States and in other countries. In the fall of 2003, more than a half million students participated in a sequence of sixteen courses in more than 10,000 Cisco Networking Academies located in all fifty states and in 152 countries (Levy 2004).

This shows that even computer education in the past has been successful with proper presentation and availability of learning programs. Cisco continues to be a very large part of networking hardware, software, and education in schools and businesses and is a great example of how computer-based learning can be successful and should be more available in today's society. Another great analysis of our history with computers and education is one made by Tatnall (2015) where he gives a brief backstory of all of the different types of computer education that was used throughout the decades:

> The first courses in what we might now call aspects of computer science were introduced in 1947 by Trevor Pearcey (the principal designer of CSIRAC) in the Department of Mathematics at the University of Sydney…In the early 1960s the Technical Colleges were typically still teaching about punched-card operated accounting machines…From the early 1970s computing courses began to proliferate in Universities and CAEs using the more affordable mini-computers that had then become available…It was in the early 1970s that school computing began when a small number of computers started to appear in Australian schools, typically resulting from the exposure of particular maths teachers to computing during their university studies…By the early 1990s the two opposing views of school computing: the need to teach about computing, and the use of computers in other subject areas had come to a head (Tatnall, 2015).

The final statement of Tatnall (2015) has lead up to today, where we use computers for education, but not as much education of computers. Computer science is becoming a larger, more normal type of education now, but it was not always this way, and for much of the 90's to early 2000's, people debated on either teaching computing or learning with computing, when now we have both.

Leaders in many of the top businesses in the nation from Facebook to Apple are calling on Congress to help out with computer science education in K-12 schools. They argue that with technology transforming nearly every industry, there needs to be more students who are literate in these technologies. These leaders worry that the United States will not be as competitive without computer science being practiced among the nation's youth (Brown, 2016). It is very important that we embrace the computer industry and computer science education, for computers are slowly changing and adapting almost every job and career out there in the workforce. Large companies need more computer-literate people than ever, and the growth of technology and computers will only continue to escalate and expand over time. Today many programs and efforts are made to teach computer science at earlier ages. One in particular is Washington State's STEM program. STEM aims to bring computer science and technology to K-12 schools and make math more interesting. According to *washingtonstem.org,* (2017) "in the last 10 years, growth in STEM jobs has been three times greater than non-STEM jobs…[and] in the next decade, almost all of the fastest growing jobs will require STEM skills…". Washington State's STEM, along with other initiatives and acts such as CSforAll are pushing for more computer science and math learning in K-12 schools. Another similar program that is now becoming a larger program is the University of Washington's Dawg Bytes program. On

the information page for the program, the University of Washington states what they believe in and what the program is trying to achieve:

> UW CSE's K-12 outreach program, DawgBytes ("A Taste of CSE"), aims to introduce both students and teachers to the exciting world of computer science & engineering. Computer science is a great field for everyone, and computer science needs the participation of the full spectrum of our nation and our world. UW CSE is serious - and successful - when it comes to increasing participation in the field. For example, in the most recent year, the proportion of women receiving degrees in Computer Science from UW CSE was twice the national average for bachelors programs at research-intensive universities (University of Washington 2017).

These are great examples of how pushes for computer science education at earlier ages are still powerful and are making strides towards success in the nation's K-12 school systems. Many states like Washington, are making an effort to getting computer science education in K-12 schools. With the successes of the past and advancement of technology, only time will tell when computer science will become a regular curriculum for K-12 schools.

CONCLUSIONS

In today's world of technology and computers, knowledge of computers and technology is very beneficial, for both are rapidly growing and changing industries. Large companies like Google and Microsoft require people with computer knowledge, yet many are not aware of computer education and the computer industry. Luckily, there are many great acts, initiatives, and programs like CSforAll, and Washington State's STEM program, that are slowly making progress towards pushing K-12 computer science education. In order for these to be successful though, the limitations and challenges should be analyzed, such as access for everyone, including those with disabilities. Computers have aided human interaction and learning for a long time and continue to. Teaching and learning computer-based education at earlier ages will not only help our students prepare for the future of technology and computers, but it will help our society by filling the large computer industry's job market and allow for great successes and creations of new technologies and jobs. Even promoting about what is out there in the computer/technology world can help make a difference.

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