Developing and Designing a Computer Science Course at the Secondary School Level
(Technical Paper)

Understanding the Origins and History of the Digital Divide in the United States

(STS Paper)

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

The state of education in the United States is a complicated and highly contested issue. We see today a number of inequalities that have been perpetuated due to the historical contexts surrounding its development and integration into society. According to a study done by Anyon (1997), the implicit biases within our education system has led to schools in working class communities preparing their students to become a part of the blue-collar workforce, while schools in upper-class communities prepare their students with more rigorous, problem-solving oriented approaches. We see the effects of this specifically in STEM education. Students that reside in underserved communities have to endure and outlast difficult situations, such as "teacher retention, a lack of STEM programmes [sic], ..., limited school resources, ..., and [a] limited number of STEM programmes [sic] in urban areas" (Avendano et al., 2017). The consequences of the lack of attention on urban STEM education is evident in the diversity of the STEM workforce. According to Pew Research Center, "Black and Hispanic workers continue to be underrepresented in the STEM workforce", with Black people making up "11% of the U.S. workforce overall but represent 9% of STEM workers", while Hispanics make-up "16% of the U.S. workforce but only 7% of all STEM workers" (Parker, 2019).

The technical portion of this prospectus project will consist of developing a computer science curriculum for a course at a local high school. By developing and integrating the course into the school, it will help promote STEM education and expose the field to a large, minority population. The STS portion of this prospectus will be centered around the *digital divide*, defined as the "the growing gap between the underprivileged members of society, especially the poor, rural, elderly, and handicapped portion of the population who do not have access to computers or the internet; and the wealthy, middle-class, and young Americans living in urban and suburban

areas who have access" (Roberts, 1999), in order to learn about the origins and implications of its presence in modern day society.

Technical Topic: Developing and Designing a Computer Science Course at the Secondary School Level

Within the field of computer science, there are a number of baselines and recommendations for creating and implementing a computer science course or curriculum. The current baseline set in place at the undergraduate level is the baseline designed by the Joint Task Force on Computing Curricula (JTFCC), which is made up of the Association for Computing Machinery (ACM) and the Institute of Electrical and Electronics Engineers Computer Society (IEEE CS). The JTFCC goes into detail about the different approaches that can be taken in order to teach introductory computer science courses at the undergraduate level, as well as the pros and cons of each method (2013).

Developing a course in computer science that can be integrated into a struggling school while still providing sufficient information and content can be considered unchartered territory. My course will be designed utilizing the research done in "Python for Teaching Introductory Programming: A Quantitative Evaluation" by Ambikesh Jayal, Stasha Lauria, and Allan Tucker, which promotes teaching "the basic programming concepts (loops, branch, and use of libraries) using Python" in preparation for a course in Java and object-oriented programming, which could be achieved at the post-secondary level (2011). The importance of the development of this curriculum is its appeal and ability to be implemented into the curriculum of underserved and minority-serving high schools using the resources being provided during the pandemic. Since

schools have been increasing efforts to provide resources for online learning environments, now is the optimal time to develop the course. In the past, technological barriers have inhibited minority students from adequately learning STEM, an issue which is highlighted by Sacks, in which he describes it as our system "fostering an increasingly class-bound education system in which only a small segment of the population can realistically hope to earn postsecondary degrees" (2009). At its core, the purpose of designing this course is to reduce the issue of underrepresented minorities having a lack of opportunities, limiting their ability to pursue careers and studies in STEM (Archer et. al., 2012).

The course will be designed to capitalize on the current state of education during the pandemic, in which more technological resources are currently being given to students to facilitate online learning. We are seeing an increase in the number of laptops and electronic resources being provided to students through large companies, such as Amazon, which donated 8,200 laptops to the Seattle Public School system (Romano, 2020). This is due to the switch to online learning, and the need for all students to have a method of connecting with their teachers and educational material while upholding current COVID-19 guidelines. The course will be designed with a programming focus, which is "useful for students from other areas of study who wish to use programming as a tool in cross-disciplinary work" (JTFCC, 2020). This approach takes advantage of the diverse curriculum that is currently in place across high schools in the United States, allowing students to utilize what is being learned in the computer science course and potentially apply it to the other classes they are taking. The main objective of the course is to provide adequate opportunities for learning the basics of computer science. The course will be designed in units to cover the range of basic topics in computer science. The first unit will be an introduction to the course along with getting to know the integrated development environment

(IDE) and coding language they will be using during the course. The next few units will cover the fundamentals of coding which includes topics such as numbers and data structures, decisions, loops. The final unit in the course will consist of a project that will apply the fundamentals that were learned during each unit to solve an inter-disciplinary topic/problem.

The success of the course will be largely dictated by the ability for schools to continue to afford students the opportunity to participate in online learning. The basic necessities in order to take and succeed in a computer science course (i.e. hardware, software, etc.) have been taken care of due to the new online learning environment that has risen due to the pandemic. The current plans for course content are based on the fundamental building blocks that are recommended in *Computer Science Curricula 2013*, which are standard guidelines for introductory computer science courses. I anticipate the deliverables for the technical project will consist of the outline for the curriculum, a plan of action for professional development in teaching the course, along with a few basic lessons and lesson plans.

STS Topic: Understanding the Origins and History of the Digital Divide in the United States

The term *digital divide* is fairly new in modern history, being coined in the mid-1990's to describe "a division between people who have access to and use of digital media and those who do not" (Dijk, 2020). In order to understand the term and frame its understanding, Dijk developed a causal model of resources and appropriation theory, as seen in Figure 1. Initially, the rise of the term was due to a report that highlighted the inequalities in digital media and digital media usage that lower-class Americans faced (NTIA, 1995). Media outlets began using the

survey in order to highlight these inequalities and to gain support for the cause to address the issue. Based on the report, the computer penetration, the percentage of households utilizing a computer, for urban areas was 8.1% and concluded that “the fewer the number of years of education, the lower the telephone, computer, and computer-household modem penetration” (NTIA, 1995). The numbers pointed to a division in the technological advancement of households in urban communities compared to upper-class communities, which would be considered a part of the personal and positional categorical inequalities that define the issue in the digital divide.

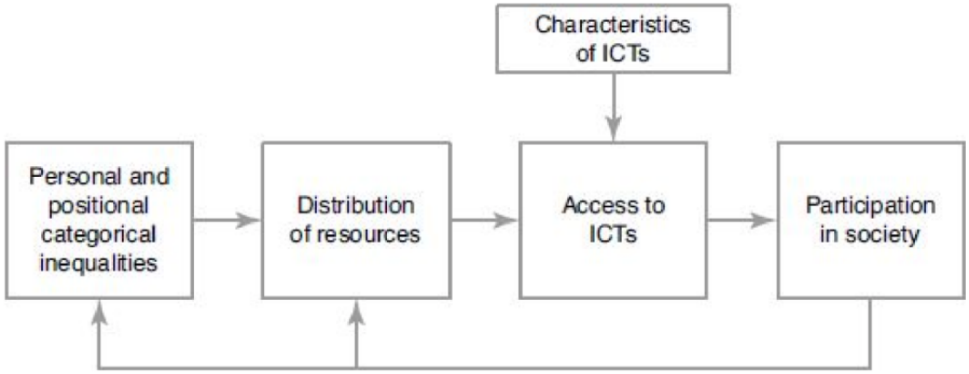

Figure 1. Dijk's Recommended Causal Model of Resources and Appropriation Theory. Information and Computing Technologies (ICTs) is abbreviated. (Dijk, 2020)

The *digital divide* became worse in the following decade due to innovations and advancements in information technology, such as increased broadband internet usage and computer usage. Based on the subsequent reports from the National Telecommunications and Information Administration (NTIA) during this time period, the studies provided “strong empirical evidence regarding disparities in rates of computer ownership and Internet usage between different racial and income groups” (Chakraborti, 2003). Households who were on the

lower side of the digital divide found themselves in worse positions technologically compared to those on the upper side. By the end of the decade, however, the gap in internet usage and smart phone ownership among minority users and upper-class users began to slowly narrow, largely due to the increase in the minority population in the United States at the time as well as the rise of social media platforms (Smith, 2010). Overall during the decade, the access to information and computing technologies had increased, which led to the gap slowly narrowing.

During the 2010s and into the present, the *digital divide* in the United States still persists. According to Winslow, research has shown that "40 percent of schools lack broadband, as do 60 percent of health care facilities outside metropolitan areas" (2019). It was also reported that "44 percent of adults in households with incomes below $30,000 don't have broadband". The numbers are troubling, as we see the world continuously moving towards a future highly dependent on technology while there continues to be segments of the population left behind. Socioeconomic factors are the leading cause to the continuing growth in difference between the two segments of society, as affording the technology to shorten the gap is ever more difficult as the economic gap widens.

Dijk created an expansion of the framework that is shown in Figure 1, which can be seen in Figure 2. I utilized this framework to evaluate the *digital divide* and its prominence in the United States over the past few decades, as well as the factors that contribute to the issue. The divide gained attention during the 1990s due to the NTIA surveys shedding light on technological access and usage disparities (1995). The report, which was updated and released a few times over the next decade, provided statistics on the personal categories of technology users, as well as the resources that users had. The data provided evidence of issues with access to information and computer technologies (ICTs) up until the late 2000s, which also led to an

expansion of participation outcomes for a larger part of the population. Although individual access and outcomes have been positively affected, the United States still has seen a lack of focus on certain institutional gaps in technology. This is evident in educational and minority-serving institutions surrounding urban neighborhoods and populations. The *digital divide*, thus, seems to have a large impact on public institutions, which in turn has an impact on the individuals that depend on them (i.e. underrepresented communities), and at this point in history remains a constant problem in rural and urban communities.

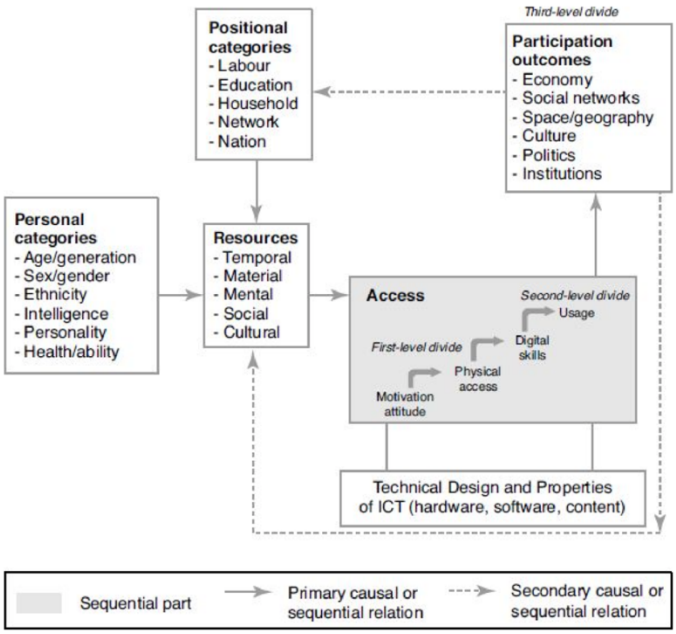

Figure 2. Dijk's Causal and Sequential Model of Digital Media Access. (Dijk, 2020)

Conclusion

In order to develop a possible solution to expanding the opportunities afforded to minority populations in STEM, the technical project of this prospectus will consist of developing a course curriculum, of which an outline will be created, a recommendation for professional

development in preparation for the course will be proposed, and a few of the first programming lessons will be developed. The course will then, hopefully, be integrated into my local high school, once the course has undergone the formal process. My STS research paper for this prospectus will utilize the framework that was developed by Dijk in order to further understand the factors that contribute to the *digital divide* in the United States. Developing the course and researching the *digital divide* will provide insights as to the constraints that many educators face when trying to provide STEM opportunities to students. By evaluating the constraints, we can better understand the fundamental issues that lead to less diversity and inclusion in STEM and utilize those insights to propose new way of approaching the issue.

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