Design and Prototype Low-Cost Education Version of Existing Laboratory Instrument

(Technical Paper)

The Ever-Evolving Classroom: The Effect of Technology in Education on Policy Making

(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

In today's world, technology is a necessity with more things being connected to the Internet. There are many benefits to implementing the Internet in education, but it is important to understand the safety and efficacy concerns for student use ("Why Have," n.d.). With the growth of and response to economic and social changes through the 2010's, countries all over the world began formulating policies that incorporated the use of technology in education (Vanderlinde et al., 2009). Countries believed that setting goals for technology would improve the education system as a whole (Vanderlinde et al., 2009). According to Yelland (2006), reconceptualization of the curriculum is necessary, and it requires creating "contexts for authentic learning that use new technologies in integrated and meaningful ways to enhance the production of knowledge and the communication and dissemination of ideas." The central research question, which will be explored in my thesis, explores how technology in education affects policy and influences the department of education. The STS Technical Report brings up the discussion of whether or not this work is benefiting students or teachers, and what is the impact on policy. The Co-production of Science and Social Order framework will be used to expand upon the central research question. The idiom of co-production is a theoretical perspective developed by a number of prominent STS scholars focusing on the mutual collaboration of technoscience and social order ("Co-production," 2015). From collaboration among experts within a certain field of science, a formal social order is developed, which results in a co-production. By looking at different scales of policy making through the lens of Co-production of Science and Social Order, I will analyze the impact of current technology and the decision making and motives behind policies.

Technical Prospectus

Multi-well plate readers have become an integral part of any laboratory conducting biological research. Their ability to detect and quantify biological, chemical, or physical events within the wells of a microplate is useful for collecting data on a wide variety of experimental subjects (Jones et al., 2004). Most labs have at least one of these plate readers and sometimes they have multiple depending on the specific function of the plate reader. However, the size and cost of these machines has created some limitations on their accessibility in certain environments. Some of these issues were addressed by a company called Cerillo, a biotechnology startup based in Charlottesville, Virginia, with their flagship product, the Stratus. The Stratus is a miniaturized multi-well plate reader that has all the functions of other currently available plate readers, but it is offered for a lesser price than its counterparts.

The work done by Cerillo has opened the door for an opportunity that involves adapting their technology to fit the needs of high school and community college classrooms looking to strengthen their curriculums through the use of biotechnology. Studies have shown that implementing technology into classrooms results in a 59% increase in student engagement, but also that 62% of teachers identify availability of equipment to be a barrier for using more technology in their lessons (Carver, 2016). Reasons for the lack of availability of equipment for students include high costs, complicated technology, and equipment that is not general use enough to justify being bought when there is a limited budget. These limitations will be addressed by this capstone design project, with the ultimate goal being to adapt the current technology to create a useful and educational version that will complement the needs of teachers and students alike.

STS Prospectus

The Different Types of Curriculum and the Application to Technology

Curriculum refers to the official list of courses offered by the schools, and it also refers to the purpose, content, activities, and organization of the educational program actually created in schools by teachers, students, and administrators. There are three distinct curriculum representations: the intended, implemented, and attained curriculum (Vanderlinde et al., 2009). The intended curriculum refers to the vision or underlying philosophy of the curriculum and the intentions specified in formal documents. The implemented curriculum comprises of the perceived curriculum as interpreted by its users and the actual process of teaching and learning. The attained curriculum refers to learning experiences and learning outcomes. Technology curricula formulated by national governments refer to intended curricula, and they aim at two main objectives: the first is to build on the rationale that all children must be digitally literate to be prepared for the knowledge-based society and the second is assuming that technology can improve student learning and take point of departure in pedagogy (Vanderlinde et al., 2009).

Technology in Education on the Micro Scale

Each year, school districts distribute more technology to their students, which gives them more and more access to the Internet. Each school has its unique cultural context influenced by the community and internal and external factors including history, politics, resources, culture, events, ideas, and networks (Zagami et al., 2018). Therefore its important to consider that a policy successfully implemented in one context may not produce the same result in another context, so policies must cater to local needs, expectations and resources. Therefore, being able to develop information and communication technology (ICT) -related policies requires the context of the situation and infrastructure within specific schools. For an ICT-related policy to be enacted within school systems, it is important

they develop basic infrastructure for technology enhancement of education comprising electricity, internet and wireless coverage, and functioning equipment (Dutoit, 2015).

Technology in Education on the Macro Scale

On the macro scale, national digital education policy developers face five specific challenges. Two of the most important challenges include developing realistic digital literacy goals and comprehensive, principles-based policies and achieving equitable access and outcomes, such as high level digital literacy for all. Other challenges include making digital education policy development evidence-based, securing teaching commitment and capacity to exploit digital learning resources, and supporting resource development for digital learning (Zagami et al., 2018). To address these challenges, it is important to resist borrowing policies from other countries because it disregards the importance of regional conditions. However, it is important to be aware of international trends, but one country's engagements are not easily mimicked in another country. It is important to consider engaging local stakeholders to determine the framework, goals and aspirations for developing these ICT-related policies. There will always be a need to involve all stakeholder groups when building awareness of the opportunities for new policy processes that involve technology. This will lead to the development of thoughtful education policies that can be adapted to different organization contexts, which would accomplish the goal of achieving high levels of digital literacy for all students and communities (Zagami et al., 2018). Another recommendation to addressing this issue is establishing transparent, accountable governance systems regionally to ensure sufficient allocated funds are disbursed as intended to enable policy goals to be realized equitably. Another factor to consider is recognizing that teachers may perceive digital resources as a threat to their jobs. Policy makers, in coordination with industry, should

persuade teachers to join within- and between-school leadership roles in digital learning communities to discuss the potential of technology for students and to redesign teacher work (Zagami et al., 2018).

Benefits & Drawbacks of Technology in Education

The incorporation of technology in education comes with several benefits and drawbacks. Technology-based projects prepare and teach students the technological skills that are required to succeed in the modern workforce. Although the up-front costs of purchasing different technologies can be quite high, they allow how systems to save money in the long-term by providing electronic documents, emails, electronic textbook and a multitude of free resources for enhancing the educational experience (Khan, 2019). Outside of the classroom, parents and guardians have extremely busy schedules and might be unavailable to assist their child with homework. There are several online resources (Google, Youtube, etc.) that provide supplemental information on topics covered in classrooms. Technology also allows for more active learning, engagement and participation. Having the ability to make online polls or quizzes during lectures with instantaneous results increases engagement within the classroom and between students. Also, having teachers apply technology in the classroom builds credibility with students and fellow colleagues (Himmelsbach, 2019). Technology also has the ability to automate tedious, time-consuming tasks including attendance, grading and participation. Access to technology within the classroom also allows for up-to-date information that can supplement the learning experience (Himmelsbach, 2019). Using a learning management system (LMS) such as Blackboard or Collab can provide constant communication between student and teacher. Currently, the digital world is increasing, and it is becoming more and more essential to understand and incorporate technology in daily activities.

Despite the benefits of technology in education, there are drawbacks to this advancement. Technology in the classroom can be a distraction for users and for those around them. It is the responsibility of the educator to ensure that the lecture is compelling and interesting. Technology also disconnects students from social interactions, and many people are skeptical about the effect technology has on verbal communication. Overemphasizing the use of technology in the classroom can negatively affect students' behaviors between each other, which can become an issue as they attempt to join the workforce. It can foster cheating in class and on assignments because the ability to copy and paste with the click of a button makes cheating and plagiarism even more attractive. This idea also introduces the idea that accessibility to the Internet suggests that students do not necessarily need to learn the material because it is so readily available. Not all students have equal access to technological resources in the classroom and outside of the classroom; therefore, it is essential to not make technology the primary focus in the classroom, but rather use it to supplement the curriculum. This idea will be explored and analyzed by looking into policy concerning technology in education over the past twenty years to provide insight into the motives for different initiatives.

Learning from Past 20 Years of Educational Technology Policymaking

Culp et al. (2005) said, "determining how best to support and advance high-quality use of educational technology in K-12 settings has continued to be a prominent concern for both practitioners and policymakers" (p. 2). To understand and learn from past policy initiatives, it is important to review recommendations made by policymakers over the past 20 years. It has been shown through analysis of several reports that technology can catalyze changes in content, methods, and overall quality of the teaching and learning process, which results in a shift from lecture-driven instruction to inquiry-oriented classrooms (Culp et al., 2005). As technology's infrastructure increases, there have been economic and

social shifts that have made technology skills critical to the future employment of today's students. For the United States, doing this allows for maintaining economic and political dominance globally (Culp et al., 2005). The key recommendations that have consistently been reviewed over time include improving access, connectivity, and requisite infrastructure; creating more high-quality content and software; providing more sustained, high-quality professional development and overall support for teachers seeking to innovate and grow in this domain; increase funding from multiple sources for a range of relevant activities; define and promote the roles of multiple stakeholders, including the public and private sectors; increase and diversify research, evaluation, and assessment; and review, revise, and update regulations and policy that affect in-school use of technology, particularly privacy and security (Culp et al., 2005). From the past 20 years, the education technology community has drawn on three distinct approaches to thinking about and investing in technology: investing in technology to support specific and long-term needs of educators, transforming education through technology, and matching technologies to public priorities for educational improvement (Culp et al., 2005).

Conclusion

With the growth of technology in educational programs, there has been an increase in the data collected and potentially monetized (Lynch, 2019). From this movement in technology within education in the past 20 years, it has been known that teachers' needs and challenges are a guiding force in shaping where and how technology is incorporated into the educational system and that there is a need for a better understanding among both researchers and policymakers of the nature of educational change in general and of educational technology in particular (Culp et al., 2005). Questions have been raised concerning how different algorithms are defined and persuade young children, and how the data is being used. This has posed serious ethical dilemmas, which need to be addressed in current technological policies. The *Alliance for Childhood* discusses how advancements in technology are occurring faster than adults can understand the ethical ramifications of its use (Mattison, 2019). Also, electronic communication between teachers and students has never been better, but students must be aware of the dangers of personal messaging which can be made public and can disrupt the student-teacher relationship. Therefore, it is important that schools address these ethical issues within policies outlining the use of technology inside and outside of the classroom. Policies must continuously be updated and reviewed to maintain current standards for acceptable, ethical and practical use of technology in the classroom. To understand how technology in education affects policy through the lens of Co-production of Science and Social Order, I will be exploring and analyzing both current and past policies pertaining to technology in education on several scales including local, national and worldwide.

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