

**THE EVER-EVOLVING CLASSROOM: THE EFFECT OF TECHNOLOGY IN EDUCATION
ON POLICY MAKING**

A Research Paper submitted to the Department of Engineering and Society
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Biomedical Engineering

By

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April 28, 2020

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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Abstract

Technology in education has become more apparent in the last 10 years, and it will increasingly grow in importance as the Internet's capacity and ecosystem evolves over time. To better be prepared for this evolution, educational technology policy makers need to understand the significance of their work by involving multiple, educational system stakeholders in the process. By researching the roles and responsibilities of these policy makers, this thesis will prove to understand the motivations and criteria for educational technology policy on the federal and school level. In coordination with the United Nations Education, Scientific and Cultural Organization (UNESCO) and other similar federal agencies including the United States Department of Education (ED), American policy makers attempt to stay ahead of this technological evolution affecting the education system. Ultimately, key stakeholders including teachers must provide input in the context of their classrooms and their own pedagogical beliefs about teaching to maintain sustainable and scalable educational technology policies.

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

Introduction

In the United States alone, spending on technology in education has exceeded \$13 billion (Wack, 2019, p. 12). There are many benefits to implementing the Internet in education, but it is important to understand the safety and efficacy concerns for student use. With economic and social changes during 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 this thesis, explores how technology in education affects policy and influences the Department of Education's (ED) decisions. The Co-production of Science and Social Order framework will be used to expand upon the central research question. From collaboration among experts within a certain field of science, a formal social order is developed, resulting in a co-production. By looking at different levels of policy making through the lens of Co-production of Science and Social Order and the motivations of policy makers, this thesis will analyze the impact of current technology and the decision making and motives behind policies.

Research Question & Methods

The main research question that will be addressed in this thesis is who is involved in policy making for technology in education and what are their motivations. To address and expand upon the central research question, the Co-Production of Science and Technology STS framework will be incorporated into the analysis. This framework aims to “provide a theoretical perspective on the mutual constitution of technoscience and social order” (*Co-production of Science and Social Order—Stswiki*, 2015). By applying this framework, this thesis will explore the agenda and motivations of policy makers and policy advisors for technology in education, and it will analyze who are given these roles and how they are given to them. To better understand the context of the central research question, this thesis will analyze papers discussing the development of educational technology policy in the United States, the organizational structure of the leaders at the federal and teacher level governing these policies, and the issues addressing the adoption of technology in education.

Federal and State Level Policy Makers and their Intentions

Federal Level of Policy Making

There are four key challenges policy makers face when developing national policies for technology in the education system empowered by technology: creating future ready policy visions, achieving systemic perspectives, promoting commitment to policy learning, and developing and implementing policy processes (Zagami et al., 2018). There is a broad international agreement that the purpose of educational technology policy is to help lead nations toward their digital future (Zagami et al., 2018). Because change is rapid, national policy will almost never be ahead of innovation. To better be prepared for this, all stakeholder groups must be involved when developing new policy processes that involve technology (Zagami et al., 2018). The international motives for educational technology policy align with the United Nations Education, Scientific and Cultural Organization's Sustainable Development Goal 5, which is to "ensure inclusive and quality education for all and promote lifelong learning" (UNESCO, 2016). Within the United States, the ED supports these endeavors.

The United States ED Office of Education Technology

The U.S. ED Office of Educational Technology (OET) states it "develops educational technology policy and establishes the vision for how technology can be used to transform teaching and learning (OET, 2020). The OET specifically researches how to make everywhere, all-the-time learning possible for early learners through K-12, higher education, and adult education (OET, 2020). There are five main objectives for the OET: promoting equity of access to transformational learning experiences enabled by technology; supporting personalized professional learning for state, district and school leaders, and educators; ensuring all learners are connected to broadband internet in their classrooms and have access to high-quality, affordable digital learning resources at school and at home; fostering a

robust ecosystem of entrepreneurs and innovators and; leading cutting-edge research to provide new types of evidence and to customize and improve learning (OET, 2020). There are several individuals within the OET team involved with developing these policies including Jim Blew, Jake Steel, Bernadette Adams, Sara Trettin and Sharon Leu. Jim Blew is the Assistant Secretary for the Office of Planning Evaluation and Policy Development at the U.S. ED. Jake Steel is the Deputy Director of the OET and the Senior Advisor over K-12 Education in the Office of Planning, Evaluation, and Policy Development at the U.S. ED, and Bernadette Adams is a Senior Policy Advisor for the OET. Sara Trettin leads the broadband and K-12 open education work for the Department, directs digital engagement for the OET and leads the office's efforts surrounding libraries and librarians. Sharon Leu leads the Office of Educational Technology's higher education innovation initiatives, including next generation assessments, individualized learning pathways, use of open resources and platforms, and strategic partnerships with stakeholders. All of these individuals have had lasting impact in the K-12 educational system or federal agencies impacting them. Their experiences have prepared them to advise policy makers towards the vision of educational technology reform. In 2014, the U.S. ED had a Technical Working Group, which was an event developed to increase the community of educators and engage leaders on how to better transition districts to digital learning (OET, 2020). These types of events allow policy makers to develop a better understanding of policy implementation at different levels to ensure their effectiveness. Many of the OET's decisions might be driven by these community events by seeking valued input from stakeholders at all levels, which can aid in the review of current policies and improvement.

The Roles and Responsibilities of the OET

The OET resides within the Office of Planning, Evaluation and Policy Development (OPEPD) and is also the primary ED office for outreach to the educational technology developer community (OET, 2020). It works in collaboration with other Department offices and federal agencies on issues related to the effective use of technology to support teaching and learning (OET, 2020). The OPEPD advises the Secretary on matters including policy development, implementation and review, and it clarifies and enforces laws related to student privacy, developing educational technology policy and establishing strategies that encourage the use of educational technology to transform teaching and learning (OPEPD, 2020). Many of their efforts are focused on developing educational technology policies including the National Education Technology Plan (NETP).

The National Education Technology Plan

The 2017 update of the NETP, which is developed by the OET and ED, serves as the flagship educational technology policy document for the United States (ED, 2017). Not only does it state that providing access to technology to all individuals in the American education system is a continuing need, but it further calls upon all involved stakeholders to ensure this equity of access to improve the overall learning experience. This ultimately provides educational learning opportunities that are not limited by the resources within the school, and it allows for tapping into resources and knowledge anywhere in the world. Having this capability has potential to expand the students' learning and engagement within the classroom and with the teacher. Another important goal highlighted in the NETP states the importance of increased connectivity, which can increase the importance of teaching learners how to become responsible digital citizens (ED, 2017). One of the most important goals of the OET has been to improve connectivity between teachers and students and to the internet. Since June 2013, the OET has been working to connect 99% of American students to next-generation broadband in their schools (OET,

2020). Without the access to the internet, it becomes difficult for students and teachers to take advantage of the opportunities to connect and engage in high quality learning. Currently, students in grades K-12 have access to the internet, but being responsible digital citizens is important for the development of these students into working adults. Having technological literacy is essential in today's workforce, so properly preparing them early on will help them improve their skills and abilities to apply technology in the future. In developing this policy, the ED and OET worked with a Technical Working Group (TWG) of leading educators, technology innovators and researchers who reviewed drafts of the guide and provided feedback from their experiences. The TWG included several individuals from universities, directors of school districts, and Google. While developing these stakeholder groups, these policy makers understood the value of inviting Google, which is a leader in technological innovation. Inviting more technology-focused stakeholders in the future may lead to more promising policies integrating educational technology. The development of the NETP required several interviews, outreach events, other public policy makers, and consistent reviews of the guide, which has greatly improved the objectives of it. The ED and specifically the OET do not rely only on their knowledge and expertise, but also other key stakeholders because of the value brought to the discussion. The OET offers the opportunities for individuals to provide input to the 2020 National Education Technology Plan Development, so the policy makers can understand the situation going on at the micro- (state) and macro- (federal) level of education.

State Level of Policy Making

Davis mentions that leaders of educational organizations, particularly K-12 schools, who struggle in regard to digital technologies, are those with low levels of digital skill, and when confronted with use of these technologies, they tend to shift the leadership of that use to others (Davis, 2017). In

Davis' research, he confirmed that taking on this leadership was not an individual process, but rather it was distributed across people who work to mobilize and guide their colleagues's innovations in ways to improve education outcomes (Davis, 2017). This means that leadership in an educational organization is a process that must be shared across multiple levels of that specific organization. Ultimately, those individuals, who carry out the policies of technology in education and have effectively incorporated digital tools in schools and other educational settings, lead and share their leadership, which leads to recognition by staff and other educators for successful identification, implementation, and integration of technology (Davis, 2017). Having these digital leaders step up and take responsibility as technological educators will drive the integration of technology in more classrooms. Some of this university's professors do not allow the use of technology in the classroom. For example, one of the professors for Ordinary Differential Equations (APMA 2130) uses only a project as a resource for technology, and all homework assignments and tests are physical copies. As for notes, only the chalkboard or a piece of paper are used, which makes it difficult if a student misses a lecture or parts of the lecture. Having these digital leaders set proper examples for other teachers can greatly improve the educational system at the state level.

Agendas and Motivations for Successful Adoption of Education Technology Policy

Macro-level Agendas and Motivations

On the macro scale, national digital education policy makers 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. It is important to be aware of international trends, but one country's engagements are not easily mimicked in another country. To reiterate, 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 educational technology policies that can be adapted to different organizational contexts, thereby accomplishing the goal of 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 funds are disbursed as intended to enable policy goals to be realized equitably. Another factor to consider is 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).

Micro-level Agendas and Motivations

On the micro scale, there are several agendas that must be considered for policy makers when developing educational technology policies. Each year, school districts distribute more technology to their students, which gives them more and more access to the Internet. Each school's culture is influenced by the community and internal and external factors including history, politics, resources, culture, events, ideas, and networks (Zagami et al., 2018). Therefore, it is important to consider that a policy successfully implemented in one context may not produce the same result in another context.

Policies must cater to local needs, expectations and resources. Being able to develop 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 it, including electricity, internet and wireless coverage, and functioning equipment (Dutoit, 2015). Along with these criteria, teachers' personal pedagogical beliefs play a key role in the decisions whether and how to integrate technology within their classrooms (Deng et al., 2014). Teachers select specific applications of technology that align with their curricular variables and methods and that align with their existing beliefs about 'good' education (Tondeur et al., 2017).

The Importance of Sustainability and Scalability

Throughout the past 30 years, the efforts to motivate teachers to integrate digital technologies and develop effective uses of technologies in learning have not reached the expected return (Niederhauser et al., 2018). Simply providing access to technology has not addressed the kinds of change hoped for by policy makers as it is a complex process with multiple interacting factors including curricular, pedagogical, technological, individual and organizational considerations (Howard & Thompson, 2016). Two important factors for integration ICT include sustainability and scalability on all levels (Niederhauser et al., 2018). Educational technology policies that are sustained over time are characterized by consistent change of the educational culture. This requires ongoing support and access to resources and strong relationships among stakeholders. Scalability is the likelihood that an innovation will diffuse effectively across a culture/context. The deepest understanding of a given educational context is held by key stakeholders at different levels: teachers, principals, students and parents at the school level, superintendents, and instructional and curricular directors at the district level, and policy makers, education advisors and lobbyists at the government level (Niederhauser et al., 2018). Each

group has important insight into the adoption and diffusion process of educational technology policy at different levels.

Issues Relating to Educational Technology Policies

Effectiveness

The 2019 Common Sense Census: Inside the 21st-Century Classroom revealed that the 58% of the K-12 teachers use video-streaming services (*The Common Sense Census*, 2019). That being said, the percentage of teachers who used digital tools at least 2-3 times a month was between 87% and 97%, while the percentage of teachers who rated the tools as “moderately,” “very,” or “extremely” effective was between 24% to 68%. This shows that educational technology is increasingly being implemented, but the effectiveness has not yet been apparent. This could mean teachers do not have the digital literacy or knowledge to produce effective learning modules for the students, while also attempting to increase the use of the technology in the classroom. Because the discipline of teaching has been around for many years but the evolution of technology has only been apparent in the last twenty years, the scaling and implementation of educational technology in K-12 classrooms can be disrupted.

Pedagogical Beliefs and Training

Along with lack of digital literacy, the pedagogical beliefs can vary amongst teachers, which results in more or less use of the technology outlined in ICT policies. Although it is suggested that teachers with greater digital literacy take leadership at the micro-level within school systems as technological leaders, the lack of training ultimately plays an important role in the digital adoption. This will always be an obstacle for policy makers because some teachers will recommend the “no technology” policy in their classrooms. By providing a standard guideline for effective use, policy makers can work with these teachers to incorporate and improve the use of educational technology.

Accessibility

Approximately 12% of teachers reported that the majority of their students (61%) did not have home access to the internet or a computer, which can be increasingly difficult for students as grade levels progress as teachers assign more homework that requires access to broadband internet. Policymakers should understand that access to technology is not limited to the classroom, but it is involved in all aspects of daily life in today's world. Specifically, within Title I schools, 45% of teachers identified "access to equipment" as a barrier to using educational technology (*The Common Sense Census*, 2019). Although policy makers attempt to prioritize accessibility, the lack of resources or of the monetary budget to provide these resources limit these policy guidelines in Title I schools. Until this situation is addressed, there will always be a discrepancy between the goal of these policy makers and the results of their work.

Results of Educational Technology Policies

Along with incorporating technology in the classroom, 91% of K-12 teachers say that digital citizenship curricula are effective at helping students make safe, smart and ethical decisions online. Of K-12 teachers involved in the census, only 43% consider their professional development to be helpful in supporting their use of educational technology, and only 36% practically never use a technology product that was provided to them. This proves that policymakers still have much to work on, but implementation has increased over the years. Developing policies that focus on effectiveness and standards of learning will aid in this process, but key input from stakeholders including those who do not use technology will be very helpful. Understanding their motivations for limiting the use of technology will help guide these policymakers in the OET. Approximately 12% of teachers reported that the majority of their students (61%) did not have home access to the internet or a computer, which can be

increasingly difficult for students as grade levels progress as teachers assign more homework that requires access to broadband internet. Policymakers should understand that access to technology is not limited to the classroom, but it is involved in all aspects of daily life in today's world. By finding the balance of too much or too little technology in education, policymakers can provide improved guidelines for implementation for teachers at all grade levels.

Conclusion

Although educational technology policies have come a long way since the early 2000's, there is still much room for improvement at many levels. Being aware of the issues and risks involved with the digital adoption will improve the process of developing policies similar to the NETP. The first step requires involving all key stakeholders at each level of the educational system's organization, which provides policy makers the necessary guidelines for ICT and educational technology. Under the guidance from the OET, national and international policies need to address the varying pedagogical beliefs and contexts of different school systems within the United States. Having the ability to sustain and scale these policies for different contexts will allow policy makers to enhance the production of knowledge and the communication and dissemination of ideas through the use of technology in the classroom.

Thesis References

- Co-production of Science and Social Order—Stswiki*. (2015, October 17).
https://web.archive.org/web/20151017160941/http://www.stswiki.org/index.php?title=Co-production_of_Science_and_Social_Order
- Davis, N. (2017). *Digital Technologies and Change in Education: The Arena Framework*. Routledge.
- Deng, F., Chai, C. S., Tsai, C.-C., & Lee, M.-H. (2014). The Relationships among Chinese Practicing Teachers' Epistemic Beliefs, Pedagogical Beliefs and Their Beliefs about the Use of ICT. *Journal of Educational Technology & Society*, 17(2), 245–256. JSTOR.
- Dutoit, B. J. (2015). *New directions for the UIS global data collection in the post-2015 context*.
- ED. (2017). *Reimagining the Role of Technology in Education: 2017 National Education Technology Plan Update*. Office of Educational Technology. <https://tech.ed.gov/netp/>
- Howard, S. K., & Thompson, K. (2016). Seeing the system: Dynamics and complexity of technology integration in secondary schools. *Education and Information Technologies*, 21(6), 1877–1894.
<https://doi.org/10.1007/s10639-015-9424-2>
- Niederhauser, D. S., Howard, S. K., Voogt, J., Agyei, D. D., Laferriere, T., Tondeur, J., & Cox, M. J. (2018). Sustainability and Scalability in Educational Technology Initiatives: Research-Informed Practice. *Technology, Knowledge and Learning*, 23(3), 507–523.
<https://doi.org/10.1007/s10758-018-9382-z>
- OET. (2020). *What We Do*. Office of Educational Technology. <https://tech.ed.gov/what-we-do/>
- The Common Sense Census: Inside the 21st-Century Classroom | Common Sense Media*. (2019).
<https://www.common Sense Media.org/research/the-common-sense-census-inside-the-21st-century-classroom-2019>

- Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. *Educational Technology Research and Development*, 65(3), 555–575. <https://doi.org/10.1007/s11423-016-9481-2>
- UNESCO. (2016). *Education 2030: Incheon Declaration and Framework for Action for the implementation of Sustainable Development Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning... - UNESCO Digital Library*. <https://unesdoc.unesco.org/ark:/48223/pf0000245656>
- Vanderlinde, R., van Braak, J., & Hermans, R. (2009). Educational Technology on a Turning Point: Curriculum Implementation in Flanders and Challenges for Schools. *Educational Technology Research and Development*, 57(4), 573–584. JSTOR.
- Wack, B. (2019, February 26). *What 126 studies say about education technology*. MIT News. <http://news.mit.edu/2019/mit-jpal-what-126-studies-tell-us-about-education-technology-impact-0226>
- Zagami, J., Bocconi, S., Starkey, L., Wilson, J. D., Gibson, D., Downie, J., Malyn-Smith, J., & Elliott, S. (2018). Creating Future Ready Information Technology Policy for National Education Systems. *Technology, Knowledge and Learning*, 23(3), 495–506. <https://doi.org/10.1007/s10758-018-9387-7>