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Software's Smile: A Critical Software Analysis of Educational Technology Certification in New York State

Tom Liam Lynch
Pace University

Abstract

Technology is increasingly positioned by policy makers as a necessary part of 21st-century schools. However, it is not always clear how well preparation programs in educational technology truly prepare educators for such work. In this study, the author critically analyzed official standards documentation for an educational technology specialist program in order to determine the degree to which preservice educators are being prepared for what is expected of them. The author articulated a framework called critical software studies, which seeks to unpack the way software, which is what comprises modern technologies, demands a kind of scrutiny few acknowledge and consider when preparing future educators. The author concluded that the standards themselves do not take a critical stance with regard to technology, but rather presuppose technology as something neutral and purely functional. Recommendations to improve standards and programs are then made to different stakeholders in teacher education.

Education is becoming increasingly steeped in technologies for both pedagogical and administrative purposes (Lynch, 2015). A hallmark of both the Obama and Bush administrations' education reform agendas has been to require that technology be integrated into classroom practices—with emphasis, for instance, on STEM (science, technology, engineering, and mathematics) initiatives—and administrative practices, as evidenced by the requirement to use digitized data to drive decision-making (Gorlewski & Porfilio, 2013; Lynch, 2014b; Ravitch, 2013; Taubman, 2009).

The use of technology in education is a multifaceted and complex issue. In order to unpack the limitations and affordances of educational technology thoroughly, what Selwyn (2014) called the "orthodoxy of optimism" (p. 13) must be ruptured. Selwyn wrote,

> Despite repeated predictions of inevitable changes and impending transformations, digital technologies are used inconsistently in educational settings, usually with little large-scale conclusive "effect." Put bluntly, then, any stridently optimistic description of technology-induced educational change should be seen more as a matter of faith than as a matter of fact. (p. 10)

Such faith and optimism runs the risk of distracting policy makers, educators, and the public from the more complicated realities of both education and technology.

In New York, education technology specialists are state-certified coaches whose role it is to broker the space between the pedagogical and the computational, helping both teachers and administrators ensure that technology serves their respective ends. How well are schools of education preparing new teachers to respond critically to the orthodoxy of optimism that surrounds the use of technologies in schools? I approached this question by critically examining New York State's key documents in the certification of educational technology specialists by drawing on a developing field called critical software studies (Lynch, 2015). The following is a review of critical scholarship in education that addresses the role of technology, then an introduction to the field of software studies, which offers researchers new concepts for approaching technology in education.

Critical Studies in Education and Technology

Researchers have examined the wide gaps in technology access across socioeconomic and demographic groups (Bromley & Apple, 1998; Madaus, 1994), as well as the historical fact that new technologies introduced to classrooms have had little of the lasting effects their promoters optimistically promised—from radio to film to television to the web (Cuban, 1986; Meier, 2005). Peter Taubman (2009) criticized reformers' use of technology to operationalize "assemblages" of instruments to translate the complexity of pedagogy into data. Specifically, he wrote that standards, rubrics, and tests are used to abstract the very human work of teaching by erasing "a language attentive to the nuances of meaning, to the beauty of the idiosyncratic, to the variegated hues of experience" and "abstract[ing] us from the specificity of our situations, turning us into a portable number..." (p. 52).

Michael Apple (1993, 1996; Bromley & Apple, 1998; Christian-Smith & Apple, 1991) offered critiques from his perspective two decades ago of neoliberal reform agendas, including how technology was positioned in both the discourse and implementation. The discursive tendency to frame all political problems in economic terms resulted, Apple argued, in misapplying market-based logic to education. More recently, critics have noted with concern the widespread application of "mechanistic approaches" (Taubman, 2009, p. 2) to education resulting in a citizenry of "technically trained people who do not know how to criticize authority, useful profit-makers with obtuse imaginations" (Nussbaum, 2010, p. 142).

Diane Ravitch (2013) noted that using technology to support sound pedagogy is one thing, but using it to promote private enterprise, as appears to be the case with some online charter schools, is quite another. Picciano and Spring (2013) mapped the convoluted technological network of which Ravitch warned across policy makers, philanthropists, and the private sector in what they called the "educational-industrial complex."

A limitation of these kinds of scholarship, however, is that scholars have treated as their sites of study the relatively familiar human world in which policies and technologies

occur, seldom addressing the less familiar world of computers, including the nature of software and the social context in which it is created and promoted. Critically analyzing the role of technology in education demands that scholars address the complex nature of software, not only of technology itself.

For instance, analysis of the ways political and ideological influence promote educational technologies is incomplete without an exploration of ways the very nature of certain educational technologies captures and renders learning experiences through software (Lynch, 2014a, 2015). I turn to the field of software studies for theoretical clarity and propose a variation of software studies for social science researchers with interest in the critical.

Critical Software Studies in Education

While individuals might speak about technology in education, all digital technologies are powered by software (Edwards, 2015; Williamson, 2015). I have proposed the terms*oftware-powered technologies* to capture the issues of power embedded in the use of software (Lynch, 2013, 2014a, 2014b, 2015). The word *technology* is inadequate because it is too broad, too familiar, and can refer either to digital or analog phenomena. Software must be called by name.

Manovich (2001) asserted that such explication is important because software is "a layer that permeates all areas of contemporary societies. Therefore, if we want to understand contemporary techniques of control, communication, representation, simulation, analysis, decision-making, memory, vision, writing, and interaction, our analysis cannot be complete until we consider this software layer" (p. 15; italics omitted).

In addition to acknowledging the ubiquity of software in society, scholars in software studies have analyzed the degree to which software shapes human experience. Kitchin and Dodge (2011) noted that "behavior is therefore necessarily reshaped to make it more amenable to capture in order to fulfill the essential requirements that make a [software] system work" (p. 89). In part, software's ability to shape human behavior is due to what Berry (2011) called "the facade of flashing lights, deceptively simple graphic user interfaces (GUIs) and sleekly designed electronic gadgets that re-presents a world to the user" (p. 4).

In short, the ubiquity of software is in many ways hidden from the average user, because users either do not see it working or engage with software in sleek ways that distract them from how their actions and desires are being made more amenable to computational logic. This phenomenon is especially difficult to articulate in education, where the orthodoxy of optimism is so strong. I propose the term *critical software studies* as a framework for examining the role of software in education as it relates to issues of power and inequity.

Critical software studies borrow theoretical and methodological tools from critical discourse and content analysis (Cazden et al., 1996; Fairclough, 2003; Huckin, 2004; Kress, 2011; Rogers, 2011), critical educational studies (Apple, 1993, 1996; Selwyn, 2014; Weis & Fine, 2012), and software studies (Berry, 2011; Frabetti, 2015; Fuller, 2008; Kitchin & Dodge, 2011; Manovich, 2001, 2013). The resulting theoretical stance defines software discursively and explores ways software represents "aspects of the world—the processes, relations and structures of the material world, the 'mental world' of thoughts, feelings, beliefs and so forth, and the social world" (Fairclough, 2003, p. 124) and

attempts to analyze it in a manner that resembles what others have called "critical bifocality" (Weis & Fine, 2012).

Critical bifocality refers to the need to account for the "braided" (p. 174) manner in which policies and language directly affect the the daily lives of human beings. The language used by officials through standards (macro) impacts the visceral everyday experiences of individuals and communities (micro). Critical software studies expand the definition of language to include human language at both the macro and micro levels, as well as computational languages.

Examining teacher education standards for educational technology specialists is one way to capture the official macro discourse about what it means to integrate technology into schools. This paper offers a partial bifocal examination, offering a way to frame how standards documents might be regarded with a critical eye, though not including deeper qualitative analysis of teachers' and students' experiences. The focus, rather, is on leveraging the critical software studies framework to interrogate standards documents for an educational technology specialist program.

In critical software studies, I use the term *software space* (Lynch, 2015) to capture what Fairclough (2003) called processes, relations, and structure of the material world while also explicating how software is situated as a ubiquitous mediator of that world. In education, the main kinds of critical discursive spaces at play must be identified, which I term political, economic, pedagogical, and administrative. Next, I identify several layers of software space in an attempt to reveal its invisible materiality. Software space consists of devices, network infrastructure, interfaces, code, and information systems. Though some of the layers might be familiar at first glance, like devices and the user interfaces on such devices, the remaining elements remain mostly hidden from view. (See Figure 1.)

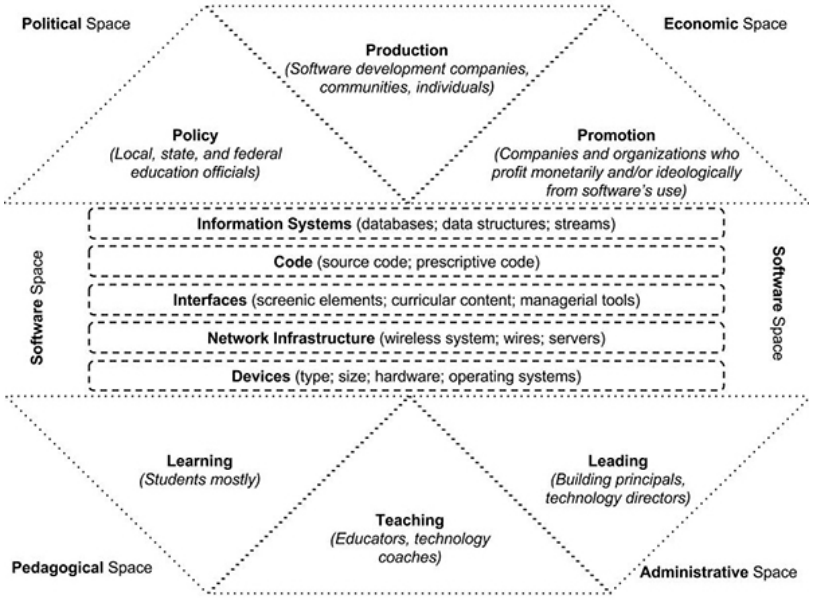

Figure 1. *Critical software studies map. A visualization showing how computational assemblages comprise software space within educational spaces.*

In sum, software is created by human beings with ideologies, epistemologies, and bottom lines. Policy makers formally and informally encourage the use of software-powered technologies developed by private companies that are willingly and unwillingly procured by schools with tax dollars. When powering education, software—to some degree—enacts the pedagogical assumptions and ideologies of those who produce and promote it, transforming teaching and learning into something the logic of the market can solve through the ontology of software space.

At the school and district level, the individual who should be most positioned to question such assumptions and empower teachers and school leaders to see how to bend software-powered technologies to pedagogy, rather than the reverse, is the educational technology specialist. The extent to which official documents promote a critical stance with regard to educational technology is described next.

Methods

In New York State a certification path exist for educational technology specialists, whose role is to bridge software space with pedagogy and administration. The state describes the role thus:

> The New York State Educational Technology Specialist has the knowledge and skills necessary to teach effectively in New York State public schools. The Educational Technology Specialist has a basic understanding of computer operations and concepts and is familiar with equity, ethics, and legal issues associated with the use of technology in education. The Educational Technology Specialist is knowledgeable about the professional applications of technology and is able to plan, implement, and assess concepts and skills relevant to educational computing and technology literacy for all students across the curriculum. The Educational Technology Specialist is able to apply technology-related research findings to the creation and maintenance of effective learning environments and knows how to develop and implement educational technology professional development programs to assist other educators in furthering his or her understanding of teaching and learning with technology. Finally, the Educational Technology Specialist understands issues related to facilities and resource management and managing the change process in the educational environment. (New York State Education Department, 2003)

These individuals represent a key position in school districts because a crucial part of their job description is to ensure that teachers do not become stunted or frustrated with the technicity of technology and that administrators make informed strategic decisions when investing in technology. As education is increasingly mediated by software, these professionals should be most qualified to understand and broker the demands of software space with the needs of pedagogy. Because teacher education programs are highly regulated by state and national accreditation agencies, official documents associated with educational technology specialist programs provide an appropriate data set for critical analysis, braiding the language of policy with the implications for practice through software space.

A Collection of Standards

I collected discursive artifacts from my university's educational technology specialist teacher education program, which is in New York State. In New York, educational technology specialists are subject to most of the same certification regulations as other

content-area teachers, including a battery of licensure exams. In the wake of recent reforms, however, educational technology specialists were exempted from having to complete an in-depth teaching performance portfolio. The preparation program is required to refer to specific standards documents in order to be accredited by both New York State and an external accreditation agency previously known as the National Council for Accreditation of Teacher Education, which was recently absorbed into a new agency called the Council for the Accreditation of Educator Preparation.

When applying to the state to recognize the university's educational technology program or to be nationally accredited, our program must map our assignments and syllabi to a collection of standards and official guidance documents. Documents include two New York State Education Department (NYSED) regulatory and guidance documents (NYSED, 2003; The University of the State of New York & NYSED, 2006), the Association for Educational Communications and Technology (AECT, 2012) standards, the International Society for Technology in Education's (ISTE, 2014) standards for technology use by teachers, the Common Core Standards in English language arts and mathematics (Common Core Standards Initiative, 2010a, 2010b), and the Danielson (2013) Framework for Teaching, which is the state's preferred rubric for conducting teacher evaluations.

I created a corpus of these six document sets for computational text analysis using an open source application called Voyant Tools (v. 1.0). During this process, the type of documents available impacted the quality of text analysis. Several documents, for instance, were available only in portable document formats (PDFs), which can be less accurate when imported into analytical software than other file types like .doc, .txt, .xml, or .html. I reviewed passages in the original PDF documents where imperfections from the import were evident, as well as the reports rendered in the analytical software application, and was satisfied that the import, while imperfect in places, did not greatly affect the final word tallies used for analysis. For example, an imperfection might include the random and occasional merging of words. I searched the corpus for misspelled words and corrected merged words manually.

Data Reduction

Next, I reduced the data by employing a grounded qualitative content analytical paradigm, in which I used "quantitative content analysis to establish basic data and qualitative analysis to interpret it" (as recommended in Huckin, 2004, p. 22). Specifically, I created a corpus of the documents and analyzed the data for how critically (or uncritically) and optimistically the authors of the documents represented software-powered technologies. One of the driving principles in critical software studies is that software is mostly hidden from view, yet it mediates and shapes user experiences with the world. The role of software is further obfuscated by the fact that many words are used to refer to software-powered technologies in schools, districts, and universities in deceptively neutral ways.

I purposively sampled the data based on the following terms that appear throughout critical software studies and software studies as signifying software-powered technologies: *software*, *technology*, *digital*, *data*, and *computer* (including *computer*, *computers*, and *computer-based*). I then reduced the data based on instances of high-frequency (raw and relative) and graphic analytical techniques. This filter reduced the total number of words from 92,699 in the total corpus to a sample of 544 words, for which I totaled the raw and relative word frequencies.

The initial analysis revealed which documents featured keywords frequently with regard to each document length. It also showed which documents left keywords conspicuously absent. Based on the initial reduction, I focused my qualitative analysis on three documents—the ISTE (2014) standards, AECT (2012) standards, and NYSED Prep Guide (The University of the State of New York & New York State Education Department, 2006)—though other documents sometimes demanded attention as well. I observed patterns in usage across the search terms, which are described next.

Software

Across documents, software was referred to discretely in relationship to hardware. The NYSED Prep Guide named software as something schools "choose" to "purchase" as part of a "package," something that is presented in objective and often proprietary terms meriting legal protection from piracy. Regarding Internet connectivity, for instance, the preparation guide stated that educational technology specialist candidates should learn to "identify strategies for troubleshooting various hardware and/or software configurations." In the AECT document, an emphasis was placed on the use of software to create and capture media, for instance. Several standards explicitly referred to software in the context of media production rather than the more functional role of software emphasized in the NYSED Prep Guide. For instance, one AECT list item described "software for capturing Web pages, audio wave files, and video files for developing off-line presentations."

Digital

The word digital was used in two main ways. The first referred to the use of digital tools and resources. The second referred to the more macro emergence of a digital age and society. For instance, the Common Core English language arts standards referred frequently to "digital tools to produce and publish," as well as the ability for students to search and vet print and digital sources. The AECT standards echoed the tool-centered emphasis, stating, "Collaborate with students, peers, parents, incorporating contemporary tools and resources and community members using digital tools to maximize content learning in context and and resources to support student success and to develop the knowledge, skills, and attitudes." The same standards added a slight variation to these references by also referring to the need for teaching candidates to understand aspects of digital data capture and analysis.

Technology

The word technology was used as a synonym for hardware and software or as a single term to subsume both. In the AECT documents, one standard stated, "To assist other educators in furthering their understanding of teaching and learning with technology." The meaning of the word varied depending on the context. The ISTE standards used the word technology similarly as a synonym not only for hardware and software, but also for digital. In addition, the ISTE standards alluded to the fact that these technologies are part of complex technology systems, in which candidates, including both educational technology specialists and other content-area teachers generally, must become fluent.

The NYSED Prep Guide followed a similar usage pattern, using the word to refer both to broad administrative goals, such as, "The Educational Technology Specialist has a basic understanding of computer operations and concepts and is familiar with equity, ethics, and legal issues associated with the use of technology in education," as well as the more

pedagogical goal of "demonstrating knowledge of how to incorporate technology into curriculum development in alignment with state and national content standards."

Computer

The word computer appeared in the sample in two ways, as a broad catch-all term, similar to the way technology was described, and as a concrete functional object. The AECT standards referred to distance computing technologies and computer literacy, for instance. In one case, the standards linked the word to computer science, but that usage was not the norm. The NYSED Prep Guide referred to computers in their more functional aspects of computer operations and systems, while also calling attention to a specific physical space where students and teachers used devices—the computer lab. The word occurred infrequently in several documents, including the Common Core ELA standards, the Danielson Framework, and the ISTE standards.

Data

The word data was used most frequently in the Common Core mathematics document; however, its use referred to data in the context of student-based mathematical problem-solving, not as it relates to educators' use of achievement or performance data. I did not include references to mathematical *data* in the analysis. Interestingly, the Common Core English language arts standards also referred to data with some regularity, for example, in the context of writing evidence-based arguments.

I focused my analysis on non-content-area-specific occurrences. The AECT standards referred to the word in the context of collecting, analyzing, and reporting data about teacher candidates. For example, "Data are gathered on an ongoing basis and are summarized in a manner which reflects pass rates, the range of performances." The NYSED Prep Guide referred to data associated with computer processing a handful of times—data compression and data transferring, for instance. The other main reference to data was in the context of a sample question about using a spreadsheet to gather and visualize data in a school setting.

Analysis and Findings

Findings suggest that while words associated with critical software studies were used with frequency they were not referred to in a way that promote a critical approach to the role software space plays in education. Rather, references to the language of software—*software*, *digital*, *technology*, *computer*, *data*—were presented as neutral, pragmatic, functional, and operational. When discussing technology in education, including teacher education, educators must account for its use within and across political, economic, pedagogical, administrative, and software spaces (Figure 1). While each of these spaces is at least implied in the standards, the connection across software space was left unexplicated and spared critical scrutiny.

Political Space

The political space is a precursor to many of the documents, which emerged from state and national agencies, the purposes of which are to create documents for accountability purposes. Occasional references to "equity, ethics, and legal issues associated with the use of technology in education" explicitly situated some of the documents in the sociopolitical landscape; albeit, such situatedness was brief and often limited in scope to the protection of intellectual property. That is, such political references were distanced

from human beings' social realities and served proprietary ends rather than raising educational technology specialists' and districts' awareness of the politics of educational technologies.

In addition, teacher education programs in New York State are required to use or adopt a variety of standards documents that were written with different political agendas and educational perspectives. This situation can present conflicting messages when, for instance, one set of standards presented a word like data to refer to mathematical content (Common Core mathematics standards) while others referred to data in terms of achievement data based on standardized test scores or teacher performance evaluations (AECT). The burden of coherence falls on educational technology specialist programs that must align their coursework to what are distinct and uncoordinated documents.

Economic Space

The role of economic entities that produce and promote software-powered technologies was, at best, implied in the documents, often referring only to procurement and quality evaluation processes. Even in these cases, such evaluation processes were named but not modeled or detailed. By positioning producers and promoters this way, however, the optimistic authors of the documents perpetuated the misassumption that products are objective and purely functional, absolving educational technology specialists of the responsibility for critically considering the ideologies and pedagogies embedded into the products and services schools are increasingly required to procure.

An example from my university is illustrative. Our school of education subscribes to a private company's web-based product that administrators use to manage accreditation reporting. Faculty members can log in, upload assignments and rubrics used to gather accreditation data about their programs, and assess student work therein. Students can log in, submit their assignments, and receive feedback. When the time comes to generate data for accreditation reporting, the data are already aligned to standards, assignments, rubrics, and individual students.

K-12 schools are increasingly encouraged to use similar products, like standards-based online grade books. The products companies offer are not neutral or objective as the standards would imply. Rather, our reporting product requires the faculty to create assignments that can easily be uploaded to a website and mapped to rubrics that fit within the parameters of the rubric tool provided.

The rubric tool I am required to use at my university is embarrassingly basic, yet it is the one the company has produced and, therefore, my own assessments must fit into its framework. Faculty members can give only typed feedback to students in an impersonal way. The functionality exists for giving audio-recorded feedback, but the company must have found such functionality too costly to include. An education technology specialist should be encouraged—through the standards and coursework—to question the ideologies that some technologies promote while supporting colleagues to navigate those conversations confidently.

Pedagogical Space

The role of pedagogy in the documents was reflected frequently in the use of the word digital, where the context of the word's use suggested how teachers were integrating digital tools and resources into instruction. Both Common Core sets of standards also provided some description of using digital texts and devices in the classroom

context. Importantly, the pedagogical value of using software-powered technologies in schools was optimistically assumed throughout, despite the lack of empirical evidence of consistent and scalable benefits in the research.

Teacher education programs inherit this assumption that using digital tools and resources is necessarily a good thing. It is not unusual, for instance, to read about the growth of large online courses in universities and more broadly. At our university, administrative business concerns have led to the increased offering of online courses to students. Online courses save space costs and lighten other infrastructural strain on the university. The motivation to promote online courses is not pedagogical. While rich resources are available for supporting online instruction, no compelling evidence exists that shows online courses lead to better learning experiences for students or teaching experiences for faculty. Rather, the motivation is both political and economic.

In addition, the software-powered technology used for online courses—often referred to as a learning management system—commonly forces instructors to think about their courses in ways that align with technological limitations imposed through the product by the private company that created it.

Instructors who find online discussion boards too daunting and ineffective and would prefer alternative modes of interaction will find many of the most popular learning management systems sorely lacking. Education technology specialists must be fluent in these kinds of phenomena, especially the ways in which technological development and the decisions of private companies compromise pedagogy.

Administrative Space

Little was said explicitly about school leaders across documents, though administrative stakeholders are implied when references were made to matters of ethics, legality, and procurement. Despite the sharp rise in emphasis on data-driven decision making, the documents took a more optimistic stance and avoided addressing how school leaders might strategically and critically juggle both compliance needs (i.e., reporting achievement data to the state) with more nuanced or constructivist pedagogical goals (i.e., 21st-century skills and project-based learning).

Pressure to use software-powered technologies is felt at many levels of administration, in part due to the emphasis placed by accreditation documents and grant money offered by public and private entities. Administrators might also be tempted by the perceived cost saving in using less physical building space or paying fewer instructors.

For example, a course I was once slated to teach had five students from one campus and four from another campus 30 miles away. Rather than pay two separate instructors, I was asked to alternate campuses each week, while students from both campuses sat in classrooms equipped with telepresence software (a form of high-end video conferencing). Though our administration saved a few thousand dollars in instructor salary, the reviews from students stated clearly that they felt like whichever group of students had me physically present with them got a better experience that week. To my administration's credit, they slowed down rolling out that teaching model to reassess its value to students. Standards documents should clearly prepare educational technology specialists to engage critically with administrators about the tension between technological efficiency and pedagogical sacrifice.

Software Space

The documents included elements from all layers of software space: devices, networking infrastructure, interfaces, code, and information systems. These different components, however, were often presented glibly and in isolation from each other and the social factors in which they are produced and consumed. Further, the notion that ideological and pedagogical assumptions are encoded in software space was absent.

Rather than considering the critical issues that involve software space, the documents approached software space in disintegrated and purely functional terms. The documents did not prompt educators to analyze critically the subtle ways software-powered technologies impact pedagogy negatively. Rather, the assumption, again, was that the use of technology is beneficial. Similarly, references to data—both in the classroom and in more operational forms—assumed the inherent goodness or at least neutrality of generating data, despite the fact that the kinds of data generated often distill learning into overly simplistic numbers.

Examples of software space being used to operationalize standards and the ideologies behind them abound. In New York State teacher education, the best recent example is the edTPA (American Association of Colleges for Teacher Education & Stanford Center for Assessment, Learning, and Equity, 2013). The edTPA is a teacher performance assessment created at Stanford University and adopted by many states who, as part of the conditions of their accepting Race to the Top grant money from the Obama administration, had to adopt new teacher evaluation and certification standards and processes.

Aspiring teachers in New York were required to pass new tests, for which study materials were not freely available, and complete a daunting three-part performance portfolio. The portfolio consisted of sections in planning, teaching, and assessment. Teaching candidates were expected to upload pedagogical artifacts to their portfolios, which included video clips of their teaching, and to reflect at substantial length on their teaching decisions.

On the surface, this reform attempt sounds noble and hardly relevant to software space. However, the tests were computer based, and the portfolios were all submitted, assessed, and reported digitally. Different devices were used to implement testing and portfolio collection, ranging in size and usability; network infrastructure varied across schools, universities, and public spaces where students connected to the Internet to work on their portfolios. The user interfaces were designed by a for-profit company, and candidates reported getting confused and lost in trying to complete their portfolios. The code that comprised the proprietary software applications was challenging to inspect. The data generated through the assessments were shared through information systems with state officials who intended to publicize results and link candidates' future students' test scores back to the education programs that prepared their teachers. Educational technology specialists should be prepared to see and critique the role software space plays in precisely these kinds of policy-driven reform efforts.

Discussion

The standards documents I analyzed demonstrate how the orthodoxy of optimism has been operationalized by state and accreditation agencies. Selwyn (2014), when discussing such orthodoxy, did so mostly in the context of proponents of educational technologies

speaking explicitly in world-altering platitudes about the inherent goodness of technologies like social media, online learning, and so on.

In standards documents, the orthodoxy has persisted but in a more veiled way. The authors of the standards did not simply herald the wonders of technology. Rather, the authors' optimism was wrapped in a genre and writing style that conveyed objective distance and neutrality. The standards documents made what appeared to be concrete statements and were intentionally created to appear official, void of any individual authorial voice.

Despite this objective appearance, the assumption across all documents appeared to be that (a) some benefit accrues to using technology in educational settings and (b) using educational technology is simply a matter of understanding how hardware and software function. The former assumption is problematic for many reasons, not the least of which is that little research evidence supports the assertion that using technology is effective at scale. In fact, evidence is compelling that the use of software-powered technologies in schools is overblown, wastes time and money, or distracts teachers and students from other pedagogical work (Cuban, 1986; Philip & Garcia, 2013; Selwyn, 2014).

The latter assumption is also problematic insofar as regarding hardware and software in falsely objective terms increases the challenge of critically examining the less obvious ways software space impacts pedagogy. In both cases, the assumptive premises do nothing to foster a critical consideration of educational technologies and detrimentally position educational technology specialists as servants of technology rather than vice versa.

The standards documents also perpetuated the assumption that data is a desirable and objective component of pedagogy. As Taubman (2009) argued, this assumption is highly disputable and contradicts claims reformers make that using data in schools will solve problems of equity. Data-focused reforms have been shown to *worsen* teaching and learning experiences in the school and community settings that need the most help (Apple, 1996; Darling-Hammond, 2010; Noguera & Wells, 2011; Ravitch, 2013).

When the authors of the AECT standards stated that "data are gathered on an ongoing basis and are summarized in a manner which reflects pass rates, the range of performances," they ignored that data are not "gathered" as much as data are forcefully generated out of highly sophisticated sociocultural experiences, that they are imperfect and inauthentic numerical and categorical representations (Behizadeh, 2014; Golden, 2014). In addition, even the legitimacy of the kinds of sampled assessments or "performances" to which the standards confidently referred have been highly contested (Giordano, 2007; Gould, 1996; Madaus, 1994).

History, bodies of theory and research, and criticism have all conveyed the rich complexity of using technologies in education. The authors of the standards chose to ignore the richness of this complexity. Educational technology specialists should be critical consumers of research, exposed to the history of educational technologies, and sensitive to the agentic qualities of software. The result could very well be that districts and schools resist the overly simplistic promises of technology companies and finally avoid making the same mistakes in educational technology implementation with the kind of Sisyphean regularity seen today.

Implications for Teacher Education

If the calls to understand and expose the ways in which software space encodes the ideologies of those who produce and promote software are to be taken seriously, and if the active and agentic nature of software can have direct effects on pedagogy are accepted, the standards documents teacher education programs use to craft their curricula must explicitly prompt teacher educators and educational technology specialist candidates to examine the nature of software critically.

States and organizations might revise standards documents to explicitly encourage educational technology specialist candidates to do the following:

- Identify assumptions about technology and software,
- Question how political and private interests influence the promotion of technology,
- Articulate how software-powered technologies can falsely appear to meet pedagogical ends, and
- Be expert in the debates that surround issues of software space, like mass data collection and public reporting.

This list is only partial and more could clearly be generated. The responsibility to generate further competencies should not rest solely in the hands of states and other institutions. As the creation of the Common Core Standards has demonstrated, a fair process of authorship can be easily feigned when, in fact, the authors represent private interests (Applebee, 2013). Rather, as Selwyn (2014) alluded, leaders must make the process truly democratic with sustained and systematic dialog among all stakeholders. Further, the resultant standards should promote candidates' fluency in the history, research, and debates about how technology is used in schools and why. Only then are candidates prepared to put their more technical skillset to use and avoid the naïve optimism of which Selwyn warned.

In addition, programs that prepare district and school leaders should emphasize the importance of educational technology directors' demonstrating a healthy awareness of potential and pitfalls. Future district and school leaders decidedly do not need technological evangelism nor perfunctory compliance. Software-powered technologies must be used to extend and deepen the highest pedagogical ends—not to appease administrative mandates, not glibly to improve student engagement, and not to quantify uncritically the humanity of students and teachers for the sake of politics and power.

Teacher preparation programs are essential partners in reshaping how software-powered technologies are perceived and enacted in schools. Creating a critical and authentic culture around technology use begins with ensuring that those to whom administrators, teachers, students, and staff turn with technology-related questions—educational technology specialists—exude skepticism that is rigorously cultivated by situating their work in the history, theory, and criticism of educational technologies.

In the end, all educational institutions are responsible to promote the development of a critically thinking citizenry—students who care, who question, and who vote. Breaking away from the orthodoxy of optimism can start with critical revisions of standards that rigorously demand schools respond to software's smile with human patience, dialog, and caution.

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Author Notes

Tom Liam Lynch
Pace University
Email: tlynch@pace.edu