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Is K-12 public education being disrupted? An exploration of the theory of disruptive innovation and online learning

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Is K-12 public education being disrupted?
An exploration of the theory of disruptive innovation and online learning

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Abstract

Is K-12 public education being disrupted? An exploration of the theory of disruptive innovation and online learning

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In 2008, Christensen, Horn, and Johnson (2008) predicted that by 2019, 50% of high school courses would be online. This paper assesses the progress from 2008 until 2017 toward that prediction. In order to make that assessment, I provide an overview of the current state of online learning and describe the ways in which it has grown since 2008. Then I describe Christensen et al.'s (2008) theory of disruptive innovation, how Christensen et al. (2008) believe their theory explains the history of education reform in the United States, and why Christensen et al. (2008) believe the theory of disruptive innovation justifies their aforementioned prediction regarding the proliferation of online learning. Finally, I discuss the implications of the outcome of the prediction for the theory of disruptive innovation and the role the theory has for forward-thinking researchers and educators involved in online learning.

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Introduction

In the early 1980s, there was growing enthusiasm for using computers for instructional purposes. Experts predicted that computers would have a substantial impact on instructional practices. For example, Papert (1984) wrote that computers were going to be “a catalyst of very deep and radical change in the educational system,” and that by 1990, it would be common for each student have her own computer in school (p. 422). As it turned out, “[a]lthough computers may eventually have a major impact on instructional practices in schools, by the mid-1990s that impact had been rather small” (Resier, 2001, p. 59). The history of educational technology is rife with predictions that turned out to be misguided, to such a degree that a pattern has emerged: “[a]s a new medium enters the educational scene, there is a great deal of initial interest and much enthusiasm about the effects it is likely to have on instructional practices” (Reiser 2001, p. 60). Eventually, however, enthusiasm and interest dissipate, and in retrospect, the medium in question turns out to have little to no impact on instructional practices (Reiser, 2001, p. 60).

Online learning has followed this pattern. As Internet access became more ubiquitous in the mid-1990s, there was a great deal of interest and enthusiasm with respect to the instructional possibilities the Internet afforded. Owston (1997) captured this attitude when he wrote:

> [n]othing before has captured the imagination and interest of educators simultaneously around the globe more than the World Wide Web. The Web is now causing educators, from preschool to graduate school, to rethink the very nature of teaching, learning, and schooling. (p. 27*)*

In 2008, this enthusiasm had yet to subside. In their book, *Disrupting Class: How Disruptive Innovation Will Change the Way the World Learns*, Christensen, Horn, and Johnson (2008) predicted that that by 2019, “about 50 percent of high school courses will be delivered online" (p. 98). This was an astounding claim to make, given that at the time, Picciano and Seaman (2009) estimated that out of 15,086,000 secondary public school students nationwide, only 721,000 (4%) were enrolled in at least one online or blended course during the 2007-2008 school year (Picciano & Seaman, 2009, p. 11; Snyder, de Brey, & Dillow, 2016, p. 60). The comparison between Christensen et al.'s (2008) prediction and Picciano and Seaman's (2009) estimate is admittedly tenuous since Christensen et al.'s (2008) prediction was given in terms of the percentage of courses taught and Picciano and Seaman's (2009) estimate was made in terms of the number of students enrolled in at least one online course. However, the number of students enrolled in an online course does give some insight into the percentage of overall courses that are delivered online. Picciano and Seaman's (2009) estimate that just 4% of all students were enrolled in *at least* one online course implies that no more than 4% *of all* classes was being delivered online. So, if Christensen et al.'s (2008) prediction that 50% *of all* classes would be delivered online proved accurate, the percentage of students enrolled in *at least* one online class would have to be much higher since students take six courses or more. In other words, Christensen et al. (2008) were predicting exponential and transformational growth in online learning in a relatively short timeframe.

In this paper, I explore, assess, and analyze Christensen et al.'s (2008) prediction. To do so, I first describe the current known state of online learning in 2017. Then, I explain how and why Christensen et al. (2008) came to believe that 50% of high school courses would be delivered online in 2019, using their argument in *Disrupting Class*. Finally, I consider the underlying assumptions and implications of that argument.

State of Online Learning in the United States

In this section, I begin by defining a set of terms regarding the topic of online learning in the United States. Next, I examine the different ways in which online learning can be classified, followed by identifying the three kinds of online learning programs most relevant for this paper. Then, I give an overview of the costs associated with online learning. Finally, I provide data that shows the ways in which online learning has expanded since 2005.

DEFINING ONLINE LEARNING

As defined by the International Association for K-12 Online Learning (INACOL), online learning is "[e]ducation in which instruction and content are delivered primarily over the Internet" (International Association for K-12 Online Learning 2011, p. 7). Online learning is a more specific form of distance education, which is the "[g]eneral term for any type of educational activity in which the participants are at a distance from each other—in other words, are separated in space" (International Association for K-12 Online Learning, 2011, p. 5). Distance education, and thus online learning, can be either synchronous (i.e., teachers and students simultaneously interact with each other) or asynchronous (i.e., teachers and students do not interact with each other at the same time). Early formulations of distance education were intended for homeschooled students and included delivery methods such as "print materials, CD-ROMS, and video conferencing to deliver instruction and facilitate communication" (Gemin, Pape, Vashaw, & Watson, 2015, p. 11). Initially, online learning initiatives attempted to combine traditional classroom practices, such as the teacher being the primary source of instruction, with distance learning concepts, like asynchronous interactions (Gemin et al., 2015, p. 11). For example, a video recording of a teacher would be made, then put online for students to watch whenever and wherever they preferred, independent of the other students in the class. In time, practitioners have begun to experiment with the model of combining existing teaching practices with distance learning concepts, leading to a variety of different use cases and types of online learning. For example, according to Wicks (2010), online learning has been "used successfully for a wide variety of purposes," including:

- expanding the range of courses available to students, especially in small, rural or inner-city schools, beyond what a single school can offer;
- providing highly qualified teachers in subjects where qualified teachers are unavailable;
- providing flexibility to students facing scheduling conflicts;
- affording opportunities for at-risk students, elite athletes and performers, dropouts, migrant youth, pregnant or incarcerated students, and students who are homebound due to illness or injury; allowing them to continue their studies outside the classroom;
- providing credit recovery programs for students that have failed courses and/or dropped out of school, allowing them to get back on track to graduate;
- helping students that are currently performing below grade-level to begin catching-up through blended learning (p. 10)

This list is not meant to be exhaustive of the possible use cases of online education. Rather, it is intended to demonstrate the heterogeneous manner in which online learning has been employed in K-12 schools.

Dimensions and Types of Online Learning Programs

Because of the scope and breadth of the ways in which online learning programs are utilized, it is necessary to develop ways of categorizing them. These dimensions allow me to describe the various types of learning programs. Each dimension consists of at least a few, and sometimes multiple categories.

The first dimension I refer to is comprehensiveness of online learning programs, which itself has two categories: supplemental and full-time. A supplemental online learning program is additional to a separate, full-time, traditional brick-and-mortar school program. A high school offering an online Advanced Placement (AP) course they would not otherwise be able to offer is an example of a supplemental program. Conversely, there are full-time online learning programs such as the Florida Virtual School, through which a student, if she so chooses, could complete her entire K-12 education fully online (Gemin et al., 2015, p. 15).

Next, geographic reach is another import dimension of online learning. Online learning programs can function within a single school district, across multiple school districts, in an entire state, nationally, or even internationally (Wicks, 2010, p. 13). As such, online learning programs can have a greater geographic range than traditional schools, such as when "a student in California may be learning from a teacher in Illinois who is employed by a program in Massachusetts" (Wicks, 2010, p. 13). This can lead to outdated polices and complicates the funding with respect to online learning programs, because each state has its own set of laws that dictate policies and funding.

Type of instruction is another dimension of online learning programs, and is a way of categorizing the source of instruction. Instruction could be delivered entirely online, entirely face-to-face, or some combination of the two. The type of instruction in the traditional classroom model is entirely face-to-face, in that the instruction is delivered to students by an instructor while they are in the same place. The online type of instruction is characterized by the instruction for a class being delivered via the Internet. For example, a series of online videos of a teacher giving lectures would be fully online instruction.

When instruction incorporates both online and face-to-face sources, it is known as blended learning. According to Christensen, Horn, and Staker (2013), there are four models that describe how blended learning can be used. First, there is the Rotation model, in which students rotate between several different learning modalities, at least one of which is online learning (Christensen et al., 2013, p. 26). For example, in the Rotation model, an Algebra 1 teacher could use full-class in-person instruction, small-group in-person instruction, worksheets, and online instruction such as the Khan Academy while teaching a topic. Next, there is the Flex model of blended learning, in which instruction for an individual student is primarily online, with some learning activity taking place offline (Christensen et al., 2013, p. 26). In the Flex model, students proceed through their coursework at their own pace, with support from an onsite instructor. For example, a student in a Flex model would watch lectures and complete assessments online, but seek assistance from a teacher for a portion of a lesson or a question on a quiz that the student does not understand. Third, there is the A La Carte model of blended learning, in which students take at least one class entirely online while simultaneously taking classes in a traditional school setting (Christensen et al., 2013, p. 26). So, a student in the A La Carte model could take an AP United States History course not offered at their school and still take other in-person courses along with other students following the traditional model. Finally, there is the Enriched Virtual model, where all students "divide their time between attending a brick-and-mortar campus and learning remotely using online delivery of content and instruction" (Christensen et al., 2013, p. 26). The Rotation and A La Carte models of blended learning are the models that are most easily implemented alongside the traditional classroom model and thus are more common among schools that implement at least one model of blended learning program. The Flex model is often used for credit-recovery coursework, and the Enriched Virtual model is often used by state virtual schools or full-time online programs, which I discuss shortly.

The last two relevant dimensions are location and grade level. Location is a dimension that determines where instruction takes place, either in school, at home, or in another place. For example, an online learning program could have no physical infrastructure, necessitating instruction taking place at a child's home. Grade level is another dimension of online learning programs. Grade level could be any grade level within either elementary, middle, or high school. Some online learning programs provide instruction for grades K-12, whereas others are intended strictly for high school.

These dimensions help define the most relevant kinds of online learning programs. Next, I highlight the three types of online learning programs that had the strongest rates of adoption in 2008, when Christensen et al. (2008) made their prediction.

First, there are state virtual schools. State virtual schools are schools "created by legislation or by a state-level agency, and/or administered by a state education agency, and/or funded by a state appropriation or grant for the purpose of providing online learning opportunities across the state" (International Association for K-12 Online Learning, 2011, p. 5). State virtual schools offer supplemental courses for traditional schools on a state-wide level and at all grade levels for the states in which they operate. The courses state virtual schools offer could be used for blended learning purposes using any of the previously discussed blended learning models.

Next, there are full-time online programs, which are sometimes called cyberschools. Full-time online programs have no physical instructional facilities, and teachers and students are usually geographically remote from one another (Gemin et al., 2015, p. 7). Full-time online programs are comprehensively full-time, and are "administered by, and serving, multiple districts, often organized in a formal consortium"

(International Association for K-12 Online Learning, 2011, p. 7). They are typically, but not always, charter schools (Watson, Murin, Vashaw, Gemin & Rapp, 2013, p. 21). The South Carolina Connections Academy (SCCA) is an example of a full-time online charter school. SCCA serves the entire state of South Carolina. The instruction for SCCA is provided by Connections Academy, a national subsidiary of Pearson Education, an instance of a formal consortium (Gemin et al., 2015, p. 39).

Finally, there are single-district online programs that are "created by a district primarily for students within that district" (Watson et al., 2013, p. 17). Single-district online programs can be fully online, but more often they supply supplemental online courses for students within a district. Most districts utilize content from a state virtual school or private providers (Watson et al., 2013, p. 17). Because students within a single-district online program necessarily live in close geographical proximity to one another, single-district online programs can, and increasingly do, implement some kind of blended learning program (Watson, Murin, Vashaw, Gemin & Rapp, 2011, p. 4). Although as of 2013 more than 75% of districts have some option for students to take an online or blended course, there are only a small minority of students actually enrolling in courses, typically for reasons such as credit recovery or dual credit (Watson et al., 2013, p. 17). Larger districts tend to have more comprehensive online and blended offerings for a larger portion of their students (Watson et al., 2013, p. 18). For example, the city of Nashville created the Metro Nashville Public School through which students can enroll in supplemental online core, elective, and AP courses (Watson et al., 2013, p. 18).

COSTS ASSOCIATED WITH ONLINE LEARNING

Because of the plethora of ways in which online learning is used and directions in which it is growing, determining costs associated with online learning is complex.

Different kinds of online learning programs have different costs associated with them. For example, full-time online programs must comply with administering state assessments, whereas supplemental programs do not. Full-time online instruction intuitively seems like it could be less expensive than face-to-face instruction due to cost savings from not having to maintain a physical school building. But this is not necessarily so, because potential savings could potentially be offset by a number of factors, including "the need for hardware, software, and connectivity for classes, ongoing technical support, comprehensive student support, course development or licensing, and other costs, especially during program start-up" (Wicks 2010, p. 14-15). The costs of an online program depend on "the quality of a program, quality of teaching, quality of content, as well as the context and instructional design," all of which have a high degree of variance from program to program (Patrick, Myers, Silverstein, Brown, & Watson, 2015, p. 28).

There are significant cost differences between levels of comprehensiveness found in online programs, full-time and supplemental. After adjusting for factors such as student-teacher ratios, student support services, administrative needs, and technology needs, a recent INACOL report estimated that "the cost of the full-time online school (that is resourced to bring all students to college- and career-ready success) is between 93% and 98% of a traditional school cost" (Patrick et al., 2015, p. 27). In short, according to Patrick et al. (2015), full-time online learning programs appear to be slightly less expensive than their traditional counterparts overall.

By contrast, supplemental courses are considerably less expensive. The cost of a single online course as part of a supplemental program is "roughly 7%" of the cost of a full-time online learning program, "assuming a student takes a full load of six courses per semester, with 12 courses annually" (Patrick et al., 2015, p. 28). Costs for supplemental programs are less expensive in part because there are reduced expenses for administrative overhead, which are covered by the "home" district of the student (Patrick et al., 2015, p. 28).

A cost-related benefit of online learning programs that is difficult to account for is that online programs make courses available to students who otherwise would not have access. Traditional schools cannot financially justify offering a course if there is not sufficient demand, such as a minimum enrollment of students, for it. Online learning unites unmet student demand for courses because geography is no longer a limitation for online courses. As a result, it can be cost-effective for an online learning program to offer supplemental course in, to cite a classic example, Mandarin Chinese, because it can accumulate enough students from across a large geographic range to make the course cost-effective (Wicks, 2010, p. 13).

GROWTH OF ONLINE LEARNING FROM 2007-2015

In 2010, Wicks commented that online learning was growing so quickly that "publications that include specific statistics and data are at risk of being out-of-date before they are published" (p. 13). At the advent of significant online learning activity, around 2004, online learning consisted of a few well-defined categories, as Watson and Murin (2014) explained, "there were state virtual schools and fully online charter schools, but there was essentially no blended learning and very little district-level activity" (p. 2). This relatively simple context has become more complex since then, as "nearly every aspect of the online and blended landscape has become more complex, more interconnected and more volatile" (Watson & Murin, 2014, p. 3). This context was facilitated in part by technological innovations that have been adopted for use in classrooms since 2008. Technological innovations such as smartphones, tablet computers, inexpensive "thin client" laptop computers, and cloud computing have created the conditions for profoundly altering the traditional classroom experience, enabling students to learn in ways that were previously not possible.

Overall growth in online learning activity

The definitive dataset available regarding national growth in enrollments in online learning programs is from two surveys conducted by Picciano and Seaman in 2006 and 2008, respectively. Both surveys collected data directly from hundreds of randomly selected public school districts. The first survey reported on the 2005-2006 academic year. In this survey, 57.9% of the school districts that responded had at least one student enrolled in an online course during the 2005-2006 school year; 32.4% of responding districts had at least one student enrolled in a blended course during the same time period (Picciano & Seaman, 2007, p. 7). Overall, 63.1% of reporting school districts had students taking either online or blended courses, and 20.7% stated they planned on introducing that option in the next three years. Based on these percentages, Picciano and Seaman (2007) estimated that "approximately 700,000 students (1.5%) of the entire population of 48,000,000 public school students were enrolled in online and blended learning courses" (Picciano & Seaman, 2007, p. 9).

In the follow-up survey they conducted in 2007, Picciano and Seaman (2009) found increases in enrollment numbers for both online and blended learning. For the 2007-2008 survey, Picciano and Seaman (2009) found that 69.8% of reporting school districts had at least one student enrolled in an online course, and 41% of districts reporting had at least one student enrolled in a blended course (p. 9). A total of 74.8% of school districts in the survey had at least one student enrolled in either an online or blended course and the remaining 15% were planning on introducing online or blended courses to their districts within the next three years (Picciano & Seaman, 2009, p. 9). This data made it clear that in 2007, "the vast majority of American school districts [were] providing some form of online learning for their students and more plan to do so within the next three years" (Picciano & Seaman, 2009, p. 9). Picciano and Seaman (2009) extrapolated the survey data they collected to calculate that "approximately 1,030,000 (2.1%) students for the entire population of 49,000,000 public school students were enrolled in online and blended learning courses in the 2007-2008 academic year," a 47% increase in just two years (p. 11). Altogether, the 2009 version of Picciano and Seaman's survey confirmed their original findings: enrollments in online and blended learning were growing and were showing no signs of slowing down (Picciano & Seaman, 2009, p. 26).

Unfortunately, Picciano and Seaman have yet to conduct a follow up survey, so other, less scientific measurements offer more current data. INACOL estimated that 1.5 million K-12 students were enrolled in online and blended courses during the 2009-2010 school year (Wicks, 2010, p. 14). The available data regarding overall growth in online learning is summarized in Table 1.

Table 1: Overall growth in online learning courses, 2005-2012

	2005-2006	**2007-2008**	**2009-2010**	**2011-2012**
Total students	48,000,000	49,000,000	49,361,000	49,522,000
Number of students enrolled in an online course	700,000	1,030,000	1,500,000	2,476,100
Percentage of total students enrolled in an online course	1.46%	2.10%	3.04%	5%

Data for 2005-2006 and 2007-2008 from Picciano & Seaman (2007) and Picciano & Seaman (2009). Data for 2009-2010 from Wicks (2010). Data for 2011-2012 from Watson et al. (2012).

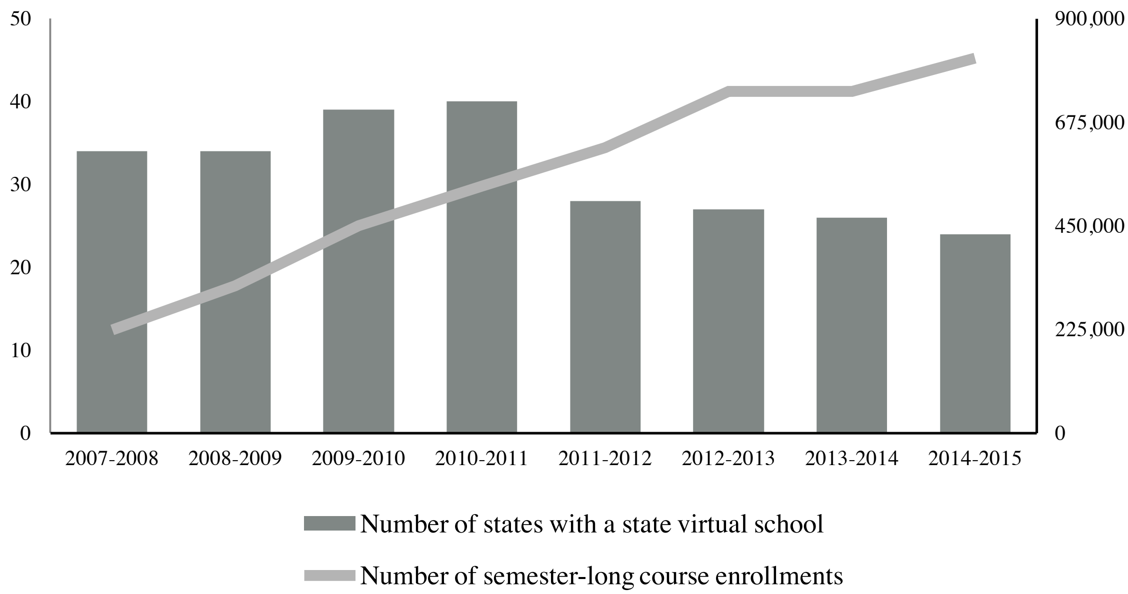
Beyond this INACOL report, the most useful information about the growth of online learning comes from the "Keeping Pace with K-12 Online Learning Reports." Since 2004, the "Keeping Pace" report has been published annually to document the latest trends, policies, and practices in the United States regarding digital learning. The "Keeping Pace" reports have three goals. First, the series of reports attempts to "add to the body of knowledge about online education policy and practice, and make recommendations for advances" ("About Keeping Pace," n.d.). Second, the series serves "as a reference source for information about programs and policies across the country, both for policymakers and practitioners who are new to online education, and for those who have extensive experience in the field" ("About Keeping Pace," n.d.). Finally, the series tries to capture new activity from the past year in the online learning scene ("About Keeping Pace," n.d.). So, the "Keeping Pace" reports are a good source of data from which to capture snapshots of the state of digital learning during the particular year in which it was published.

In the 2012 edition of the "Keeping Pace" reports, the authors wrote that "[t]he total number of students taking part in [online learning programs] is unknown, but is likely several million, or slightly more than 5% of the total K-12 student population across the United States" (Watson, Murin, Vashaw, Gemin & Rapp, 2012, p. 5). The National Center for Education Statistics data from the 2011-2012 school year indicates that there were 49,522,000 students enrolled in both public and private elementary and secondary schools (Snyder et al., 2016, p. 60). So, based on these two numbers, and in order to have a rough comparison between this and previously stated calculations, the 2012 "Keeping Pace" report estimated that 2,476,100 students were enrolled in at least one online or blended learning course. Notably, Watson et al. (2012) emphasized that their reported numbers were computed "by triangulating from close to a dozen sources" and moreover that "[n]o single source is comprehensive" (p. 5). This qualification is a reflection of the growing difficulty in tracking online and blended learning at this time. After 2012, these comprehensive estimates about online and blended learning were not available. In the 2013 "Keeping Pace" report, Watson et al. (2013) wrote that their 2012 estimate of 5% of the total K-12 student population continued to grow "steadily, although not explosively" (p. 17). The general trend of steady, but not explosive growth is reflected in the levels of growth for state virtual and full-time online schools.

Growth in state virtual schools

In 2007, state virtual schools were expanding rapidly, both in terms of the number of states who funded them and the number of students who were enrolled in courses offered by state virtual schools. From 2007 until 2015, the "Keeping Pace" reports tracked the number of states with state virtual school and estimated the number of students enrolled at those schools. This data is summarized in Figure 1. At their peak rate of growth in the 2009-2010 school year, state virtual schools were operating in 31 states and had 450,000 course enrollments (Watson, Murin, Vashaw, Gemin & Rapp, 2010, p. 21). Since then, although the total number of enrollments has grown, this growth is concentrated in the largest state virtual schools, such as Florida and North Carolina. On the whole, there are two reasons why state virtual schools became less relevant as time went on. First, in most states, individual districts, various consortia, and private course content providers are providing an increasing share of supplemental online courses (Watson et al., 2012, p. 29). Second, many virtual schools were underfunded or defunded (Watson et al., 2012, p. 29). Notably, one of the fastest growing services that state virtual schools provide is supporting blended learning programs that use the A La Carte and Enriched Virtual models (Gemin et al., 2015, p. 81). In 2015, there were 24 states with state virtual schools, enrolling 815,000 students. State virtual schools continue to supply some states with supplemental online course content and related services, but their impact is limited to the states in which state virtual schools operate (Gemin et al., 2015, p. 70).

Figure 1: Growth in state virtual schools, 2007-2015

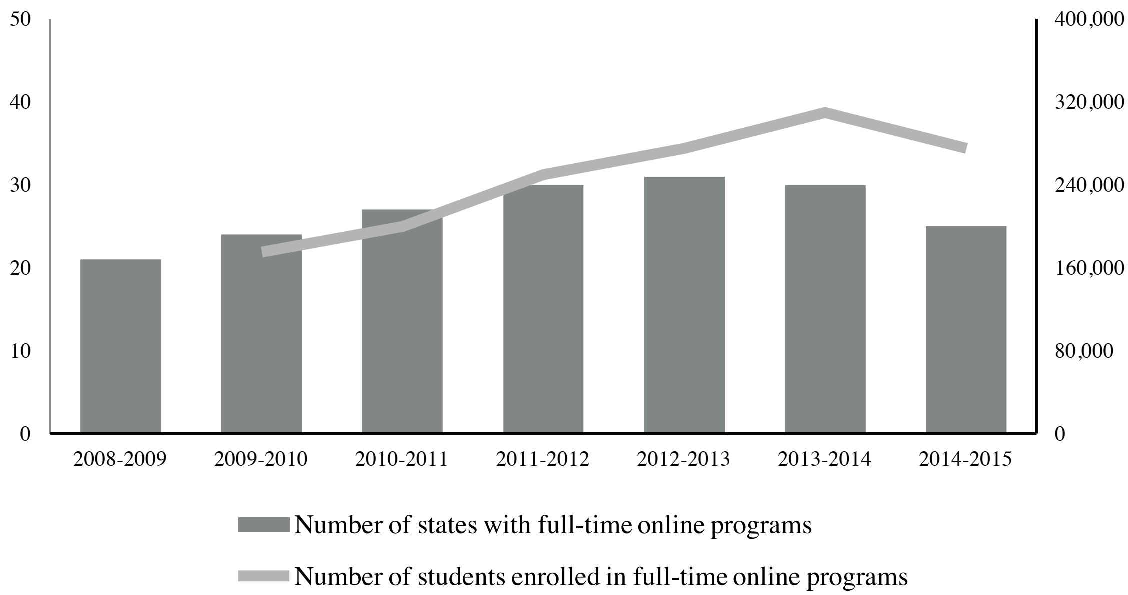


Data from "Keeping Pace" Reports, 2007-2015

Growth in full-time online learning programs

Full-time online programs share a similar arc of growth with state virtual schools. Total enrollment for full-time online courses has trended upwards, but growth has slowed in recent years. The number of states that allowed students to enroll in full-time online programs, along with estimated enrollment numbers as reported in the "Keeping Pace" reports from 2008 to 2015 is displayed in Figure 2. In the 2012 school year, 31 states allowed students to enroll in full-time online programs, but as shown in Figure 2, this number has fallen to 25 for the 2014-2015 school year (Gemin et al., 2015, p. 39; Watson et al., 2011, p. 6). This is due in part to some states restricting by law the "total number of schools, students, or out-of-district students who may be served" by full-time online programs (Watson & Murin, 2014, p. 9). Other reasons for the dwindling growth of full-time online learning are related to the belief that "face-to-face socialization is a key component of student maturation" and also because "many parents are unable to serve as a learning coach for their children in the home," which full-time online programs demand (Gemin et al., 2015, p. 40). According to Gemin et al. (2015), students are increasingly likely to select district-level online course offerings as such offerings have increased and diversified (p. 40).

Figure 2: Growth in full-time online programs, 2008-2015



Data from "Keeping Pace" Reports, 2008-2015

Overall, the data regarding growth in online learning indicates steady, but not exponential growth from 2007-2015. Before analyzing this growth further, I turn to the justification Christensen et al. (2008) presented for their prediction in *Disrupting Class*.

The Prediction and the Theory of Disruptive Innovation

Christensen et al. (2008) predicted that by 2019, "about 50 percent of high school courses will be delivered online" (p. 98). In *Disrupting Class*, Christensen et al. (2008) admit that such a shift would be "breathtaking" (p. 102). Other critics also recognized the audacity of the prediction. Glazer (2008) wrote that "[t]his is an astonishing projection, and one doesn't know what to make of it. Is it really possible?" (p. 79). Martone (2015) felt the prediction seemed "too lofty" (p. 144). Zucker (2008) reported that "[m]any experts, including experienced leaders of online schools and others who have studied them for years, find this claim unbelievable" (p. 3). Watson, Gemin, and Ryan (2008) characterized the prediction as "startling" (p. 44). Finally, Frost (2011) wrote that "[i]t's a prediction that evokes thoughtful, varied, and often passionate reactions, especially from those of us that work in education and education technology" (para. 2). When Christensen et al. (2008) made their prediction, just 4.8% of public high school students were enrolled in at least one online or blended course, yet in just over 10 years, Christensen et al. (2008) thought that half of all the courses high school students take would be delivered online. This drastic increase is in part why members of the education technology community had such a strong reaction to Christensen et al.'s (2008) prediction.

Later in the paper, I assess whether or not Christensen et al.'s (2008) prediction is coming to fruition. But first, I examine how Christensen et al. (2008) arrived at their controversial prediction. I begin by providing an overview of the theory of disruptive innovation. Then I explore how Christensen et al. (2008) applied the theory of disruptive innovation to education in the United States in *Disrupting Class*.

THE THEORY OF DISRUPTIVE INNOVATION

The theory of disruptive innovation is an attempt to account for the ways in which private sector markets react to innovations over time (Christensen et al., 2008, p. 45). According to the theory, any industry can be described by looking at what Christensen et al. (2008) call the plane of competition. The plane of competition is a measure of performance and time. Customers in a market decide whether or not to purchase a product based on whether or not that product meets their needs at that time. As time goes on, private sector firms tend to make improvements to their products based on what those firms perceive to be their customers' current and future needs. The rate at which firms improve their products is called the performance improvement trajectory. Customers are willing to pay more in exchange for higher performance.

Sustaining innovations

An improvement to a product that is made to appeal to existing customers' current or future needs is called a sustaining innovation because it sustains the existing performance improvement trajectory. Private sector firms that are in a market leading position are incentivized to make sustaining innovations to their products because sustaining innovations justify charging existing customers higher prices, leading to higher profits. But continuously adding features to a product has a hidden cost, namely an increasingly complicated and expensive product. So, as a result of private sector firms making the economically rational decision to seek profits, their products eventually become costly and complex, which influences the kinds of consumers who would like and are able to purchase them. To use expensive and complicated products, consumers must have both money and expertise. This set of circumstances creates an entry point for a different kind of innovation.

Disruptive innovations

A disruptive innovation is a kind of innovation that results in a new plane of competition and thus, a distinct performance improvement trajectory from the one being used in the previous plane of competition. In other words, it disrupts the previous plane of competition by creating a new measure of performance. A disruptive innovation has a few telling characteristics and consequences for an industry. First, products that are representative of a disruptive innovation are not as good as products that were brought to market as a result of the incentive structure in the previous plane of competition. Disruptively innovative products tend to be cheaper and simpler than products that have matured as a result of sustaining innovations. As a result, disruptively innovative products do not appeal to customers in the previous plane of competition, and therefore are ignored by private sector firms in the previous plane. In other words, disruptively innovative products do not seem to threaten the profits of the firms competing in the previous plane of competition. However, this also means that disruptively innovative products do appeal to a new set of customers who were "nonconsumers" of the previous product, who are willing to accept the tradeoff of fewer features for a lower price point. The concept of nonconsumers has a critical role to play in the framework of the theory of disruptive innovation.

Cramming

Private sector firms have struggled to simultaneously compete in more than one plane of competition because their motivations for making sustaining innovations, which have allowed them to obtain and maintain their current market position, are antithetical to the kinds of improvements they would need to make to their product in order to compete with the disruptively innovative product. Instead, private sector firms tend to mold innovative ideas to "fit the interests of the groups in the company that must support the proposal in order for it to receive funding" (Christensen et al., 2008, p. 75). So, potentially disruptive innovations are refashioned into sustaining innovations by the firms who are successful in the original plane of competition. In the parlance of disruptive innovation theory, this tendency is known as cramming. As a result of the tendency of successful firms to cram potentially disruptive innovations, disruptive innovations almost always come from new entrants to a market.

Eventually, the private sector firms that brought the disruptively innovative product to market improves the product through a series of sustaining innovations. Those firms continue to sustainably improve their product until users are able to substitute the new, disruptive product for the old product for the same task without sacrificing any significant functionality. This new product overtakes the products competing in the previous plane of competition because they are able to perform the same tasks for a lower cost.

To summarize, the essential characteristics of a disruptive innovation are:

- it creates a new measure of performance and thus a new plane of competition
- it appeals to nonconsumers of the previous plane of competition
- it tends to result in products that are relatively simpler and cheaper

Next, I discuss the rationale for using the theory of disruptive innovation as a tool for analysis.

The purpose of the theory

The theory of disruptive innovation is intended to serve two purposes. As Lepore (2014) explained in her essay criticizing the theory of disruptive innovation, the theory is "meant to serve both as a chronicle of the past (this has happened) and as a model for the future (it will keep happening)" (para. 13). In other words, the theory was conceived with the expectation that it could be used to understand past trends in a given marketplace and to provide a framework with which to forecast future trends. This comports with the ways in which Christensen et al. (2008) used the theory of disruptive innovation in *Disrupting Class*. In the acknowledgements of *Disrupting Class*, Christensen himself wrote that "…disruption—a powerful body of theory that describes how people interact and react, how behavior is shaped, how organizational cultures form and influence decisions—can usefully frame why our schools have struggled to improve and how to solve these problems" (Christensen et al., 2008, p. v). So, I use these two purposes of the theory of disruptive innovation to explain why Christensen et al. (2008) made their ambitious prediction.

DISRUPTIVE INNOVATION AND THE HISTORY OF EDUCATION REFORM IN THE UNITED STATES

In *Disrupting Class*, Christensen et al. (2008) used the theory of disruptive innovation to account for the ways in which the public school system has changed over time. It seems dubious that the theory of disruptive innovation would translate to the public sector, since it seems to depend on private sector mechanisms such as profit seeking. However, Christensen et al. (2008) argued that their model still applied to the public sector, with one simple adjustment. Rather than the plane of competition consisting of a measure of performance and time as in the private sector, the plane of competition for the public sector consists of the political or societal importance of a program and time (Christensen et al., 2008, p. 51). So, for the public sector, the performance improvement metric could actually be called the political importance metric. And, akin to the behavior of firms in private sector, public agencies make "sustaining innovations" in the form of policy decisions that conform to the current political importance metric until society disrupts the public agency by changing what they deem to be politically important, at which point a new political importance metric is created in a new plane of competition.

Sources of disruption in the private sector

One outstanding difference between the public and private sectors as it relates to disruptive innovation is the source of disruption. In the private sector, an innovation becomes disruptive when it is brought to market in a new product that appeals to consumers who were interested in the features of an existing product, but found the existing product too complicated, expensive or both. As a reminder, these kinds of consumers are called nonconsumers. Generally, new entrants to a market disruptively deploy products to nonconsumers. In the public sector, according to Christensen et al. (2008), society is the source of disruption by "mov[ing] the goal posts on schools and impos[ing] upon them new measures of performance" (p. 51). Furthermore, public education is set up as a virtual monopoly in the United States, so it is impossible for new organizations with different business models to disrupt school districts. As a result, school districts have had to "negotiate… disruptive redefinition of performance entirely within their existing schools" (Christensen et al., 2008, p. 61). This is particularly remarkable given that in all the research Christensen et al. (2008) had conducted, they "are not aware of a single instance in which a for-profit company was able to implement successfully the disruptive innovation within its core business…" (p. 61). So, by redefining the performance improvement metric as the political importance metric, Christensen et al. (2008) believed that the theory of disruptive innovation could apply to the public sector in general, and the public school system specifically.

Capacity for schools to change

Christensen et al. (2008) contended that there have been four disruptive shifts of the political importance metric for public education since the United States was founded in 1776. According to Christensen et al. (2008), these four shifts accounted for the major landmarks in the history of education reform in the United States. These shifts also demonstrate the capability of the school system to make itself over in response to disruptive changes in the political importance metric.

When the United States was founded, most children did not attend school. In the language of the theory of disruptive innovation, there was a great deal of nonconsumption of education in the late 18th and early to mid-19th century. The first shift of the political importance metric dealt with preserving the newly founded democracy and inculcating democratic values (Christensen et al., 2008, p. 52). Important political figures in this time period, such as Thomas Jefferson and Noah Webster, believed schools had a role to play in preserving the newly founded democracy. To do this job, a formal school system was established over time and elementary education swiftly expanded. Most schools were one-room schoolhouses, and only a small subset of students continued to be educated beyond grade school (Christensen et al., 2008, p. 53).

Then, in the 1890s and early 1900s, Christensen et al. (2008) wrote that "competition with a fast-rising industrial Germany constituted a minicrisis…" (p. 53). In response to this "minicrisis," Americans shifted the political importance metric from preparing students to lead and participate in democracy to providing more students with an education to prepare them to enter the workforce by increasing the breadth and depth of offerings. This movement qualifies as a disruptive shift in Christensen et al.'s (2008) framework. School systems began to respond to this disruptive shift by enacting policies that extended high school to more students. At that time, school attendance was not compulsory, so there was a great deal of nonconsumption of education, especially in high school. At the beginning of the 20th century, “only a third of children who enrolled in grade 1 made it to high school” and of those students, “roughly a third of those graduated” (Christensen et al., 2008, p. 54). But by 1930, over 75% of students entered high school, and about 45 percent graduated (Christensen et al., 2008, p. 54). At first, high schools offered a relatively narrow curriculum, including subjects like Latin or Greek, because those were the courses the students who were still attending high school would have needed to prepare for college. But, as the number of students attending high school increased, and the role of high schools changed, high schools made the sustaining innovation to offer music, art, physical education, and vocational classes, such as shop work.

There were two significant shocks to the education system as time went on, but both resulted in sustaining innovations, because the political importance metric remained in place. First, *Brown v. Board of Education* ordered the desegregation of schools. This expanded the definition of what “everyone” meant in the existing formulation of the political importance metric (providing more students with an education to prepare them to enter the workforce by increasing the breadth and depth of offerings). The second shock to the education system was the launch of the Soviet satellite Sputnik in 1958. Christensen et al. (2008) argued that the public’s response to this shock was a demand for “more rigorous science and math courses,” and schools responded by offering more courses and lab equipment over the next decade (Christensen et al., 2008, p. 56). In other words, the school system continued to make sustaining innovations along the existing political importance metric of expanding the breadth and depth of offerings to students.

Sustaining innovations that expanded the breadth and depth of offerings continued until around 1970, when Americans began to think that their school system was being outperformed by school systems in other countries because of the results of nationally administered standardized tests (Christensen et al., 2008, p. 58). The American people's angst about this situation was exacerbated in the mid-1970s when the College Board revealed that average SAT scores had been declining since 1963 (Christensen et al., 2008, p. 58). Consequently, the political importance metric shifted again to improvement in average test scores. As evidence of this shift in the political importance metric, Christensen et al. (2008) cited the "A Nation at Risk" report, issued in 1983. According to Christensen et al. (2008), the report "did take note of schools' unparalleled breadth of courses, services, and access, but [the repot] was less sure this was a good thing" (p. 59). The "A Nation at Risk" report wrote that "[s]econdary school curricula have been homogenized, diluted, and diffused to the point that they no longer have a central purpose. In effect, we have a cafeteria style curriculum in which the appetizers and desserts can easily be mistaken for the main courses" (National Commission on Excellence in Education, 1983, para. 2). As evidence of the shortcomings of the current curriculum, "A Nation at Risk" gave "several accounts of U.S. students' subpar performance on output measures, such as test scores" (Christensen et al., 2008, p. 59). At the state level, laws were passed to put the new political importance metric into practice and as a result, "[m]ore standardized tests were implemented, and students, teachers, and schools were held accountable for test-score performance" (Christensen et al., 2008, p. 60). Again, the school system produced remarkable results. National Assessment of Education Progress scores in math and reading have trended positively since the early 1980s (Christensen et al., 2008, p. 60).

According to Christensen et al. (2008), as a consequence of passing the No Child Left Behind Act in 2001, the federal government assured that standardized tests would continue to be "the primary metric for performance improvement" in schools (p. 62).

However, the No Child Left Behind Act arguably shifted the political importance metric because the law mandated that "public schools must see to it that *every* child in *every* demographic improves his or her test scores," as opposed to the previous political importance metric, average standardized test scores. Christensen et al. (2008) contended that this is a disruptive shift because the motivation behind requiring every student to be proficient in core subjects is "to eliminate poverty" (Christensen et al., 2008, p. 62-63).

In presenting this overview of the history of public education in the United States from the perspective of disruptive innovation, Christensen et al. (2008) sought to provide evidence that "in the face of enormous hurdles and despite changing demands on schools, teachers and administrators have constantly improved public schools in the United States and navigated the disruptions imposed upon them" (p. 65). In other words, schools have consistently shown the capacity to adapt to disruptive changes in the political importance metric. For Christensen et al. (2008), this is proof that the theory of disruptive innovation can be applied to public education.

DISRUPTIVE INNOVATION AND THE PRESENT AND FUTURE OF EDUCATION PRACTICE

Christensen et al. (2008) believed that the theory of disruptive innovation does not just explain the past. The theory can also provide a model to help plan for the future. In this section of the paper, I expound on Christensen et al.'s (2008) assessment of the present education system in the United States. Then I consider what the theory of disruptive innovation suggests to resolve the problems Christensen et al. (2008) identified in their analysis.

Why schools have struggled to improve

Christensen et al. (2008) had lofty but laudable expectations for schools, as summarized at the outset of *Disrupting Class*:

> 1. Maximize human potential.
>
> 2. Facilitate a vibrant, participative democracy in which we have an informed electorate that is capable of not being 'spun' by self-interested leaders.
>
> 3. Hone the skills, capabilities, and attitudes that will help our economy remain prosperous and economically competitive.
>
> 4. Nurture the understanding that people can see things differently—and that those differences merit respect rather than persecution. (p. 1)

But, Christensen et al. (2008) asserted that "[w]e're not doing very well in the journey toward these aspirations" and that "most of us wish schools were playing a much more effective role in our efforts to move society toward goals like these" (p. 1). In other words, Christensen et al. (2008) believed that schools were struggling to improve themselves. As opposed to the commonly held explanations of why schools have struggled to improve, such as "too little money, too few computers, uninterested or unprepared students (and parents), a broken teaching paradigm, and strong unions," Christensen et al. (2008) believed there was a more fundamental, root cause: the way schools motivated students (p. 5, 7). If students are not properly motivated, they "reject the rigor of any learning task and abandon it before achieving success" (Christensen et al., 2008 p. 7). Christensen et al. (2008) thought that education "can and should be an intrinsically motivating experience," wherein "the work itself stimulates and compels and individual to stay with the task" (p. 9, 7). The best way to intrinsically motivate students in Christensen et al.'s (2008) view was to customize the educational experience for each student so that the instruction each student receives best matches the way that student learns.

Interdependencies and standardization in schools

According to Christensen et al. (2008), the school system was averse to customizing education on a student-by-student basis because of the interdependent architecture of the structures that comprise the system. Christensen et al. (2008) identified four types of interdependencies in the school system (Christensen et al., 2008, p. 33): temporal, lateral, physical, and hierarchical. Temporal interdependency means there is a defined order in which subjects are taught across the U.S. public school system (Christensen et al., 2008, p. 33). Next, there is lateral interdependency, by which Christensen et al. (2008) mean the way one topic is taught affects the way other topics are taught. For example, Christensen et al. (2008) pointed out that there are "more efficient" ways of teaching foreign languages, but they are not taught that way because "you'd have to change the way English grammar is taught; and changing the way grammar is taught would mandate changes elsewhere in the English curriculum" (p. 33). Then, there is physical interdependency, in the layout of school buildings encourages a teacher-based instruction and makes other kinds of teaching, such as project-based learning, difficult to implement at scale. Finally, there are hierarchical interdependencies. By this, Christensen et al. (2008) were referring to the federal, state, and local government laws that turn into policies at the state and district levels. As an example, Christensen et al. (2008) pointed out that "[c]urriculum and textbook decisions made at school district headquarters…circumscribe the ability of teachers to innovate…" (p. 33). These interdependencies constituted a school system that has been designed to facilitate standardization, from "the way it trains teachers, the way it groups students, the way the curriculum is designed, and the way the school buildings are laid out" (Christensen et al., 2008, p. 37). As a result of these interdependencies, the school system hindered the student-based customizations Christensen et al. (2008) contended were necessary to intrinsically motivate students. If schools could find a way to intrinsically motivate students at scale, the system would eventually be able to realize the goals Christensen et al. (2008) outlined at the beginning of *Disrupting Class*.

Student-centered learning

In order to intrinsically motivate students, Christensen et al. (2008) contended that "we must find a way to move toward…a 'student-centric' model" of education (p. 38). For Christensen et al. (2008), student-centric learning meant that students would learn "in ways that match their intelligence types in the places and at the paces they prefer by combing content in customized sequences" (Christensen et al., 2008 p. 38-39). Student-centric learning is any kind of student learning that can be customized relative to the needs of that student. A tutor personalizing instruction to meet the learning needs of an individual student is an example of a student-centric learning model. However, student-centered learning is more commonly thought of as "a computer with software…which can tailor itself to a student's specific type of intelligence or learning style" (Christensen et al., 2008, p. 11). If learning were to be customized on a per-student basis, a student's learning would no longer be constrained by temporal, lateral, physical interdependencies, and implementing a student-centric model across the school system would entail a disruption of the remaining interdependency (hierarchical).

To expand student-centric learning across the entire education system, Christensen et al. (2008) looked to technology, specifically in the form of computer-based learning. Computer-based learning is an intermediary step between the existing monolithic teaching style and the student-centric model for which Christensen et al. (2008) were advocating. Christensen et al. (2008) believed that computer-based learning was "emerging as a disruptive force and a promising opportunity" and that "[t]he proper use of technology as a platform for learning offers a chance to…customize learning" (Christensen et al., 2008, p. 38). If the school system was ever going to migrate to a system in which student-centric learning is commonplace, Christensen et al. (2008) believed that the school system must first integrate computer-based learning, and the school system must do it in a way in keeping with the principles of theory of disruptive innovation. Restated, the school system must disruptively deploy computer-based learning by exploiting opportunities created by areas of nonconsumption in education. By explaining Christensen et al.'s (2008) conception of computer-based learning and how it ought to be implemented in public schools, I show why Christensen et al. (2008) were so optimistic about the adoption of online courses, and accordingly why Christensen et al. (2008) made their prediction.

COMPUTER-BASED LEARNING AND DISRUPTING K-12 EDUCATION

To discuss the role of computer-based learning in the disruption process as it applies to K-12 public education, I first provide a definition of what exactly computer-based learning is. Then I explain why computer-based learning has not yet resulted in widespread disruption. Finally, I explain how computer-based learning, if properly managed, could eventually trigger the student-centered learning disruption for which Christensen et al. (2008) have been advocating.

Defining computer-based learning

Christensen et al. (2008) did not give an explicit definition of computer-based learning, so I must infer one. Christensen et al. (2008) described computer-based learning as "proprietary and relatively expensive to develop" and also wrote, "it will be monolithic, with respect to students' types of intelligence and learning styles" (p. 91). Based on examples Christensen et al. (2008) used in the context of writing about computer-based learning, he seems to be talking about online learning, which is a sub-type of computer-based learning in which instruction for a course is delivered primarily online, as I previously defined it.

Why computer-based learning has yet to disrupt education

By this definition of computer-based learning, schools had access to computer-based learning since the 1980s onward. Beginning in the 1980s, the school system invested "$60 billion in equipping classrooms with computers" (Christensen et al., 2008, p. 81). Yet, classrooms look largely the same as they did before the invention of the personal computer and there is no evidence that computers have improved learning outcomes (Christensen et al., 2008, p. 72, 3). Computers have had "little effect on how teachers teach and students learn" and "haven't brought schools any closer to realizing the promising path of building students' intrinsic motivation through student-centric learning" (Christensen et al., 2008, p. 72-73). Since schools have had access to computer-based learning for so long without any measurable improvements in learning outcomes, it is somewhat remarkable that Christensen et al. (2008) believed that computer-based learning was at all a part of the disruption process. However, the theory of disruptive innovation provides an explanation for the lack of results, namely the tendency of organizations to cram potentially disruptive technologies into existing practices. In Christensen et al.'s (2008) view, schools have "crammed [computers] to sustain and marginally improve the way they already teach" (p. 73). To fulfill their promise, potentially disruptive technologies "must be applied in applications where the alternative is nothing" (Christensen et al., 2008, p. 74). In other words, potentially disruptive technologies must first be deployed to nonconsumers to realize their disruptive capacity. Christensen et al. (2008) go so far as to say that how a product is framed is "far more important for the successful implementation of the technology than is the technology itself" (p. 74). Christensen et al. (2008) reported that schools "use[d] computers as a tool and a topic, not as a primary instructional mechanism that helps students learn in ways that are customized to their type of intelligence" (p. 81). Until relatively recently, despite the possible affordances of computer-based learning, teachers were the primary means by which instruction is delivered, and when computer-based learning was used, it was to "supplement and reinforce the existing teaching model" (Christensen et al., 2008, p. 82). Computer-based learning has largely not been used by schools in a way that would allow for each student to learn in the way that would be best suited for them. Thus, according to Christensen et al. (2008)'s argument, teaching practices and student outcomes have remained static.

Nonconsumption in education

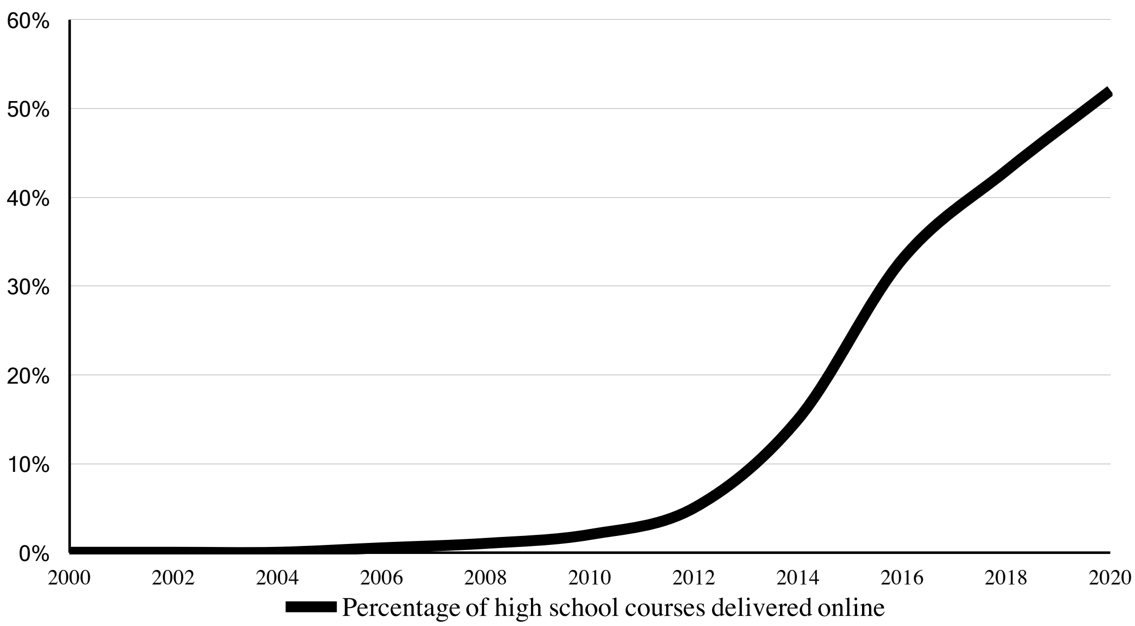
In 2008, when *Disrupting Class* was published, not every school was cramming computer-based learning. In fact, Christensen et al. (2008) wrote that "if you know where to look—competing against nonconsumption—computer-based learning is methodically gaining ground as students, educators, and families find it to be better than the alternative—having nothing at all" (p. 90). This seems somewhat nonsensical because, due to compulsory education laws that have been in effect for over a century, there was a trivial level of nonconsumption of education in the United States. But Christensen et al. (2008) envisaged several instances of nonconsumption from which disruption could take hold:

> Advanced Placement…and other specialized courses; small, rural, and urban schools that are unable to offer breadth; 'credit recovery' for students who must retake courses in order to graduate; home-schooled students and those who can't keep up with the schedule of regular school; students needing special tutoring, and prekindergarteners. (p. 91)

All of these examples were cases in which some students were being underserved by the existing system. For instance, if a student would have liked to have taken an AP Calculus course, but her school did not have a certified AP instructor, the student would have had to wait until college. Deploying against nonconsumption means offering students like the one in the example opportunities for learning that the student would not otherwise have had. If school administrators would "change course" and take actions like "implement[ing] computer-based learning in places and for courses where there are no teachers to teach," then administrators would be avoiding the cramming problem and at the same time disrupting current teaching practices (Christensen et al., 2008, p. 73). Schools, in Christensen et al.'s (2008) estimation, ought to treat instances of nonconsumption as "opportunities to implement a long-range plan to shift the instructional job to student-centric technology step by step and course by course" (p. 103).

One reason Christensen et al. (2008) were so confident in their prediction is the conclusions drawn from previous research on disruption. According to Christensen et al. (2008), disruptions have always followed the same path, from competing against nonconsumption in a new plane of competition until the disruptive technology becomes good enough to appeal to consumers of the products still competing in the original plane of competition, at which point the old customers begin switching from the old product to the new one. This evolution is a process, and not a singular event; instead it occurs gradually. According to Christensen et al. (2008), this evolution would happen at a predictable rate, in the shape of an S-curve: "the initial pace is slow; then it steepens dramatically; and finally, it asymptotically approaches 100 percent of the market" (p. 96). Moreover, Christensen et al. (2008) argued that, based on previous examples of disruption, there was a formula (called a "substitution curve") for predicting when a disruption is occurring based on the ratio of new "market shares" of a product divided by the old (p. 97). In *Disrupting Class*, Christensen et al. (2008) asserted that from the available data, "about 50 percent of high school courses will be delivered online" (p. 98). Christensen et al.'s (2008) projected rate of growth for the percentage of classes that will be delivered online can be seen in Figure 3. From this projected rate of growth, Christensen et al. (2008) extrapolated that “within a few years, after a long period of incubation, the world is likely to begin flipping rapidly to student-centric online technology” (p. 98). Christensen et al. (2008) believed this would happen “because of the technological and economic advantages of computer-based learning, compared to the monolithic school model” (p. 99).

Figure 3: Projected growth of high school courses delivered online, 2000-2020



Reprinted from *Disrupting Class*, by C. M. Christensen, M. B. Horn, & C. W. Johnson 2008, p. 99. Copyright 2008 by Clayton M. Christensen.

What the disruption process would look like

Christensen et al. (2008) cited four factors that would drive the rate of substitution from traditional instruction to monolithic instruction. If the disruption process was taking hold in the school system, Christensen et al. (2008) expected that these indicators would be present. First, computer-based learning would “become more enjoyable and take full advantage of the online medium by layering in enhanced video, audio, and interactive elements" (Christensen et al., 2008, p. 100). Second, it would be clear that disruption was occurring if there was evidence that it was easier for students, teachers, and parents to "select a learning pathway through each body of material that fits each of the types of learners," or in other words, to individualize learning (Christensen et al., 2008, p. 100). Third, Christensen et al. (2008) anticipated that an emerging teacher shortage would necessitate some kind of adaptation to the current model of education, so school districts would need to come up with some kind of solution to address this problem (p. 100-101). Christensen et al. (2008) seemed to think that school districts would be inclined to use computer-based learning as a hedge against teacher shortages. The fourth and final factor that would drive substitution of computer-based learning for monolithic learning would be the cost savings that would be realized as the market for computer-based learning grew. Although producing and improving computer-based learning technologies would be expensive initially, as the software improved teachers would be able to supervise more students, becoming more like "one-on-one tutors rather than teaching monolithically" (p. 101). Since, as time went on, teachers would be able to oversee more students at time, Christensen et al. (2008) thought that "the cost per student per course over the next 10 years is likely to decline by 15 percent for each doubling of volume, so that the cost will be one-third of today's costs, and the courses will be much better" because of the aforementioned improvements in software (p. 101).

Altogether, Christensen et al. (2008) believed the conditions in education in 2008 were suitable for a disruption and that the substation from teacher-led to computer-based instruction would proceed at a trajectory consistent with an S-curve, as long as this substitution is managed in keeping with the principles stemming from the theory of disruptive innovation (p. 102), namely seizing on opportunities of nonconsumption. Thus, based on the theory of disruptive innovation and analysis of the available data regarding online growth in 2008, Christensen et al. (2008) made their prediction.

Next, using information from the first section, I assess the progress that has been made towards Christensen et al.'s (2008) prediction that 50% of all classes would be delivered online in 2019.

Assessing the Prediction

In this section, I explain whether or not the ways in which education has grown since Christensen et al. (2008) made their prediction comports with what Christensen et al. (2008) expected. To do so, I first describe the ways in which online learning would have had to grow if Christensen et al.'s (2008) prediction was going to be met. Then I give an account of how online learning actually grew from 2007-2015, looking for evidence of elements of the theory of disruptive innovation, such as nonconsumptive deployment of online learning at scale and a shift in the performance improvement metric. Finally, I give my appraisal of Christensen et al.'s (2008) prediction by contrasting Christensen et al.'s (2008) conjectures and what in fact transpired in the growth of online learning.

EXPECTATIONS FOR GROWTH OF ONLINE LEARNING

Christensen et al.'s (2008) bullish outlook for the rate of adoption for online courses was rooted in their belief in the power of properly deployed disruptive innovation. In *Disrupting Class*, Christensen et al. (2008) gave a blueprint for what "proper deployment" looked like in education, namely that computer-based learning ought to be leveraged in cases where the alternative to using a computer-based learning solution is nothing. Restated using Christensen et al.'s (2008) terminology, there should be evidence of computer-based learning in place of nonconsumption. In addition to evidence of nonconsumption, Christensen et al. (2008) gave two other essential characteristics of a disruptive innovation, namely the creation of a new measure of performance and the tendency for disruptive innovations to be simpler and cheaper. I do not address the latter of these characteristics, because characterizing the nature of the growth of online learning is completely subjective and because it is too difficult to determine whether or not the ways in which online learning grew are in fact less expensive that traditional models of instruction.

If Christensen et al.'s (2008) prediction was coming true, there should be evidence that computer-based learning was being used as a substitute for nonconsumption on an increasing basis, followed by a period of rapid expansion in the number of consumers of online instruction. Because of the way the data is reported, it is not possible to precisely know the percentage of courses in which instruction is delivered via the Internet. However, increases in access and enrollment of both major kinds of online learning programs would be indicative of the growth of overall online learning patterns. So, I would expect an increasing number of states to have some form of state virtual school and an increase in the number of students enrolled in full-time online courses. Christensen et al.'s (2008) argument would be substantiated if students were enrolling in online courses in cases where taking a traditional, in-person course was not possible. The level of substitution could be measured by the rate of growth in supplemental online courses. Also, since a shift in the political importance metric is so critical to the theory of disruptive innovation, I would expect that to be apparent, either by mandate in the form of a common federal, state, or district-level policy regarding online learning, or by substantial funding of online learning programs at the federal, state, or district level.

How online learning grew from 2007-2015

State virtual schools and full-time online programs were growing steadily in 2007, and an increasing number of students were enrolling in online courses. However, a new form of online learning began to show signs of growth at the district level: blended learning. The 2007 "Keeping Pace" report was the first "Keeping Pace" report to mention blended learning. The report noted that "[t]he distinction between online and face-to-face [instruction] is blurring" (Watson & Ryan, 2007, p. 26). In 2009, the "Keeping Pace" report noted that despite limited available data, the number of district-level programs that "combine supplemental online courses and blended (online and face-to-face) learning opportunities" was growing (Watson et al., 2009, p. 7). The growth of single-district blended learning programs reached a tipping point in 2011: "[w]hen we look back on 2011 from some future year, it may be clear in retrospect that 2011 was the year that online and blended learning went digital, transcending their distance-learning or computer-based instruction origins and taking root in classrooms and schools across the country" (Watson et al., 2011, p. 6). In 2012, the "Keeping Pace" report began to provide estimates about single-district options of online and blended learning, albeit in somewhat nebulous terms: "perhaps two-thirds of districts are offering some online or blended program" (Watson et al., 2012, p. 5). The 2012 "Keeping Pace" report also added "blended learning" to its title, reflecting the growing importance of blended learning to the overall landscape. The 2013 "Keeping Pace" report indicated that "an increasing number of districts are making online and blended options available to their students, and that in SY 2013-14 we believe that more than 75% of districts have some online or blended options" (Watson et al., 2013, p. 17). In the 2013 edition of the "Keeping Pace" report, Watson et al. (2013) also noted that even though most school districts were offering online or blended options, only a small percentage of students were actually enrolled in online or blended courses. The students who were enrolled were doing so to take recovering credit courses or to take AP or dual credit courses, in keeping with the A La Carte and Flex models of blended learning, respectively (Watson et al., 2013, p. 17).

In 2014, the "Keeping Pace" report changed its title again, from "Keeping Pace with K–12 Online and Blended Learning" to "Keeping Pace with K–12 Digital Learning"

(Watson et al., 2014, p. 1). Watson et al. (2014) made this change for two reasons. First, the authors of the report concluded that “an ever-increasing amount of online learning activity developed inside individual schools and districts, as an ever-increasing number of students were taking online courses from within their own districts instead of from state virtual schools and virtual charter schools” (p. 4). This kind of online learning activity is representative of the A La Carte model of blended learning. Second, an increasing number of districts were using digital content in innovative and novels ways, by combining “an online or digital content component with regular face-to-face classroom instruction” (Watson et al., 2014, p. 4). In other words, the Rotation and Flex models of blended learning were being used in traditional classrooms more and more as time went on. According to the 2014 “Keeping Pace” report, most schools were using some form of digital learning, which means that by 2014, most instruction could be categorized as “blended” (Watson et al., 2014, p. 5). As a result, the “Keeping Pace” report elected to shift its focus to “identify and track student usage [of digital learning resources] across the entirety of K–12 education” (Watson et al., 2014, p. 5). Changing the focus of “Keeping Pace” was representative of a “significant evolution in the landscape,” namely the rise of blended learning (Watson et al., 2014, p. 4). The most recent “Keeping Pace” report, issued in 2015, substantiated the locus of growth in online learning from state virtual schools and full-time online learning programs to single-district blended programs:

> …the center of activity and growth has moved from state-level organizations, such as state virtual schools and online charter schools drawing students across entire states, to individual districts and schools. It has also moved from being mostly online to frequently combining online and onsite components. Most students accessing online courses or content are doing so from a physical school or some other formal learning center, not from home. The number of courses using online content in which the teacher of record is based at the physical school

> dwarfs the number of courses in which the teacher is online. (Gemin et al., 2015, p. 9-10)

Thus, from 2007 to 2015, the story of growth in online learning programs is tantamount to the story of growth in single-district blended learning programs employing the Rotation, Flex, or A La Carte models. The prevalence of blended learning is problematic for documentation and data collection purposes, because “if one defines blended learning as any combination of digital learning and face-to-face instruction, then blended learning implementations have infinite permutations, making it extremely difficult to identify and study these activities…” (Watson et al., 2014, p. 4). So, I cannot give an exact percentage of the number of courses that are blended relative to the overall number of courses taken in the United States. However, given the information found in the “Keeping Pace” reports, I conclude with certainty that blended learning is ubiquitous across the United States public school system.

Evidence of nonconsumption and online learning

From 2007 to 2015, there is some evidence that online learning continued to be used in cases of potential nonconsumption. As Christensen et al. (2008) wrote, computer-based learning was already “gaining market share” in areas such as taking AP or other courses not offered at a student’s own school. Online learning was still being used for these purposes in 2015. The 2015 “Keeping Pace” report found that “47% of students in grades 9–12 pursue online learning to access courses not offered at the school” (Gemin et al., 2015, p. 24). In the same report, Gemin et al. (2015) analyzed several million course enrollments of online course providers to break down online course enrollment by subject area. The category “Electives and other” was the third most common area of online enrollment, falling in the middle of core subject areas such as language arts, math, and science, which supports “the anecdotal evidence that schools will often select elective online courses for students that the school does not offer" (Gemin et al., 2015, p. 16). Smaller school districts continue to supplement their course catalogs with online courses: "[i]n small districts with good Internet access, online courses are often an important method by which the district augments the smaller number of courses offered by the district's own schools" (Gemin et al., 2015, p. 30).

Evidence of a shift in the performance improvement metric

Christensen et al. (2008) cited four major shifts in the political importance metric in the history of public education in the United States, and argued that shifts in the political importance metric are a crucial component in the creation of a new plane of competition, which creates the market conditions for disruptive innovation to gain market share. In the previous cases Christensen et al. (2008) cited in their discussion about the political importance metric, there were consistently instances of federal, state, and local governments responding to changes in the political will by passing laws or providing funding to address those changes. I do not believe there is evidence of a shift in the political importance metric with respect to online learning. Initially, public policy had a great deal to do with the growth of online learning. Gemin et al. (2015) wrote that in the early 1990s and through 2010, "State legislatures, governors, and boards of education passed laws, enacted budgets, and created rules that supported online schools operating across entire states, funded state virtual schools, and in other ways provided for increased opportunities for students via support of online schools and courses (p. 104). However, these policies were not put in place in every state, and there are still "significant gaps in access to online courses" (Gemin et al., 2015, p. 104). In 2017, the United States Department of Education issued an update to its National Educational Technology Plan (NETP), which "sets a national vision and plan for learning enabled by technology through building on the work of leading education researchers; district, school, and higher education leaders; classroom teachers; developers; entrepreneurs; and nonprofit organizations" (p. 3). In other words, the NETP is a good indicator of where the political importance metric stands. The NETP found that although "significant progress" has been made in terms of closing the digital divide among students who had access to the Internet and those who did not, there are still schools that are lagging (U.S. Department of Education, 2017, p. 7). Furthermore, a digital *use* divide remains "between learners who are using technology in active, creative ways to support their learning and those who predominantly use technology for passive content consumption" (U.S. Department of Education, 2017, p. 7). So, according to the NETP, there is a consensus that technology should be used to support learning, but there are still issues related to access to these resources for all students across the socioeconomic and geographic spectrums. While public policy is "still an important driver of digital learning," as is clear in the NETP, public policy itself is "less direct now than it was in the past" towards online learning (Gemin et al., 2015, p. 104). The public's attention has shifted to issues that are peripheral to online learning, such as Common Core standards and the reauthorization of the Elementary and Secondary Schools Act (Gemin et al., 2015, p. 104-105). These issues affect online learning, but online learning is not the focus of such policies. In other words, as of 2017, there is no mandate from the public to any level of government to implement the kinds of policies and funding that would be indicative of a shift in the political importance metric with respect to online learning.

OUTCOME OF THE PREDICTION

In summary, while there is some evidence of using online learning in areas of potential nonconsumption, there has been no shift in the political importance metric in the context of online learning. State virtual schools and full-time online learning programs remain viable computer-based learning opportunities for a small minority of students, as they were in 2007. However, both state virtual schools and full-time online programs have seen their growth slow and even in some states and cases decline, beginning around 2011. After 2011, most of the growth in online learning shifted to single-district blended learning programs. In 2015, single-district blended learning is the most common implementation of online learning: “[t]he most prevalent use of digital content is in classrooms where online or local digital instructional content is used to augment courses that are offered on a traditional daily and semester schedule, with the teacher of record located on the school campus” (Gemin et al., 2015, p. 26). Christensen et al. (2008) predicted that by 2019, 50% of all high school classes would be delivered online. There are no indications that this will happen. The data regarding online learning adoption, specifically the number of state virtual schools and enrollments in full-time online programs, is not indicative of the kind of exponential growth Christensen et al. (2008) predicted. Moreover, the theory of disruptive innovation did not predict the pervasiveness of single-district blended learning programs.

In fact, blended learning seems to be more like a sustaining innovation in the context of the traditional model of instruction. As I wrote, blended learning is using a combination of digital tools and face-to-face instruction. Online learning, a potentially disruptive force to the traditional model of instruction, is being used in a way that preserves the existing model. According to Christensen et al.’s (2008) theory of disruptive innovation, cramming occurs when firms take innovative ideas and use them in ways that “fit the interests of the groups in the company that must support the proposal in order for it to receive funding” (Christensen et al., 2008, p. 75). Thus, blended learning seems to be a classic example of cramming.

In 2013, Christensen et al. amended the theory of disruptive innovation, responding in part to the growth of blended learning programs in context of online learning by introducing the concept of hybrid innovation, in addition to sustaining and disruptive innovations. A hybrid innovation is “a combination of the new, disruptive technology with the old technology and represents a sustaining innovation relative to the old technology” (Christensen et al., 2013, p. 2). Christensen et al. (2013) believed the newly introduced concept of hybrids accounts for the growth of blended learning programs, and moreover expected the shift towards blended learning to continue. However, in the 2013 formulation of the theory of disruptive innovation, and in contrast to the phrasing Christensen et al. (2008) used in *Disrupting Class*, Christensen et al. (2013) were more judicious in predicting exactly how long it may take for the disruption process to cycle: “the disruptive models of blended learning are…positioned to replace the classroom model and become the engines of change over the long term,” which might turn out to be “quite long” (p. 33, 35). By using more nebulous language in making their revised prediction, Christensen et al. (2013) seem to have recognized their previous mistake of making such a bold and precise prediction in the inherently complex and ever-changing problem space of technology and the public education system. In 2008, Christensen et al. could not possibly have foreseen the forthcoming technological innovations, such as mobile devices or thin client laptops, that in part have facilitated the growth of blended learning programs. The ways in which technology is used in classrooms will change as quickly as technology changes, which is to say that change and innovation will continue ad infinitum. Any predictions made in such fluid conditions are almost certainly going to be inaccurate in some sense.

Having said that, I believe that there is a more fundamental critique of the theory of disruptive innovation as it applies to the public education system in the United States.

In the next section, I argue that there are two reasons why Christensen et al.'s (2008) prediction was mistaken.

Why the Prediction Failed

The theory of disruptive innovation was originally conceived in the realm of private sector firms. Despite this, Christensen et al. (2008) believed the theory of disruptive innovation still applied to other contexts. In this section, I argue that because of inherent features of the public education system in the United States, the theory of disruptive innovation should not necessarily be used as a tool for analyzing the public school system in the United States and using that analysis to project future outcomes. There are at least two reasons why the theory is not applicable in the case of the public education system. First the theory of disruptive innovation makes certain assumptions about how markets react to changing conditions. These assumptions do not apply to the public education system. Second, I argue that Christensen et al. (2008) underestimate the complexity of the public education system.

THE K-12 SCHOOL SYSTEM IS NOT A FREE MARKET

One problem with applying the disruptive innovation model to the public education system is that it was originally conceived based on evidence from the private sector. According to Christensen (2006), one of the underlying assumptions of the theory of disruptive innovations makes is that "the objective function of management should be to maximize shareholder value" (p. 50). Private firms maximize shareholder value by making the type of improvements to their products that allows them to charge higher and higher prices to their existing customer base (Christensen et al. 2008, p. 51). As I wrote previously, this is what Christensen et al. (2008) called the performance improvement metric. According to the theory of disruptive innovation, private firms maximize their shareholder value by improving their products for their existing customers by making sustaining innovations using the existing performance improvement metric until another firm, which is also trying to maximize shareholder value, disruptively deploys a product to nonconsumers of previous products, creating a new performance improvement metric. The theory of disruption asserts that this cycle of disruption continues ad infinitum.

Christensen et al. (2008) wrote that the analogous performance improvement metric for the public sector is "the political or societal importance of programs," which I referred to as the political importance metric (p. 51). If the performance improvement metric for the private sector is equivalent to the political importance metric for the public sector, then the underlying assumption that managers ought to make decisions that result in the highest possible shareholder values is nonsensical in the context the U.S. public school system; there are no shareholders expecting profits, and there is no actual value to be earned, or profit to be gained. Students and parents do not purchase education in the way that consumers purchase products from firms. There is a much more intricate relationship between federal and state elected officials, school districts, and tax payers that determines how money is allocated and used in the public school system. Moreover, in the United States, the relationship between different levels of government is not analogous to the relationship between an executive and her shareholders and customers. State governments ultimately maintain the power to interpret and implement federal guidelines that are not mandated by law. For example, in 2009, the Obama administration created a program named "Race to the Top" (RTTT), which granted relatively more funds to states that, among other measures, implemented specific reforms to their teacher evaluation systems. From 2009 to 2015, the number of states that were in compliance with the guidelines related to teacher evaluation systems went from 15 to 43 as a direct result of RTTT (Doherty & Jacobs, 2015, p. 2). Forty-three state governments decided that it was best to comply with the federal guidelines and thus received more money from the federal government. Seven other states chose not to comply and therefore were not eligible for the same funds. Making a deliberate decision to receive less overall funding is an irrational decision in a pure market system. However, state governments make what would be viewed as irrational decisions in the private sector every year for a variety of reasons. Thus, government entities do not respond to market forces in the way that firms in the private sector do. Therefore, it is uncertain that there is a useful analogy to be drawn between the way private sector firms and public sector entities respond to market forces.

King and Baatartogtokh (2015) found the assumption that public entities act so as to maximize shareholder value to be "problematic" in the cases of disruption Christensen wrote about across his body of research that concerned nonprofit organizations or publicly regulated utilities (p. 82). An expert in higher education King and Baatartogtokh (2015) interviewed said that "the access mission of community colleges often runs counter to what presidents or other leaders might do to cut costs or improve completion outcomes" which "…makes it not such a great example for the theory because as a mission-driven institution, they are responsible to the public and a higher calling (p. 82). This critique of higher education also applies to the K-12 public education system. Lepore (2014) acknowledges this critique as well:

> Doctors have obligations to their patients, teachers to their students, pastors to their congregations, curators to the public, and journalists to their readers—obligations that lie outside the realm of earnings, and are fundamentally different from the obligations that a business executive has to employees, partners, and investors. (para. 29)

The incentive structures for public sector organizations are fundamentally different from the ones that govern the private sector, and the rules that apply in the realm of the private sector are not universal. This raises serious questions as to the generalizability of the theory of disruptive innovation to the public sector overall, and the K-12 school system specifically.

COMPLICATED VS. COMPLEX SYSTEMS

Christensen et al. (2008) argued that while schools gave nonconsumers access to technology, they did not do it correctly. Instead of treating computers as a potentially disruptive technology, Christensen et al. (2008) contended that schools have “crammed” computers into their existing teaching practices: “the way schools have employed computers has been perfectly predictable, perfectly logical—and perfectly wrong” (p. 73). Moreover, Christensen et al. (2008) suggested that if school administrators would “change course” by following the guidance found in *Disrupting Class*, then the problems of student motivation and lagging test scores that plague the U.S. school system could potentially be allayed and eventually resolved (p. 73). Proposing that the profound problems Christensen et al. (2008) are trying to fix is as simple as school administrators “changing course” reveals a lack of understanding of just how complex of a system Christensen et al. (2008) are trying to reform.

In trying to explain why there have been so many structural changes in schools without commensurate reforms in teaching practices, Cuban (2013) drew a distinction between complicated systems and complex systems. A complicated system “assumes expert and rational leaders, top-down planning with a ‘mission control’ unit pursuing scrupulous implementation of policies in a clockwork-precise organization” (p. 156). Examples of complicated systems include an effort to land a rocket landing on the moon and the 2003 invasion of Iraq (Cuban 2013, p. 155). Contrastingly, complex systems:

> …are filled with hundreds of moving parts, but many of the parts are human, and these players have varied expertise and independence. Moreover, missing in such systems is a “mission control” that runs all these different parts within ever-

> changing political, economic, and societal surroundings. The result: constant adaptations and compromises in design and action. (Cuban 2013, p. 156)

Schools are an example of a complex system. There are several levels of interaction and interdependence. Students, parents, teachers, administrators, policy makers all interact with each other on classroom, school, and district levels, in addition to the "community, state, and national economic, political and social factors" that influence schools (Cuban 2013, p. 159). Christensen et al. (2008) must be somewhat aware of this because they presented the "high level of interdependence in a classroom" as an obstacle to be overcome in trying to introduce more personalized learning (Christensen et al. 2008, p. 35). Yet, in suggesting that structural reform could begin with school administrators "changing course," they have made one of the oversights that Cuban (2013) claimed policy makers have in their attempts to legislate fundamental shifts in teaching practice. Specifically, Christensen et al. (2008) have mistaken public schools for complicated, not complex, systems in that they seem to "…see schooling as a collection of complicated structures that can be broken down into discrete segments and reengineered through algorithms and flowcharts to perfection" rather than as the "complex, dynamic, and very messy multilevel system" that it is (p. 163). Martone (2015) made a similar critique when she wrote that Christensen et al. (2008) "do not address the legislative realities involved when making significant educational changes" (p. 145-146).

The confusion between complicated and complex systems is also evident in Christensen et al.'s (2008) account of how the U.S. school system evolved in response to changes in the political importance metric. Christensen et al. (2008) began the section of *Disrupting Class* that focused on the history of the public school system in the United States with a qualification: "[b]ecause it is a summary, we necessarily resort to generalizations that will mask important details and exceptions. But our aim is simply to provide some general context to understand how society and schools evolved over time" (Christensen et al. 2008, p. 52). Nevertheless, Christensen et al.'s (2008) account exaggerated certain historical facts to the degree that the inferences they drew from their account do not follow. Christensen et al. (2008) wrote:

> In the 1890s and early 1900s, competition with a fast-rising industrial Germany constituted a minicrisis; Americans responded in the early twentieth century by handing schools a new job: prepare everyone for vocations. The goal was to produce a sound workforce for jobs ranging from administrative functions to technically demanding manufacturing positions so that America could compete with Germany. (p. 53)

Then Christensen et al. (2008) gave data to confirm that schools acted in the way that fulfilled this job, specifically increases in school enrollments and a diversification of this kinds of courses schools offered (p. 54-57). So, Christensen et al. (2008) defined a political importance metric, in this case "the depth and breadth of courses and the percentages enrolling in and progressing through high school," then gave evidence that schools behaved in ways that conformed to that political importance metric (p. 54). In fact, the impetus for the increase in high school enrollment and course offerings were dramatically more complex than Christensen et al. (2008) indicated. This growth did not happen as a reaction to a singular event, according to the very source Christensen et al. (2008) cited in giving their account.

There certainly was a "rapid increase of students enrolled and graduating" during the 20th century, and "as the numbers of students have soared, high schools have grown steadily larger and more elaborate in structure and curriculum" (Tyack & Cuban 1995, p. 47-48). But this growth is credited in part to "a number of broad societal trends—economic, demographic, and attitudinal…" (Tyack & Cuban 1995, p. 48). Specifically, Tyack and Cuban (1995) mentioned the rising gross national product which helped create the resources necessary to build up the infrastructure for high schools to expand;

urbanization and the consolidation of rural districts which changed the makeup of the student body and required larger and more diverse high schools; a fall in birth rate which made it more likely that parents could afford to let their children continue to attend school instead of joining the labor force; at the same time, the demand for full-time teenaged employees fell as the government passed anti-child labor and compulsory school attendance laws (p. 48-49). Additionally, parents and students came to the realization that secondary school was necessary to secure a good job (Tyack & Cuban 1995, p. 49). These events took place over the course of several decades.

Tyack and Cuban (1995) do allude to the economic rivalry with Germany in the 1890s that Christensen et al. (2008) claimed was the catalyst for a shift in the performance improvement metric. But Tyack and Cuban (1995) did so in the context of commenting on how the varied the interpretations of and responses to the expansion of access to education over time: "when Americans repeatedly turned to secondary education to solve profound economic, social, and political problems, they differed in their diagnoses and their solutions" (p. 49). The rivalry with Germany was part of that narrative, but according to Tyack and Cuban (1995) there were many other factors that were influencing schools in the United States during this time period. Tyack and Cuban (1995) showed that the number of people attending high schools and the courses high schools offered did not grow because of "competition with a fast-rising industrial Germany," so it does not necessarily follow that "Americans responded by handing schools a new job" (Christensen et al. 2008, p. 53). This calls into question the implied causal relationship between changes in the political importance metric and the reasons why schools evolved in the various ways that they have over time.

Conclusion

Christensen and Raynor (2003) maintained that the theory of disruption is predictive: "[d]isruption is a theory: a conceptual model of cause and effect that makes it possible to better predict the outcomes of competitive battles in different circumstances" (p. 55). In a separate article, Christensen (2006) argued that the predictive power of the theory is a criterion on which the validity of the theory should be judged and that "any assertion that the model has not or cannot be used to predict outcomes simply does not square with historical fact" (p. 42, 46)

In the case of the public education system in the United States, I found that the theory of disruptive innovation failed to predict the ways in which online learning would affect instruction from 2007 to 2015. Furthermore, I argued that the theory of disruptive innovation may not be applicable to the public education system in the United States at all, because the theory does not account for differences between the public and private markets, and because the public education system in the United States is much more complex than Christensen et al. (2008) portray.

Despite that, I regard Christensen's (2006) standard for judging the usefulness of his theory by the degree to which it is predictive as too high of a threshold. Even though the theory of disruptive innovation was not predictive in this particular case, the theory can still prove useful to educators who are trying to improve their schools or districts, especially when a new innovation is introduced. Gobble (2015) argued that the theory of disruption is best used as an instrument of analysis:

> Disruptive innovation…is a useful framework for strategy that innovators, entrepreneurs, and managers can use to understand the market, identify potential threats and opportunities, and plot a way forward. It is not the only way to win, and it doesn't always apply. But properly understood and thoughtfully applied, it is neither more nor less than a powerful tool (p. 61)

The theory of disruptive innovation, then, does not foretell the future, and it does not adequately describe the past. Rather, its best use for educators is as a framework for thinking about the means by which they educate, and how innovations could be used in the service of improving education. For example, a school principal could reimagine how their school might operate if the school was in a private sector market, competing with other schools. Following some kind of instructional innovation, the principal could assess whether the school could serve the existing "market" using that innovation and perhaps come up with changes she could make to achieve the most optimal outcomes for her "customers" or students using this new innovation. Furthermore, the principal could identify opportunities to address students whose needs are not currently being met or accounted for in the existing "market," and use the new innovation to reach such students. Forcing educators to question their assumptions about how their students' needs are being met could lead to a better overall educational experience for more students. Reducing the scope of the theory of disruptive innovation to a single classroom for an individual teacher in a specific learning context could prove to be a more effective usage of the theory. For example, when evaluating whether or not to implement a specific technology in a classroom, a teacher could ask herself, in keeping with the notion of nonconsumption, "does this tool address needs that are not currently being met in my classroom?" Moreover, applying the political importance metric to a classroom context, a teacher could ask herself, "does the learning situation require this specific technology?"

Applying the theory of disruption on a smaller scale could be way to discern how useful a potential innovation might be. As Meyer (2011) observed, "[i]t isn't the technology per se, but the new thinking it inspires, that can be disruptive" (p. 45). It is not possible to know what new innovations the future holds for all classrooms across the United States, but perhaps the theory of disruptive innovation could be informative for assessing educational innovations one classroom at a time.

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