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Advancing a critical artificial intelligence theory for schooling

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Abstract. 'Artificial intelligence' (AI) has gradually been integrated into major aspects of schooling and academic learning following breakthroughs in algorithmic machine learning over the past decade. Interestingly, history shows us that as new technologies become perceived as 'normal' they fade into uncritical aspects of institutions. Considering that schools produce and reproduce social practices and normative behavior through both explicit and implicit codes, the introduction of AI to classrooms can reveal much about schooling. Nevertheless, artificial intelligence technology (specifically new machine learning applications) has yet to be properly framed as a lens with which to critically analyze and interpret school-based inequities. Recent education discourse focuses more on practical applications of technology than on the institutional inequalities that are revealed when analyzing artificial intelligence technology in the classroom. Accordingly, this paper advances the case for a critical artificial intelligence theory as a valuable lens through which to examine institutions, particularly schools. On the cusp of 'machine learning' and artificial intelligence becoming widespread in schools' academic and hidden curricula, establishing a practical epistemology of artificial intelligence may be particularly useful for researchers and scholars who are interested in what artificial intelligence says about school institutions and beyond.
Keywords: education; epistemology; hermeneutic; technology.

[es] Hacia una teoría crítica de la inteligencia artificial en el ámbito de la enseñanza

Resumen. A partir de los avances en el aprendizaje automático basado en algoritmos que han tenido lugar en la última década, la 'inteligencia artificial' (IA) se ha integrado gradualmente en los principales aspectos de la escolarización y el aprendizaje académico. Curiosamente, la historia muestra cómo a medida que las nuevas tecnologías incrementan su presencia en la sociedad, se integran de forma naturalizada y acrítica en las instituciones. Teniendo en cuenta que las escuelas producen y reproducen prácticas sociales y comportamientos normativos mediante códigos explícitos e implícitos, la introducción de la IA en las aulas podría ser una importante fuente de información sobre las escuelas. Sin embargo, esta tecnología (específicamente sus nuevas aplicaciones en el campo del aprendizaje automático) todavía no se ha utilizado para mirar, analizar e interpretar críticamente las inequidades escolares. El discurso educativo actual está más centrado en las aplicaciones prácticas de la tecnología que en las desigualdades institucionales que muestra el análisis sobre cómo la tecnología digital se está insertando en las aulas. En consecuencia, este artículo defiende la necesidad de desarrollar una teoría crítica de la inteligencia artificial y sus posibilidades para estudiar las instituciones, particularmente las escuelas. En este momento cumbre de la inteligencia habitual y su fuerte presencia tanto en los planes de estudio académicos como en el 'currículo oculto', es fundamental establecer una epistemología práctica que permita a los investigadores y académicos estudiar las instituciones y sus implicaciones generales.
Palabras clave: educación; epistemología; hermenéutica; tecnología.

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1. Introduction

Regarding schools, some of the most pressing questions are about digital technology in the classroom. Why do some technologies fit into curricula, but others do not? In what ways do teachers and students use technology? How are decisions made about which technologies to integrate into which schools? Who benefits from certain technologies? Who does not? These questions and many more have gone unanswered. Meanwhile, more laptops, tablets, and smartphones are appearing in classrooms. In response, school systems are monitoring web traffic, implementing local internet firewalls, and drafting social media use policies. These, in turn, prompt additional questions about how surveillance, security, and control function in schools. To address these questions and better understand how human beings and systems interact with intelligent machines, I suggest a theory that uses new technology (i.e., artificial intelligence) as a lens to interpret institutional systems.

Today, 'artificial intelligence' is most frequently defined in three ways: 1) as science fiction humanlike entities, 2) as intelligent machines (i.e., 'narrow' AI), and 3) as intelligent machines programmed by 'machine learning' (ML). To be clear, this paper is not concerned with science fiction approaches to AI; artificial intelligence in schools is in no way related to science fiction confabulations such as HAL 9000 or the Terminator. Those are fiction. AI in schools, however, is quite real. In this paper, the term artificial intelligence refers to an intelligent machine that can do 'any tasks previously performable only by human minds' (Hofstadter, 1979/1999, p. 601). Artificial intelligence is instantiated in a wide array of applications, even in clothes dryers that can sense when a load is no longer wet. In computer science, this type of artificial intelligence is deemed 'narrow' in light of its performance of specific, limited practices (Haenlein and Kaplan, 2019; Reese, 2018; Tegmark, 2017). Applications of narrow AI include virtual assistants (e.g., Siri, Alexa), navigation software (e.g., Google Maps, Waze), grammar checkers (e.g., Grammarly, Ginger), translation services (e.g., Google Translate), game-playing systems (e.g., Deep Blue, AlphaGo, Watson), self-driving cars (e.g., Google's robocar), surveillance (Condliffe, 2019; Morse, 2019; Selinger and Hartzog, 2019), and even toothbrushes (Oral-B's Genius X).

The most recent advancements in narrow artificial intelligence have been in machine learning (ML), an algorithmic means by which a computer system actively 'learns'. ML was made possible by recent advances in artificial neural networks, which simulate human cognition. In machine learning, artificial intelligence programs its own code to achieve a set goal. For example, with the input of millions of images of dogs, AI can discern the salient characteristics of a canine and distinguish between pictures that contain or do not contain dogs. Machine learning has multifarious revolutionary uses. For instance, machine learning has altogether changed how language translation occurs. Using machine learning, engineers reduced Google Translate's programming code from over 500.000 manually created lines to just 500 lines through machine learning (Intel, 2019; Schuster, Johnson and Thorat, 2016). Machine learning AI, therefore, has profoundly changed how humans and machines interact and is already entering schools.

The framework that I propose in these pages is by no means brand new or an entirely original invention. Albeit distinct, Marx (1867/1978) first suggested a 'critical history of technology' that would investigate the social development of inventions and would through technology show «the mode of formation of his social relations, and of the mental conceptions that flow from them» (Marx, 1867/1978, p. 330). One hundred years later, Heilbroner (1967) proposed that 1) technological invention is a 'social activity' characteristic of some societies but not others; 2) technological advance is in response to social directions, which determine the areas to which those advances are applied; and 3) that technological change needs to be consonant with contemporary social conditions. MacKenzie (1996) has written about the non-neutrality of new technologies and their adopting civilizations. Gee (2003) examined literacy and learning through the lens of video games. Many other thoughtful technological determinists have also considered how technology and artificial intelligence have figured into society, and their conclusions are part of the synthesis that led to the ideas expressed herein. I owe a great debt to all of them for the work they have done beforehand, and I hope that a formalized framework for examining the role of interpretive artificial intelligence helps to organize this field for new, innovative thinking.

The critical artificial intelligence theory that I describe in these pages is for 'schooling', not for 'education', 'learning', or 'teaching'. By 'schooling' I intentionally refer to an understanding of schools as political and economic institutions that articulate education in specific ways (Hall, 1981; Hamilton, 2013). To put it differently, a school is an institutional apparatus that represents learning but is not synonymous with education. Schooling is a constructed 'thing', a vessel of innovations that today may seem commonplace but were revolutionary in their times (e.g., the separation of pupils into different classes). As I will discuss later, the institution of schooling is adept at making certain ideas–such as having a set 'curriculum'–appear to be universal and normal but 'their origins and evolution [is] hidden from both educationists and historians alike' (Hamilton, 2013, p. 35). Schooling obscures the distinction between education and politics, between learning and economics; it is inextricably linked to certain social practices and organizational structures. The purpose of a critical artificial intelligence theory for schooling is to regard anew this elusive institution, to peer upon its characteristics not through direct scrutiny but by examining the new technologies that fit, like puzzle pieces, into the existing frameworks of schools. Once we understand 'why' and 'how' this technology has been adopted by or into schools, perhaps we may then obtain better insight into the school institutions serving particular people and places, as well as the inequities that operate unabatedly behind the veneer of schooling.

2. Defining critical artificial intelligence theory

Despite the growing institutional presence of artificial intelligence, a means for interpreting this new technology has not yet been formally established. To meet this need, I propose critical artificial intelligence theory as a 'socioculturally-informed hermeneutic'. I use the word 'theory' to identify that artificial intelligence helps to explain and understand schools. I use the word 'hermeneutic' to reference artificial intelligence itself (i.e., the machine or program) as a lens for inquiry. With this theory, new technologies, particularly artificial intelligence, is reflexively turned back to challenge reified social and cultural practices.

A broader theory of artificial intelligence would be one for computer scientists and philosophers to wrangle with tough questions of life, intelligence, and consciousness. In contrast, a critical artificial intelligence theory continues in the tradition of critical social theory, particularly critical pedagogy: the belief that teaching is a value-laden, socially informed act that, through critical consciousness, can result in greater equity and social justice (Apple, 1979/2018; Bowles and Gintis, 1976/2011; Freire, 1979/2018). Unlike other critical traditions (e.g., critical race theory) that by-and-large have prioritized 'who' and 'where', critical artificial intelligence theory focuses on 'how' and 'what'. Drawing from Foucault (1990), the critical artificial intelligence theory outlined in this paper interprets how AI informs or is informed by social practices at the level of institutional discourse. Schools in the United States show a remarkable obduracy in that, despite decades of digital technological adoption, systemic discourse is relatively unchanged. Critical artificial intelligence theory, therefore, concerns itself with analyzing stagnant systems and institutions with the new technologies of schooling.

Critical artificial intelligence theory advances the purposeful, interrogative analysis of social institutions, such as schools, through the hermeneutic lens of artificial intelligence technology by the meaningful investigation of reified social practices within institutional discourses consequently embedded within codified and commoditized algorithms. It aims to reveal, through the mirror of artificial intelligence, the implicit biases of institutions and to suggest meaningful understandings to more equitably introduce technology into schooling.

All technologies are programmed; that is, they operate according to instructions integrated into the very design of objects and programs. This is true of programming choices that appear banal or even axiomatic. Flusser (2012, p. 27) reminds us that the convention of writing in straight lines from left to right is, in fact, «programmed in the typewriter». So too, then, is the typewriter programmed to make nonlinear writing more difficult, even if this were not the ostensible purpose of the programming. The technology of the typewriter and, today, the computer have further normalized this approach to writing to the point that it has become banal, slipping below awareness as a constructed thing. As another example, consider the twelve-month calendar, which has now become a nearly universally accepted measure of time. The Gregorian calendar imposes its measure of time through its ubiquity, which «short-circuits every other form of calendarity» (Stiegler, 2019, p. 45). Artificial intelligence is not an exception. It is also designed and programmed with societal conventions at its core, and many social practices, albeit universalized within North American schools, are not equitable. By examining the functions of the artificial intelligence brought into classrooms or adopted by teachers and students, one can identify social conventions reified in their designs and programming.

As a note of clarification, critical artificial intelligence theory is aligned neither with technophiles nor technophobes. Rather than critical of technology, the theory proposed here is critical 'with' or 'through' artificial intelligence. While both may use the word 'critical', the premise introduced in this paper is different than techno-pessimism, such as captured in the cogent arguments of Selwyn (2013) who recommended that teachers be more critical of technology. His wariness was based in part on Golding's (2000) description of 'type one' and 'type two' technologies: common technologies that improve existing processes (type one) and rare technologies that enable profoundly new types of activity (type two). Building from this, Selwyn wrote that «it is important to resist the temptation to unthinkingly associate digital technologies with the inevitable change and progress associated with "type two" technology» (Selwyn, 2013, p. 17). As type two technologies, artificial intelligence highlights the social discourses into which they integrate and sidestep this criticism. In short, I see criticisms of technology as distinct from critical artificial intelligence theory, which I posit as criticism with technology.

3. The AI effect, hidden AI, and web 3.0

Early artificial intelligence was designed to programmatically complete a task; today, machine learning AI achieves similar goals by performing 'us'. ML algorithms reify discourse performativity through the internalization and then enactment of socially constructed behavior. Social practices performed by AI reinforce institutional discourses in the technological 'other'. No longer do only humans perform identities (Butler, 1990), but our AI assistants do, too.

However, the constructed nature of AI can be difficult to apprehend since the apparent visibility of the computer interface obscures its invisible code (Chun, 2011). From grammar checkers to surveillance facial recognition systems, certain assumptions and biases are codified and commoditized by AI systems. In recent years, the black box of digital code has resulted in an uncritical acceptance of new technologies, resulting in a populace that usually does not question the value-laden choices that have gone into the coding of machines (Feenberg, 2012). For this reason, I draw from Kant's (1855) notions of the 'noumenal' and 'phenomenal' to identify what I see as the dual nature of artificial intelligence. By noumenal, I refer to the computer code, algorithms, etc. that invisibly comprise artificial intelligence. By phenomenal, I refer to AI programs perceivable to human senses (i.e., applications and user interfaces). Critical artificial intelligence theory resists

the invisibility of noumenal code by reflecting AI on its own institutions, making familiar interfaces on computer monitors and phone screens strange once again (Freud, 1919/2003).

Further obscuring artificial intelligence, new technological achievements in AI are usually branded without explicit AI appellations. Few consider Siri to be artificial intelligence, for instance (Castrounis, 2019), for breakthroughs in AI are often repackaged into (or as) broader products and systems (Kaplan and Haenlein, 2019; Minsky, 1990). Many users may not even realize that artificial intelligence is a component of their products, thus feeling to consumers as if artificial intelligence has never arrived. This 'AI Effect' is the documented tendency for artificial intelligence to be repeatedly redefined as an ever-receding not-yet-achieved goal, which results in end-users not knowing that they are using AI (Haenlein and Kaplan, 2019; McCorduck, 2004; Reed, 2006). Applying this propensity across generations of innovations, new technologies throughout history could arguably be, retrospectively, defined as artificial intelligence insofar as they made tasks possible that were previous accomplished by leveraging human intellect. This theory might, therefore, be called a 'critical new technology theory', which would cast a wider net around all types of new technologies. However, such terminology might unwittingly include technologies that do not meet the definition of intelligent machines executing «any tasks previously performable only by human minds» (Hofstadter, 1979/1999, p. 601). I ergo use the words artificial intelligence as an umbrella term that captures technologies both historically innovative as well as cutting edge technologies today, but I am aware that this is not common usage today.

In defining a critical artificial intelligence theory, this paper draws attention to a human proclivity toward normalizing technology. By resisting this universalizing and uncritical trend, artificial intelligence used as a hermeneutic can lead to better insight into the biases perpetuated in various institutions as we welcome new technologies. For instance, it can help to reveal institutional intersections of gender inequalities perpetuated by and through new technologies (Wajcman, 2000, 2001). This was exemplified in artificial intelligence when UNESCO (West, Kraut and Chew, 2019) examined Siri and other virtual assistants, concluding that the feminization of virtual assistants perpetuates institutional gender stereotypes[2].

Transparency has long been an issue for digital (i.e., online, computer-mediated person-to-person communication) technologies (Jenkins, Clinton, Purushotma, Robison and Weigel, 2006). The seeming visibility of computer programs and applications is deceiving (Chun, 2011). Users may see their actions on graphical user interfaces, but they are not seeing a great deal more–what I earlier called the noumenal, or invisible, aspects of programs. Beyond traditional software, the artificiality of AI is often intentionally masked by attempting to get programs to pass as human beings (Toncic, 2020). I offer that, as Web 2.0 was defined by an economic model of user-generated content within platform sandboxes (Lankshear and Knobel, 2011), AI has initiated Web 3.0 by instantiating economic models that depend on AI remaining hidden or unknown, deepening capitalist and bureaucratic market trends.

Recent applications of narrow AI have intentionally sought to capitalize on low transparency. For example, a data breach in 2016 revealed that Ashley Madison, a web platform promoting spousal infidelity, had been using AI chatbots to persuade its male user base that far more human women were using the service than actually were (Morris, 2016). Other companies have begun to adopt various forms of AI customer service, ranging from AI sales reps to personalized movie recommendations (Ostrom, Fotheringham and Bitner, 2019). At Georgia Tech, IBM's Watson worked incognito alongside 13 other online teaching assistants, and at the end of the semester, most students (87%) could not distinguish an AI teaching assistant from human counterparts (Maderer, 2017). More insidiously, 'deepfakes' (i.e., audio or video that uses AI to impersonate an individual in a convincing way) have passed as real people for political and monetary gain, such as thieves who believably mimicked a CEO's voice and stole $220,000 from a UK-based energy company (CNBC, 2019; Simonite, 2019). Researchers at the Allen Institute for Artificial Intelligence have recently released a neural fake news generator to demonstrate concerns about disinformation (Zellers et al., 2019). Furthermore, a 2019 essay contest for teenagers run by *The Economist* about climate change included a submission written entirely by an AI program. Judges did not award the essay with a win, but neither did they call the submission into question. One judge who graded the submission as a 'Maybe', wrote, «It is strongly worded and backs up claims with evidence, but the idea is not incredibly original» (Intell, 2019, p. 34).

In summary, hidden AI has become the lynchpin of a changing networked society, best described in Web 3.0 terms. Users in this new phase of connectivity are often interfacing with AI that is intentionally programmed and designed to obscure its artificiality. While codified behavioral norms have existed since the beginning of civilizations, AI has masked its noumenal coding behind anthropomorphic actions–humanlike behavior endlessly reproduced on autopilot. A formal theory to analyze artificial intelligence, therefore, can be helpful in resisting this trend toward uncritical (and unaware) AI adoption.

4. Exploring critical artificial intelligence theory for schooling

Critical artificial intelligence theory developed in part from a study I conducted on AI-grammar checkers (Toncic, 2020). For the past few years, AI grammar checkers have been quietly improving student grades. Grammarly

[2] While no cause-effect relationship is immediately apparent, Amazon's Alexa (another female-voiced virtual assistant) was to soon receive an alternative voice, that of male actor Samuel L. Jackson (Trammell, 2019).

(2019) touted that 99% of its users received higher scores in writing. However, the majority of high school English teachers I interviewed in 2019 had not considered how AI grammar checking impacted writing pedagogy or assessment in classrooms or on standardized tests. What emerged from the findings of this study was that teachers were frequently assessing grammar but rarely teaching it, ascribing that responsibility to elementary school teachers. In turn, students who submitted work with high grammatical accuracy would achieve higher scores even though they did not demonstrate better classroom learning. This practice of assessment valued grammatical fluency in Standard English, impacting students' grades throughout high school without any explicit relationship to teachers' lessons. Writing about students without the linguistic capital of Standard English favored in schools, Bourdieu and Passeron (1990, p. 73) argued that «the educational mortality rate can only increase as one moves towards the classes most distant from scholarly language». In short, AI grammar checkers such as Grammarly have further reified a variety of English as correct, benefitting those students whose home languages were more aligned with Standard English (Gee, 2004; Heath, 1983; Street, 1997; Schiefflin and Ochs, 1986). By considering the functionality of an AI grammar checker (i.e., how it fit into the institution of school), it became clear that grammar was used as a proxy for dominant discourses.

I ultimately theorized that artificial intelligence is so proficient with grammar in part because of its rule-based similarities to gaming, which is one of AI's main proficiencies. Comparatively, school-based grammar was about knowing the rules to win a game, not an accurate metric of student learning in high school English classrooms. Critical artificial intelligence theory emerged from this use of an artificial intelligence program as a lens analyzing the role of grammar in schools in the United States.

Schools are not value-free sites. Their organization is often directed by homogenous social practices, for institutional (i.e., school) leaders are often white, Standard English-speaking men (Carton and Rosette, 2011; Rosette, Leonardelli and Phillips, 2008). Public schools in the United States are monomodal instructional institutions, perpetuating static forms of curricula, pedagogy, and assessment (Illich, 1971; Lee, 2006). Like in schools, the technical development of AI is predominantly carried out by white, English-speaking men (Crawford, 2016; Sgoutas-Emch, Baird, Myers, Camacho and Lord, 2016). AI, like earlier new technologies, purportedly offers ways to revolutionize education, but despite major changes in digital technologies over the last few decades, much of the same inequality remains. Technology like AI is inscribed by the social discourses within which it was developed. As Feenberg (2012, p. 139) has written, «Technology is the bearer of a tradition that favors specific interests and specific ideas about the good life». Educational institutions are indeed shaped by new technologies (Grosvenor, Lawn and Rousmaniere, 2000) but perhaps to a smaller degree than might be assumed. Determinant of what technologies become part of schooling are the institutional values that have been socially constructed as practices of educational institutions (Goodson, Knobel, Lankshear and Managan, 2002). The goal of a critical artificial intelligence theory is to render apparent the discourses that unequally favor certain types of students.

These inequitable discourses are frequently called the 'hidden curricula' of schools, the implicit lessons taught by school institutions about the cultural capital valued in a society (Anyon, 1980; Apple and King, 1977; Giroux and Penna, 1979; Rosenbaum, 1976). Anyon (1980, p. 32), for example, noted that the curriculum for students in working class districts was based on reproducing mechanical behaviors. Critical artificial intelligence theory prompts revisiting the school-based social inequity of the hidden curriculum, revealing that various mechanical aspects of schooling are gradually being automated by AI and shifting a locus of inequality, at least in part. Artificial intelligence signifies an evolution of 'governmentality' (Foucault, 1991) in schools. The hidden curriculum originally emerged from and was enacted by individual school districts (Vallance, 1974). Artificial intelligence is indeed different, for it reifies inequities across individual districts and into automated programs used broadly, such as grammar checking programs that recognize only a handful of English varieties as correct. Schools have often framed the 'hidden curriculum' as perpetuated by and to certain types of people. I add to this an exploration of the 'tools' and 'technologies' of classrooms, particularly artificial intelligence.

In schools, AI is poised to obviate many of the rote, mechanical functions that have traditionally defined working-class school systems. AI, however, achieves Web 3.0 economic goals by remaining hidden. Special consideration can be paid, therefore, to the intersections of hidden AI and hidden curriculum: the hidden-hidden curriculum. This hidden-hidden curriculum will be a point of special interest as technologies that mitigate the need for mechanical skills instruction-such as grammar-become commercially available. Critical artificial intelligence theory rests on the fulcrum of past and present, examining how new technologies are integrated into existing institutions and how those systems respond. AI may address some inequities, but it will exacerbate others. For example, even though grammar checkers may help students with usage and mechanics rules, it further reifies school-based grammar as correct, leading to valent discrepancies between students' home discourses and those privileged by institutions. AI thus reproduces institutional discourses within new technologies of control, as machine learning (and coding generally), makes frictionless certain social practices that guide individual behavior.

5. Advancing a critical artificial intelligence theory for schooling: teachers and students

As I saw with artificial intelligence grammar checkers, few of my previous study's participating teachers were then aware of the capabilities of new AI technologies or how they might impact curriculum, instruction, or assessment. Yet AI instantiates manifold applications for schools.

Teacher education and development, therefore, would benefit from educating teachers about AI (Lu and Harris, 2018). However, since recent scholarship suggests that a focus on particular applications of technology may lead to a lack of meaningful classroom integration, teacher educators and developers may be better served learning about new technologies overall (Bullock, 2016). Critical artificial intelligence theory can provide a broad framework within which educators can think about how new AI technologies integrate into existing institutional structures, situating various technologies in the classroom as physical and digital manifestations of school norms.

Educating teachers about the newest technologies is important, for they deal with populations who may be the most vulnerable to exploitation by new technologies. Genevieve Bell, the director of Intel Corporation's Interaction and Experience Research, has said that «moral panic… is always played out in the bodies of children and women», such as in early fears that electric lighting would indicate to predators that women and children were home (Rooney, 2011, p. 3). With new technologies, children (particularly girls) are treated as contested entities (Bivens and Fairbairn, 2015), and schooling acts as one conduit through which power is enacted. Shortly after the aforementioned panic over electricity, the Ohio Human Society declared in 1910 that 40% of moving pictures (i.e., movies) were «unfit for children's eyes» (Nasaw, 1999, p. 175). More recently, it was suggested that children and teenagers were sprouting literal horns due to their use of mobile devices, a theory quickly debunked (Marsden, 2019).

New technologies are often portrayed as creating new dangers, enabling (in fact, legitimizing) control of populations deemed by dominant groups to be vulnerable (Dourish and Bell, 2011), such as when Day (2001) identified that men had used danger to circumscribe the actions of women in public spaces in Irvine, California. An example helps piece this all together. After a study in 1995 (later found to be of questionable methodology) from Carnegie Mellon determined that 83.5% of images online were pornographic (Rimm, 1994), *Time* magazine published the following salacious front page: «Cyberporn: A new study shows how pervasive and wild it really is. Can we protect our kids – and free speech?» (Elmer–DeWitt, 1995, cover page). The article bolstered subsequent attempts by members of the U.S. Senate, such as Nebraska Senator James Exon, to pass legislation to restrict children from indecent exposure online (Marwick, 2008).

Considering these moral and ethical battles waged over children and new technology, it is not surprising that schools in the United States have already been battlegrounds for AI. School districts like Texas City in South Houston, Texas and Putnam City in Oklahoma have already deployed video analytics (i.e., AI-enabled facial recognition video) to automatically track individual movement throughout school campuses and identify potential threats (Simonite and Barber, 2019). However, AI on school campuses is fraught with issues of misuse and discrimination. Facial recognition systems, for example, have been found to misidentify black women's faces (Bowyer, 2019; Cook, Howard, Sirotin, Tipton and Vemury, 2019; Grother, Ngan and Hanaoka, 2019; Simonite, 2019; Singer, 2019; Stanley, 2019). Backlash from students and parents in Lockport, New York, led school district officials to abandon plans to use algorithmic face-tracking software in its schools (Carter, 2019). In China, schools have installed cameras (referred to as teaching assistants) in classrooms themselves: students' faces are continually scanned for attentiveness in order to curtail distraction or confusion (Moon, 2018). One affected student remarked, «Since the school has introduced these cameras, it is like there are a pair of mystery eyes constantly watching me, and I don't dare let my mind wander» (Moon, 2018, p. 5). Teachers are under similar scrutiny from administrators using the technology. Reminiscent of George Orwell's Big Brother from *1984*, the unblinking eye of AI surveillance raises various moral and ethical concerns. Back in the United States, for example, disquiet about facial recognition technology has been so acute that the city of San Francisco outright banned the technology (Barber, 2019), and even Microsoft has called for regulation of facial recognition AI (Singer, 2018).

Of note, too, is the fact that facial recognition AI has obviated some of the foundations of theoretical panopticism (Foucault, 1977). In a panoptical prison (in which prisoners were always potentially surveilled and thus subject to punishment), prisoners would begin to police themselves, altering their behavior as if they were continually watched. In the case of AI, the supervising person becomes unnecessary. Institutions, no longer delimited by human surveillance, can be omnipresent. Schools have historically functioned with at best a limited panopticism (Gallagher, 2010). The advent of AI facial recognition, however, signals the advent of a control far beyond panopticism, one that preempts human limitation with an always-watchful mechanical gaze. This is no longer a mostly theoretical or psychological apparatus, but one that can actually achieve panoptic watchfulness, realizing what Haraway (2006) might call the epitome of the 'informatics of domination'. Since schools that serve students of color are more likely to use draconian surveillance than other schools (Nance, 2016), implicit bias is an integral aspect of this AI use.

Implicit bias may also appear in the pedagogical structures designed into generalized products by AI-tech developers. The company Lumilo piloted a pair of Teacher Smart Glasses for math teaching in more than 30 Pittsburgh-area schools (Holstein, McLaren and Aleven, 2019). These AI-Augmented Reality glasses allowed teachers to see students' assignment completion and accuracy above the students' heads. Marketed as a way to help students who need assistance but are not actively requesting it, these glasses raise numerous questions about teacher surveillance, the role of testing and scoring in education, the correlation of a students' identities with numbers, etc. This is a manifestation of what I earlier called the hidden-hidden curriculum, the ways in which AI technology can become a means of perpetuating certain practices within institutional school systems. A critical artificial intelligence theory, therefore, identifies how/where AI technology is deployed and then hermeneutically repositions that same AI, symbolically turning it back upon itself to explore reified institutional biases. It is a theory that is based in

practice, in examining the implementation or adoption of technologies *in situ* and in use.

6. Beyond schooling, beyond AI: technological metaphors and historical heuristics

> They seem to talk to you as though they were intelligent, but if you ask them anything about what they say, from a desire to be instructed, they go on telling you just the same thing forever (Plato, 1925, p. 275c).

In this penultimate section, I begin with the above argument against new technology to suggest that a critical artificial intelligence theory may be applicable in other ways, beyond schooling and outside of modern machine learning AI. The epigraph above echoes many arguments against machine-based learning and artificial intelligence in schools: that technologies are incapable of responding in nuanced ways to learners and are unable to either truly instruct or answer a learner's questions. But this introductory statement is not about 21st century computerized instruction. Rather, it dates from almost 2,500 years ago as a criticism of the written word.

The epigraph comes from Plato's *Phaedrus*, which was penned in approximately 370 B.C.E. (Cooper and Hutchinson, 1997). Socrates tells the story of the Egyptian god Theuth who had given an Egyptian ruler a gift for his people: writing. But the king, Thamus, balks. He responds plainly that writing would weaken his subjects' minds, not sharpen them. King Thamus says, according to Socrates, «You offer your pupils the appearance of wisdom, not true wisdom, for they will read many things without instruction and will therefore seem to know many things, when they are for the most part ignorant and hard to get along with, since they are not wise, but only appear wise» (Plato, 1925, p. 275a-b). In other words, Thamus argues that writing would weaken intellects because people would no longer learn from others (Werner, 2012).

Socrates' argument deserves consideration today: not for its cogency but because its example is so transitive to technology and education. Underpinning Socrates' rebuke of the written word were three central concerns that, throughout history, seem to reappear whenever new technologies are introduced: 1) new technologies are symbolic abstractions and artificial in nature; 2) these symbolic abstractions are therefore limited in value because they cannot operate independently; and 3) by relying on a new technology to complete a task, humans are construed to become less capable. These concerns resurfaced, for example, with the advent of the telegraph in the 1800s (LaFrance, 2014). Writers from *The New York Times* lambasted the telegraph. One reporter described it as, «Superficial, sudden, unshifted, too fast for the truth, must be all telegraphic intelligence» (The New York Times, 1858, p. 4) and another quipped that «the telegraph is not a very clear narrator of facts» (The New York Times, 1861, p. 4). Still, the arguments against technology are not what I find interesting, but rather their reappearance throughout the ages (in one form or another) whenever new technology has threatened extant discursive practices. The reappearance of these claims points to underlying, deeper social structures that are challenged during periods of institutional, technological transition.

Each of these three concerns has been revisited in various texts about new technology, but perhaps the most well-known is Mary Shelley's *Frankenstein* (1818/2009). In the book, a scientist (Victor Frankenstein) builds a patchwork human-like body and galvanizes it with electricity, animating it into existence. Although he intends to create a beautiful humanoid, he finds his creation repulsive and abandons the monster. Frankenstein's creation is denied a human identity and rejected by society, despite the creature's ability to read, think, and reason. Socrates' earlier points reappear in Shelley's admonition of new technology.

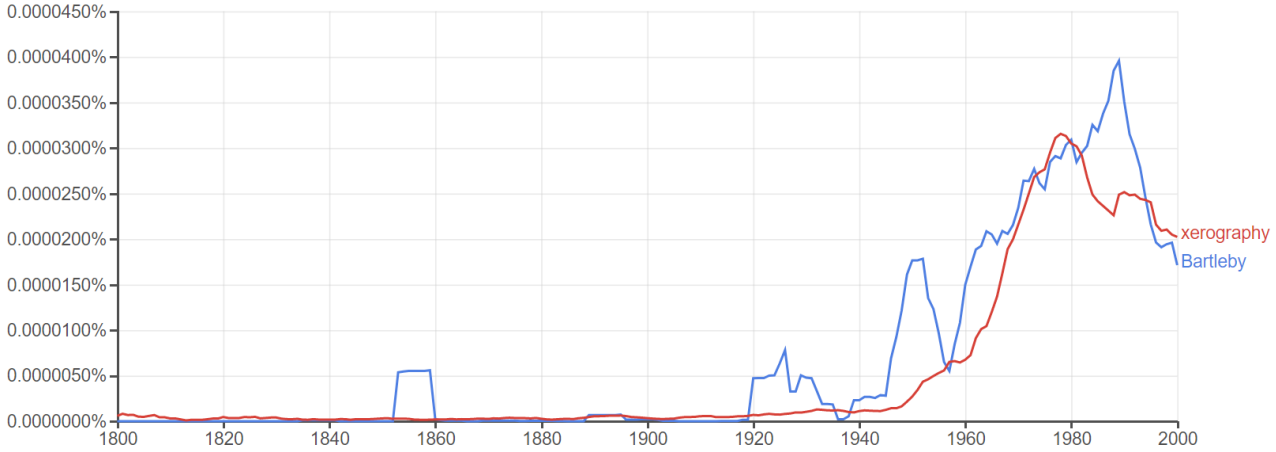
Shelley's *Frankenstein* identifies what makes us, as humans, monstrous. It was not the book's technophobia that has made it a lasting classic, but rather what its technology allows us to see about who we are: this, in essence, is the crux of critical artificial intelligence theory. Too often we are, like Victor Frankenstein, entranced by what new technology can do. Or, like Socrates, we see new technology as negative progress, adulterating our humanity. Both miss a key point captured by critical artificial intelligence theory: new technology, like writing was to the Ancient Greeks, offers a hermeneutic with which to examine the biases intrinsic to former methods and practices, hidden in the noumenal code of uncritical, everyday social practices. And only infrequently do we consider what technologies reveal about institutions and the discourses that comprise them.

Perhaps this is because the technology of the day invariably becomes a metaphor whereby humans understand the world and themselves (Lakoff and Johnson, 1980). Critically questioning technology would be like interrogating ourselves. In recent years, for instance, the human brain has been described in computational terms (Brooks, 2008, 2014). This tendency is not a recent phenomenon, with earlier new technologies also functioning as mental metaphors. This is apparent in examples ranging from Ancient Greek hydraulic systems (manifesting as the four humors) to Enlightenment era clockwork technology (resulting in metaphors about what makes people tick) (Daugman, 1993; Kean, 2014). Drawing from McLuhan (1962), Postman (1979, p. 39) explains, «The printing press, the computer, and television are not therefore simply machines which convey information. They are metaphors through which we conceptualize reality in one way or another». As metaphors are the basis for philosophical convictions (Rorty, 1979), technological metaphors become new ways that humans interpret society.

New technological metaphors can reshape our perceptions of history, elucidating social practices that had until then been uncritically accepted as normal. An example of this critical reframing at the societal level can be seen in the popularity surge of Herman Melville's short story *Bartleby, the Scrivener* (1853) during the 1960s. The story tells of a lawyer who has hired a new scrivener (i.e., a copyist of legal documents) for his law office. The new hire, Bartleby, begins productively. But he soon disengages from making copies, replying

in stoic tones, «I prefer not to». The story, like much of Melville's work, was met apathetically by the public (Robertson-Lorant, 1998). A review of *Bartleby, the Scrivener* from this time concluded that it was a «wild, weird tale» (Halifax, 1856). Indeed, for almost 80 years beginning in the 1860s, the story went undiscussed; Melville, for his part, was so commercially unsuccessful that he took a job in a New York City Customs House.

Figure 1. Graph of the relative usage of the words 'Bartleby' and 'xerography' from the years 1800 to 2000. Source: Prepared by the author created with Google Ngram Viewer



Yet that is not all there is to be said of the story about this strange copyist. After a negligible revival in 1919 honoring the centennial of Melville's birth (Weaver, 1919), the story's popularity really began to skyrocket in the 1940s (see Figure 1). Melville's tale of Bartleby was the same as before, but its readership was using a different technological metaphor, for in 1942, the United States Patent Office granted Chester Carlson the patent for xerography, better known today as the Xerox or copy machine (Carlson, 1942). The first commercially available model, the Xerox 914, was released in 1960 (Owen, 2004). Neither office work nor interpretations of *Bartleby, the Scrivener* would ever be the same. Not only did the appearance frequency of Melville's story in print grow in correlative simultaneity with xerography (see Figure 1), but the reviews changed, too. One reviewer in 1969 explicitly described the work of a scrivener «as preceding Xerox machines» (Ward, 1961, p. 61), and another that same year clarified that Bartleby was «the nearest thing the 1850s had to a copy machine» (Green, 1969, p. 66). Modern readers of *Bartleby, the Scrivener*, many of whom are students, start with an understanding of copy machines and work backwards to the scrivener: they are operating from this modern technological metaphor. Even the popular website Shmoop, which provides study materials and text summaries for students, defines a scrivener as «a kind of human Xerox machine» (Shmoop, 2019, p. 1). Reviewers and students today understand the drudgery, the repetition, and the lifelessness of the toiling workman scrivener through the hermeneutic of a copy machine.

This anachronistic reframing is not limited to copy machines. These lenses are also continually updated by the newest technologies. As Lisa Gitelman (2014, p. 87) wrote in her extensive history of the Xerox, «Today the idea of the photocopy has been *corrupted* [emphasis added] by our knowledge of things digital». The 'corrupted' influence that Gitelman alludes to is the propensity for human conceptions to become mired in the now, not significantly distinguishing between past and present. A critical artificial intelligence theory resists this homogenizing trend. When explicitly framed as emerging from the past rather than solely repainting the past in the metaphor of the day, new technologies can facilitate the development of a generative and revealing conception of history, one that places into context how new technologies have, as Foucault (1978) and Nietzsche (1998) might have put it, genealogically emerged from an unbroken historical chain of social practices, tools, and human behavior. After all, metaphors derived from contemporary technologies are integral to people's mental constructions of the world. These metaphors, in fact, create reality (Chun, 2011).

The newest metaphors are, of course, those of computers and artificial intelligence. The modern computational metaphor of the mind likely can be seen as early as the transition of the word computer from human to machine that occurred in the 1950s. Women had been hired as mathematical computers at California's Jet Propulsion Laboratory in the 1930s to calculate data and formulae (Holland, 2018). By the 1950s, however, their jobs–and the computer designation-were taken up by digital computers. The former human computers found new work as early computer programmers, working directly with the machines. In fact, they soon felt a special connection with an IBM 1620 computer, nicknaming it CORA and giving it its own office (Holland, 2018). The workers apparently saw themselves in this computer, and anthropomorphically treated it like one of their own. Computers soon became a technological metaphor to explain neural processes (for example, Dawkins, 1993). Since then, computers have been further anthropomorphized as humans increasingly understood themselves in terms of technological metaphors.

The consequent social-changing capacity of technological metaphors is apparent in the early AI research (between 1964 and 1966) of Joseph Weizenbaum's natural

language processing computer program ELIZA (Haenlein and Kaplan, 2019; Turkle, 2017). The ELIZA program was coded to act as a psychotherapist, eliciting conversation as a form of therapy (Weizenbaum, 1976). Weizenbaum was dismayed by the undeserved authenticity that others granted ELIZA as a therapist. His subsequent analysis exemplifies similar tenets as espoused by critical artificial intelligence theory. Weizenbaum, citing research contemporary with his ELIZA project, took issue with the reframing of humans in analogy with machines, specifically the contention that «a human therapist can be viewed as an information processor» (Colby, Watt and Gilbert, 1966 as cited in Weizenbaum, 1976, p. 6). Technology, Weizenbaum asserted, had reshaped how therapists were perceived–the language of computers became a metaphor for understanding human social roles. Humans became machine-like; machines became human-like. And today, by examining institutional systems through the AI they incorporate, we may be better able to understand institutions and how they have shaped our perceptions of the world.

The rejection of new technologies throughout history (exemplified by Socrates and Shelley) may initially appear to be incompatible with the adoption of new technological metaphors. That is, unless one recognizes recurring criticisms of technology as natural responses to new competing technological metaphors that challenge individuals already established conceptions of the world. Consider the example of *Bartleby*, however. Readers since the 1960s may have understood scriveners anew through the technological metaphor of the photocopy machine, but the institution was untouched; in fact, the ritual of copying only became further entrenched. The Xerox built upon bureaucratic tradition, perhaps liberating individuals from the monotonous task of copying but doing nothing to challenge the underlying reproduction-based workplaces of bureaucracies. It is thus that a critical artificial intelligence theory emphasizes the importance of swiveling new technologies as lenses on the past to elucidate inflexible, underlying structures of institutions reified by tools and technologies.

7. Conclusion

Returning to the questions from the introductory section of this paper, much scholarship has been devoted to making sense of technology in schools in the United States, as if the acquisition of new technologies changes schooling. Indeed, a number of my own studies have been based on theoretical frameworks that suggest new technologies are disruptive innovations for learning and facilitate materially different forms of education in schools. This is an optimistic perspective. Despite more than eighty years since Dewey (1938) identified the major challenges in United States schools, little meaningful progress has been made toward addressing them. Instead, technological innovations in schools stand in as substitutes for real, meaningful change at a systemic level. Heated discourse may rage about the best ways to use new technologies in classrooms, but the systems into which those technologies were adopted in the first place remain untouched, further sequestered from awareness by additional gadgets and programs.

Critical artificial intelligence theory suggests a way to reframe our understanding of new technologies in schools: rather than seeing new technologies as disruptive innovations, how can the forms of artificial intelligence in schools help us to understand schooling itself? By exploring how new technologies fit squarely into already existing institutional frameworks, we can better understand that tools and technologies adopted by or into school districts explicate some deeper part of the system itself. This newly adopted technology is not innovative within the context of schools; it merely repackages (often inequitable) social practices and beliefs that predated its existence. Of course, some new technologies may be apparatuses of resistance, used by students or staff to resist the institution. The point, however, remains. The critical artificial intelligence theory explained in these pages proposes a shift from thinking about technology as liberating and offering new possibilities to reframing intelligent machines as perpetuating school-based social practices of control and domination.

AI is being integrated into school institutions and curricula at a rapid pace in multifarious ways, far beyond those expressed in this paper. Some school subject areas like literacy, journalism, foreign languages, and mathematics are already seeing AI applications. And school officials using AI have increased their scope of surveillance, trawling student computer use and social media posts to allegedly detect threats to student safety (Gaggle, 2019; Kamenetz, 2019; Shade and Singh, 2016). The incorporation of AI into schooling is likely to continue as the technology advances and new programs are created.

Throughout history we have witnessed the social and institutional discourse embedded within technology slink uncontested behind normalization, culminating in arguments for or against a new technology. These debates are perhaps ineluctable, but they miss an opportunity afforded by a dispassionate eye. Critical artificial intelligence theory examines technology as an artifact of the moment, reflective of the present within a genealogical history of institutional discourse (Foucault, 1978; Nietzsche, 1998), which therefore is situated within codes of social practice and behavior.

Artificial intelligence and its implementation are not a neutral practice. It reproduces institutional discourse and produces new behaviors that further instantiate institutional norms. AI itself is often hidden within lines of noumenal code that nonetheless express social bias, no less than a written rule system codifies social behavior. As AI enters schools in manifold forms, the hidden-hidden curriculum it begets threatens to further obfuscate social practices as normal behavior. The goal of this paper is thus to raise a call for scholarship in various fields of education to disengage from the scuffle over technophilic or technophobic, to purposefully apply the hermeneutic of artificial intelligence, and to discern what artificial intelligence critically reveals about institutional practices. Modernity calls for an overdue critical theory that directly engages with the newest technologies in schools. This paper suggests critical artificial intelligence theory as one way to advance toward deeper understandings of schooling and its biases.

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