Technological Determinism and School: Is Technology Today Driving the Reshaping of Practices and Curriculum in the Contemporary Classroom?

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Abstract

With the ubiquitousness of technology in all aspects and all levels of education, educators are faced with new challenges daily and the answers are not to be found in manuals, precedent, or traditional references. This paper revisits a theoretical issue which is highly relevant in the discussion of where we are going in education today and why. The question "Does technology determine change?" is key in our understanding of what we will embrace, what we will consider, and what we will reject. Is there a choice? In surveying approaches to the question as formulated in theories of hard and soft determinism and applying the ideas to scenarios which are occurring in education today, this inquiry draws the conclusion that indeed, though the forces driving the change are not uniquely and in isolation born of the technology itself, many challenges being faced in education today are resultant of the new technology. The implications created by its mass adoption outside of the traditional educational spheres has put significant pressure on institutions and systems within education to adapt, should they remain effective and relevant. The paper argues that based on this evidence -- technological determinism is a reality in the new digital universe.
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The theory of technological determinism and in media specifically, has been debated since thinkers first started to contemplate the relationship between knowledge, the mind, our thoughts and the tools we employ to develop, record and share them. In consideration of the radical changes in the 20th and 21st century, the need to investigate and formulate a theory regarding the impact of technology and media on the human brain and society in general has come to the forefront of debate once again. The unique relationship between cognitive processes in the brain and the physiological effects of technology in shaping or molding those processes is one aspect of "technological determinism". The other more commonly discussed aspect is a query into what are the agents driving social change, their force, their roles and the nature of the relationships between the agents. The critical point of this discussion seeks to ascertain an answer to the following question: Are we consciously designing, driving, and controlling the changes in our society brought about by the technology we are creating or once created, does the technology itself take on a power of its own which we therefore must learn to adapt to and deal with, consequences intended and unintended.

In the field of education and technology we can narrow the concept of "technology" to media and those technologies which directly affect the gathering, organizing, synthesizing and dissemination of knowledge: that is to say digital media and ICTs. Obviously today, more than ever, we are facing an unprecedented permeation of new technologies in our teaching and learning environments. As educators in this period of exponential and momentous change, we need to consider the pedagogical, social, and psychological implications of this transformation so that we can be as effective as possible in attuning ourselves to this shift and the constancy of shifting - that being the new reality. As Kanuka (2008 p1) quotes Elias and Merriam;

"Theory without practice leads to an empty idealism, and action without philosophical reflection leads to mindless activism."
In examining the theories of technological determinism we refer more specifically to the idea of media determinism. In the essay, "Who's Afraid of Technological Determinism? Another Look at Medium Theory", Potts (2003) states that the changing landscape does require a second look. Also as Kanuka points out that to know where we stand from a theoretical perspective affords us the opportunity to be in control. Further to that, the philosophies we ascribe to must be practical, accessible, useful and reliable. Positioning ourselves with a firm understanding of what we are doing and why, affords us the tools to make informed decisions about how we conduct our practice in this new landscape, not necessarily giving us a map, but tools to navigate. If we ask the question "does technology determine how and what we teach?" In view of current trends and changes in education, one would have to say yes. Does technology influence the structure of those institutions? Yes.

Technologically determined change is everywhere. The shift from library to learning commons in schools, the use of ICT's in the classroom, and curriculum outlines and outcomes being revised throughout the world at all levels of education are the effect of technology driven change. The new skill sets learner s have to develop are being shaped by technological impacts. As stated in the "What If?" paper, (Ontario Public School Boards Association, 2009) "Rapid technological change, global pressures, new patterns of work are demanding a more sophisticated set of transferable skill such as problem solving communication, decision making, teamwork, leadership, and entrepreneurship and adaptability ". Furthermore, as cited in the Horizon Report (2012), the digital revolution is also bringing great challenges to traditional institutions as they face economic pressures and competition from new educational models. Apart from practical considerations regarding implementing technological changes on physical and virtual campuses, there are other pressing concerns. For one, "digital media literacy is key and training in the supporting skills and techniques is rare in teacher education and non-existent in the preparation of most university faculty." (p6). The report also goes on to cite emerging challenges in new metrics of evaluation for scholarly work,
questioning how does one compare research that is disseminated via blogs, tweets, ratings, tags, etc. They also state that "Institutional barriers present formidable challenges to moving forward in a constructive way with emerging technology", explaining that there is great resistance in established (post secondary) institutions as the adoption of new technologies is seen outside of the traditional roles of faculty, researchers, and scientists. As well, libraries and university collections are facing challenges in how to curate and facilitate collections and "are under extreme pressure to evolve new ways of supporting and curating scholarship". It appears that these necessary changes are not welcomed by all nor were they planned. Rather, they are the repercussions of the impact of the digital revolution which comes from the outside.

**History and technological determinism**

In a technology led theory of social change, technology is seen as the "prime mover" in history. Daniel Chandler (2003) makes a simple comparison to economic theory whereby it is a technology "push" rather than a society or demand "pull" phenomena. Or as Gens Pedersen puts forth in his article on Technological Determinism in the School (2001) the question is: "Is the development of technology autonomous and inevitable and does it determinethe development of society? " Various schools of thought have arisen in the fields of historical, social, and philosophical theory. The black and white argument can be seen as the extreme view points between hard technological determinism and its counterpoint, social determinism. Does technology have a logic of its own or is it socially constructed,? Within the spectrum of these two opposing theories are variations of thought and analysis which consider the interplay of causal agents: society, politics, economics, science, technology and are shaped by philosophical approaches. In the article "Technological determinism in educational technology research: some alternative ways of thinking about the relationship between learning and technology" Oliver, M. (2011) provides a summary of current schools of thought regarding technology in society. He too advocates that "alternative conceptions of technology is important in developing our understanding of the relationship between technology and learning, and identifying potential methodological implications." (2011)
In his discussion of technological determinism, Oliver outlines four current theories which can be labelled "soft" determinism or "holistic". These contrast to other theories such as media determinism as proposed by Marshal McLuhan in the 1960's which could be defined as "hard" or "reductionist". In the four theories Oliver outlines, the common aspect is that the changes technology affords on society are the result of agents or actors in differing roles or relationships creating a formula for change. He also comments on the usefulness of each of these theories as well. The popular theories in this "soft" camp include Activity theory - which understands the role of technology through the use of tools which mediate the actions of society and it must be understood in a historical and cultural context. Technology mediates action it doesn't control it. These theories are in accordance with the ideas of Vygotsky, commonly associated with social development theory in psychology. In this context the user is in control of the tools. The Communities of Practice theory proposes that technology is created by the community for the community and that it is a socially constructed tool which is reified or treated as an object that is restructured so that all in the community are able to use it. There is a consensus that this change is to be brought upon the practitioners and also there is an obligation to participate. Actor Network Theory (ANT) proposes a model of interrelationship in the roles of the actors or agents, social, conceptual, and technical, in the formula of change but doesn't assign any particular reason to look at what is driving the change -- just to observe and analyze what is happening and thereby adjust or account for impacts and outcomes by looking at the agencies impartially when the system "fails". SCOT - or the Social construction of technology argues that technology does not determine human action, but that rather, human action shapes technology or that technology is the consequence of practice.

The array of variations within the school of thought of technological determinism suggest an implicit interrelationship between the creative forces of society shaping the technology and the control over the desired outcomes. This is still in opposition to a hard determinist stance which would concur that technology itself once created takes on an independent force or power by nature of its construction and the form of the
technology has the ability to impact change beyond its intended function or use. The various theories within the camp of technological determinism all serve to explain probable cause and effect in different scenarios; however, it does appear that more and more the simple "hard" deterministic viewpoint is gaining validity as we view changes in the educational arena. While new technologies introduced into society are adopted, they are also effecting unintended consequences, both positive and negative. The "society" that has created them or agreed to participate in the development and use of them, and focussing mainly on teachers in our context, is left struggling with a maze of new technologies. These technologies do not come with pre-identified contraindications or neat manuals indicating best practices. Rather, they are new forms of media and tools and require new models. Technology is driving the change. Arguing against this reductionist stance, Goguen (2003) declares the concept of technological determinism as totally false. He says "technology is always a product of society, and therefore technology is never autonomous; moreover, technology and society are always mutually interacting, always mutually co-arising." It seems the main argument is that the creation must come from somewhere and that somewhere is us. His fear of granting an independent power to the force of technology is a reaction to what he believes is the exploitation of a (lesser than wise) society by these claims, and as a defense to protect us against exploitation and the "evil potency" of such a theory by corporate, organizational and ideological interests. It would seem that by denying the aspect of technology which propels and creates or invents a new paradigm of its own intrinsic nature, it can be deemed to not exist or to be the creation of an ideological campaign. Rather, in my point of view, it would be more productive to view the constructs which have arisen from the new technology and see what is it that the powers that be are so quick to exploit and recognize as something that can revolutionize or impact our daily lives.

Another aspect of the equation of whether or not society or technology is in control would be to look at the current state of educational practices. There is growing pressure to conform to the new technologies, be they mandated, prescribed or suggested. However, it is also met with great resistance as there is still massive doubt brought on by this grand experiment in technology in the classroom. Accordingly, as
several authors have pointed out, it would seem that ironically, education is one of the last institutions in the modern world to use technology openly and willingly. (West and Bleiberg, Huffington post 2013) (Pearson 2009). If change were societally driven, it is more than likely that the schools today would be exactly as the schools of 30 years ago. Change is work. Change is unsettling. Change is not for everyone. Technology is driving the change, not the society, for the society of education and educators are not the ones driving the revolution. They are not creating the technologies that have become indispensable to networking and communication. But, they must now find ways of integrating them into their educational practices which makes sense in relation to the reality that is outside the halls of the school.

When Marshal McLuhan wrote "Understanding Media" in 1964 he brought forth key concepts inherent in the idea of technological determinism: “The most significant cultural and social effects of media derive from the intrinsic properties of the media itself”. He believed that “the medium shapes and controls the scale and form of human association and action” and in his time, that the advent of mass media for example - the television - brought a shift from the individual consciousness to a "tribal" or group consciousness. With the massive use of collaborative social media tools, this group consciousness has become even more profound today. In addition to the power of media to shape culture and societal values, the other effect aspect of media theory is concerned with the relationship to the cognitive processes of the human mind. More specifically, that the media tools we use to develop our knowledge may indeed alter and shape the processes in perceiving, remembering, organizing and synthesizing information. This idea of "neuroplasticity " or how one adapts to environment through the 5 senses and our brain is shaped has also become key in contemporary studies of the effects of technology on the brain. In fact, the ideas of media theory are not totally new as one can see a historical antecedent in the writings of Plato in 370 BC as he bemoans “writing is the debasement of memory - the degradation of thought”. Neitzche in 1882 states that with the invention of the typewriter: “our writing instruments contribute to our thoughts” and in more recent times, Ong (1982) "Writing more than any other single invention has transformed human consciousness, introducing
“intellectual technologies” which brought about different cognitive potentiality – analytical, rational, artificial memory, linearity, abstraction…"

Neil Postman, a student of McLuhan and a theorist in education, also proposed a set of theories outlining the relationship of media to the self and society. He stated that although the effects are not inevitable they are unpredictable. In his view of technological determinism, "the uses made of technology are largely determined by the structure of the technology itself, that is, that its functions follow from its form". (Postman 1979) He proposes that '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. They will classify the world for us, sequence it, frame it, enlarge it, reduce it, argue a case for what it is like. Through these media metaphors, we do not see the world as it is. We see it as our coding systems are. Such is the power of the form of information' (Postman 1979, p. 39).

He argued that:

"(1) because of the symbolic forms in which information is encoded, different media have different intellectual and emotional biases;
(2) because of the accessibility and speed of their information, different media have different political biases;
(3) because of their physical form, different media have different sensory biases;
(4) because of the conditions in which we attend to them, different media have different social biases;
(5) because of their technical and economic structure, different media have different content biases." (Postman 1979, p. 193).

Postman also puts forth "The Frankenstein Syndrome". He states that "One creates a machine for a particular and limited purpose. But once the machine is built, we discover, always to our surprise - that it has ideas of its own; that it is quite capable not only of changing our habits but... of changing our habits of mind' (Postman 1983, p. 23).
Prenksy and the Digital Age

Decades later, Marc Prensky working in the field of educational psychology and teaching - proposes a similar idea to the writings of Ong and how literacy revolutionized thought. Prensky also proposes a theory of cognitive change or evolution which is based on digital enhancements that extend our faculties in unprecedented ways. In the article "From Digital Immigrants and Digital Natives to Digital Wisdom "(2009), Prensky proposes that digital technology enhances memory, for example, via data input/output - through external memory banks, PDA's, internet resources etc. Digital data-gathering and decision-making tools enhance judgment. We are capable of deeper analysis and are able to plan and prioritize with the help programs to analyze second and third order effects. Massive networking and collaborating opportunities enhance our insight into others and offer alternative perspectives. An intelligent person in this digital age is one who is cognizant that the digital information and programs available to us are to be used as extensions of our personal intelligence or as he coins the phrase - digital cognitive enhancement. “As technology becomes more sophisticated, developing the capacity to help us make moral and ethical choices as well as more pragmatic decisions, what we call "human wisdom" will reach new levels.” While Prensky is clearly subjectively optimistic about the effects of digital enhancements, neuroscience is also looking carefully at the effects of digital stimulation on the brain and is indeed finding that overstimulation creates problems in short term memory and cognitive functioning tests.(Miller, 2013)

In the article Digital Natives and Digital Immigrants (2001), Prensky speaking of the divide in education between the "natives" (young students) and the "immigrants" or teachers says:

“It's very serious, because the single biggest problem facing education today is that our Digital Immigrant instructors, who speak an outdated language (that of the pre-digital age), are struggling to teach a population that speaks an entirely new language... school often feels pretty much as if we've brought in a population of heavily accented, unintelligible foreigners to lecture them”(P9)

Prensky also goes on to categorize new learning styles which teachers must adapt to and exploit if they are to be effective in the classroom.
"Digital Natives are used to receiving information really fast. They can parallel process and multi-task. They are used to graphics before their text rather than the opposite. They prefer random access (like hypertext). They function best when networked. They thrive on instant gratification and frequent rewards. They prefer games to “serious” work."

Whether these are positive attributes or negative, the fact is he is correct in saying that this generation is inherently cognitively different due to the phenomena of "neuroplasticity". As he states:

“It is now clear that as a result of this ubiquitous environment and the sheer volume of their interaction with it, today’s students think and process information fundamentally differently from their predecessors.”(P4)

The concept of neuroplasticity is not new. And now more than before, science is calling for more studies regarding the effects of these new technologies on the brain."Our brains evolve with new technology by creating new pathways that were never there before. "No one is born knowing how to read a clock, but when the technology was invented, the brain learned to use it" Miller explains in "Neuroscience in the Digital Age"(VennScience 2013). As presented in a summary of the article Miller wrote as part of a series in the Providence Journal (2013) the findings do support the idea of digital technology "rewiring" the brain... and not necessarily all positive changes.

"The brain will adapt as new technology is created but what effect does digital stimulation have? Scientists conducted an experiment on mice and found that over-stimulated mice performed worse in short-term memory and cognitive functioning tests. This is especially critical during a persons developmental stages. Any non-ordinary brain stimulation can have adverse affects on the neurocognitive function as an adult. In the first two years of age a child's brain grows three times in size and is unable to filter out surroundings forcing the brain to process everything it senses. Mobile devices use 4 out of the 5 senses at once causing an overload in information for the brain to handle. Every experience we have forces the brain to rewire."

In general there has been a call for more research in this area as in fact, there is little definitive research up to now. Increasingly, science is being called in to analyze the digital impact in many aspects affecting the physiology of the human being and the role of neuroscience in education. (Jones, 2012)

In his paper Digital Natives Digital Immigrants(2001) Prensky also refers to what he believes are various changes that must be made in the educational system to adapt to two changing conditions of the effects of technology on education."Digital natives" who have been shaped by the new technology are placing demands on an outdated
education system that must change its focus and curriculum to prepare for the world the digital natives will be entering into (specifically as a work force). Concurrently methodology and practice must adapt to "new" digitally influenced learning styles and cognitive processes of the new generation which have been shaped by their early childhood learning experiences and "real world" education. The "digital immigrants" or the teachers, who have not grown up in this environment are struggling to understand the new culture and the natives who speak a different language. While in his later article Prensky notes that the relevance of this argument is becoming less and less as we move into the 21st century, the issue remains of what is even the "digitally wise" teacher to do in the classroom. Is the new landscape populated with digital super kids who can multi-task, teach you how to use the latest program, come up with their own PLP and lead and participate in a multiplatform discussion group on "The Hunger Games" while designing, scripting and creating a multimedia presentation on Leonardo? Prensky also says:

"A lot of our kids say they come to school and they say when I come into the building I have to power down. They don't mean that devices. They mean their brains. They mean they get to do more powerful stuff outside of school than they do inside of school." (2010)

Thus, it seems, the brain is changing to adapt to the new media. Curriculums, learning objectives and outcomes are changing to keep up with the new demands created in a digitally powered work place. And finally the institutions in their architectural, institutional, organizational, and instructional designs are having to be restructured and designed to adapt to the driving forces.

NEW PARADIGMS FOR LEARNING

One of the most definitive examples of technological determinism in our society today may be illustrated by the shift of the school library now known as the "Learning Commons". Educational institutions from elementary to secondary to university to public libraries have embraced or are being called to embrace this new paradigm shift of a learning centre. The Learning Commons is a collaborative, dynamic and interactive common place of learning designed to invite the learners into comfortable environments
where conversations take place and technology drives research and response. It is an exciting space – physical and virtual, that belongs to every learner where face to face and online activities unfold, in group and/or individual setting (Reierson, K. 2012). The role of the teacher librarian has also changed – now TL’s are guiding students through the myriad of resources of information available to their students – essentially the world – engaging on a research inquiry project today is completely different than what is was even 5 years ago.

School Districts now pay for access to hosting databases such as Alexandria, EBSCO, etc. – and students have to be taught how to find information through these rich sources of literally thousands and thousands of possibilities. The skill set required to navigate through the resources of the internet is situated around literacies that necessitate a higher order and critical thinking competency. TL’s today are focusing on teaching skills to their students through inquiry and research that enable them how to effectively find and use information to problem solve and make decisions; how to access, use & understand databases & other media sources. They are being taught evaluation skills such as how to assess a website’s credibility & relevance; how to discern and make sense of bias and differing perspectives; how to use different types of sources and recognize the perspective from which they are written.

Digital Citizenship is also a new concept which is being taught. Students are learning how to respectfully use the internet; about fair use and Creative Commons; how to build and create bibliographies using online programs to give appropriate credit and be respectful of the work of others; how to build an appropriate digital profile on social media such as Facebook and Twitter; how to safely share & collaborate online using tools like Dropbox and GoogleDocs.

Changes also affect faculty roles and responsibilities. In the learning commons, the teacher and teacher librarian also shift in their roles and work as a team. For example at Samuel Roberts Technical in Maple Ridge, teachers spend time collaborating with the teacher-librarians to create innovative and engaging inquiry based learning projects. They support teachers in learning new technologies, using online
resources, establishing teacher websites, and using other online media. Also, now with access to technology, teacher librarians are building virtual libraries through networking with each other within districts, communities and around the world. I.e, a Maple Ridge high school library is collaborating with a Coquitlam high school library and together they have shared and built lesson plans and databases on inquiry projects that all teachers may access – from anywhere, anytime.

On a larger but less specific scale, news from the BC Ministry of Education, announced they are currently moving to adjust their curriculum to facilitate" fewer outcomes and more flexible curriculum that is less prescriptive while focusing on higher order learning". (BC Min of Ed Doc. Jan.2013 ) While this shift is to enable teachers to innovate and personalize learning and focus on essential understandings that support lifelong learning, it would seem that technology and schools servicing the 21st century learner also play a key role in driving these changes. The personalized learning and innovations that will occur in the classroom will be determined by the technology teachers will employ and how and what they teach will be shaped through these mediums. For example, classes using i-Pads, math teachers doing lessons on smart boards through blackberry notebooks that students have access to and can respond to the main screen, students using apps to create their own lessons in response to a math lesson, English novels are downloaded, and lit circles can be facilitated through a Prezi conference, students respond to conversations through Twitter, Tumblr, wikis, and blogs. Conversations take place digitally now.

Many middle school and high school principals have the expectations that all their staff have websites so that parents and students have access to homework, lesson plans, and assessments, etc. on a regular basis. Many teachers are moving to multiplatform and inquiry based and project learning designs. Teachers now maintain websites wherein whole units and lesson plans are accessible to students in an "anytime anywhere” model. Technology is driving pedagogical practice.
CONCLUSION

Technology builds capacity for social networks, collaborations and communications within the classroom walls, outside the classroom walls and beyond the classroom walls. As presented in the Pearson Education video series "A Canadian Perspective" : “this is not an information age – it is an age of networked intelligence” and that intelligence pervades throughout all spaces that we inhabit. "The "connect" and "disconnect" factor of engaging students today in the classroom has everything to do with using technology. Students are “powered up” and we are technically asking them to power down when we do not acknowledge the tools at their fingertips and in their pockets”.

"We have to accept as educators that technology is not really a choice. It has created a world. Its not just here to help you teach traditional subjects. It has invented. It has emerged a completely new environment."

Knowledge at all levels is available to anyone now with technology, not just those previously few privileged. The world is now a virtual classroom. The question is what should learning look like in today's classroom, not what machines or devices to use. The teacher is the expert guide -facilitating development of critical thinking skills. Now more than ever students need to be able to discern what is true. The human element is the same but dynamics have changed. The role of the teacher in directing and guiding the student in the new arena is critical. Educators have a duty to adapt fiercely to these changes and to help to navigate through the multiple universes of the digital literacy age. If we do not adapt to the shift, and adapt the education system at an equal pace to technological changes, our schools are ineffective and possibly will become, as we know them, obsolete. While the idea of connectedness and communication are key factors permeating the new age, we can see that the social power of the digital tools is key in determining their success, their relevance, and their longevity....and the new "invented" world has created a need for a dramatic change in educational settings should they remain relevant. A complex interrelationship of the agents of technology,
the social forces driving them, the communities of practice which accept or reject them, the politics, economics, and designers are all responsible for creating the technology. However, it does appear that also, the technology itself once created, by virtue of its intrinsic properties has autonomously impacted change on society in ways that were not predicted, envisioned, or prescribed. The causal agent is the agent itself. The new form invented invents a new society.
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