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The co-dependent relationship of technology and communities

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Abstract

Technology is one the defining features of humanity. It is ubiquitous in modern society and plays an important role in nearly everything that humans do. New technologies frequently spur our imagination, can evoke powerful emotions and often serve as the topic of heated debate. Many people are in awe of the power and potential of new technologies while others fear its increasing importance in human life. New technologies can create new employment opportunities, spawn new businesses and even revitalize entire economies. Conversely, they can cause unemployment, destroy long-standing organizations and lead to global economic upheaval. While technology undoubtedly impacts people and societies in profound ways, people and societies also impact the development and use of technologies. The intelligence, dedication and support of numerous people, businesses and social groups are needed to develop even relatively simple technologies. Once developed, new technologies rely on a myriad of economic, social, human and political forces for their continued use and expansion. The field of learning technologies serves as an important and interesting case in which to explore the complex relationship between technology and society. In this paper, we will provide an overview of some of the most important philosophical and theoretical views of the relationship between technology and social systems, describe key issues related to the topic that are important for Learning Technologists to consider, and provide a series of recommendations for research and practice.

Introduction

One of the most fascinating things about technology is the impact it has on various aspects of our lives. From the earliest moments of humanity, perhaps around 3 million years ago (de la Torre, 2011), technology has played an important role in the development of human beings and our cultures. In a very real sense, the success of humans as a species is inexorably linked to advances in technology. Technologies related to agriculture, the domestication of animals, the creation and control of fire, language, metallurgy, currency, water and steam power, printing, transportation, communication, health and medicine, and electricity represent only a few of the tens of thousands of technologies that have significantly influenced human history. Even focusing more recently in the area of learning, a vast number of technologies, including books, projectors, films, audio and video media, computers, interactive white boards, the World Wide Web, mobile devices, and software for management and record keeping, have had a profound impact on the education

Practitioner Notes

What is already known about this topic

- Technology has become an important component of nearly every aspect of modern life and influences developments in numerous fields and industries.
- Many of the most important philosophers in history, including Aristotle, Marx and Heidegger, have devoted much of their work to the topic of technology.
- "Technological Determinism," one of the most enduring philosophical perspectives of technology, holds that technology has become essentially autonomous and beyond direct human control.
- The "Tool Metaphor," another widely held perspective of technology, holds that all technology is a tool that people and societies use in more or less rational ways to achieve specific goals.

What this paper adds

- The discussion of newer and emerging philosophical perspectives of technology, including Social Construction of Technology, Co-Construction of Technology and Sociotechnical Systems Theory adds to the growing body of literature in those areas.
- The application of both traditional and emerging perspectives of technology provides a unique framework for analysis of current and future developments in the field of Learning Technology.

Implications for practice and/or policy

- Learning technologists should find a balance between the power and functionality of technology and the inherently human and social nature of learning when designing, developing and implementing new programs
- Technology should not be viewed as value neutral but as the embodiment of a complex system of political, social, economic, and technical priorities and philosophical stances.
- Learning technologists should try to anticipate and account for the unintended consequences of a new technology and ensure that the core values of any learning organization are not compromised during the process of technological expansion and progress.
- Given the extremely complex, insidious, enduring and ubiquitous nature of technology in modern society, Learning technologists must develop new models for investigating and understanding the relationship between technology and learning and must avoid simplistic, Decontextualized or superficial research into the topic.

and training of millions of people worldwide. Just as it is becoming increasingly difficult to think about humankind independent from the technology we use, it is becoming increasingly difficult to think about learning independent from learning technology.

This ubiquity of technology helps to ensure that it is a common topic for discussion in contemporary life. Current perspectives of technology are shaped from a variety of sources. It is likely that the average person thinks about and interacts with technology many times throughout the course of a day, and engages in brief discussions that are at least indirectly related to technology a few times a week. These experiences contribute to the development of numerous theories of technology and build our fascination with the topic. In fact, humans have sought to understand technology for centuries. Some of the most important philosophers in history have focused on technology in their scholarship and writing. Philosophers such as Aristotle (1984), Bacon

(Scharff & Dusek, 2014), Marx (Wendling, 2009), Heidegger (1954), McLuhan (1964) and Ellul (1967) each challenged the conception of technology that was dominant in their time and provided powerful and enduring ideas that shape the way we view technology today. For example, among Aristotle's many profound contributions to the philosophy of technology was his belief that natural objects and technological artifacts should be considered as fundamentally different entities (Schiemann, 2005). Technologies, according to Aristotle, existed outside of nature and were brought into being by human action. McLuhan's (1964) iconic statement "the medium is the message" is, upon closer examination, more a statement about the pervasive role technology plays in shaping our understanding of the world than it is a statement about "media" in the traditional sense. Ellul (1967) saw technology as a monolithic force that insidiously drives human desires and has effectively transcended direct human control.

In addition to academic and philosophical stances, many authors and filmmakers have sought to understand the relationship between technology and humans. In fact, many of the most influential and widely acclaimed works of literature have focused on the interplay between technology and people. Orwell's *1984* (1949), Bradbury's *Fahrenheit 451* (1953), Huxley's *Brave New World* (1969) and Collins' *The Hunger Games* (2008) are among the most well-known fictional examples of how technology might be used to control human behavior and thoughts and create ostensibly perfect societies. The mass media also contributes to our personal and societal fascination with technology. Even a cursory glance at any news channel or pop culture event will provide many examples of the latest and most powerful technologies. These examples can help provide insight into cultural perspectives toward technology. The portrayal of Learning Technology in films suggests that popular culture views technology as a means for creating or erasing certain knowledge, skills and attitudes in people and for changing the time structures required for learning (Mehta, Henriksen & Mishra, 2014). Learning Technology has also been viewed as a pathway for enabling new types of instruction to occur (eg, Mitra, 2005, Mitra & Dangwal, 2010; Papert, 1993; Siemens, 2005), and has fundamentally shifted the way that some other approaches to instruction are practiced (Baker, 2014). The dynamic interaction between technology and humanity is certainly intriguing and has shaped our perception of it over the years, but the nature of technology has also been passionately debated and is still not commonly agreed upon.

Technology does not have to play the dominant role in a human interaction in order to have a significant impact. Even the mere presence of technology in a given context can change how people interact within that context. For example, it can force us to reframe and reevaluate the basic design of our work environments (Jasperson, Carter & Zmud, 2005). It can provide new outlets that amplify our ability to express personal characteristics, be they positive or negative (Ehrenberg, Juckes, White & Walsh, 2008). Technology can also become addictive to us so that we cling to it at all costs (Turel & Serenko, 2010). It can be unpredictable and the introduction of a technology often has unintended consequences (Tenner, 1997). Technology can change what behaviors are considered normal within a given situation. It can be intentionally designed to influence the occurrence of certain behaviors over others so that our preferences and behaviors are shaped by its affordances (Berdichevsky & Neuenschwander, 1999; Lockton, Harrison & Stanton, 2008; Norman, 1988). These designs can even encourage certain emotional reactions to the technology that impact how we view it (Norman, 2007). In fact, people tend to project feelings of emotional reciprocity upon certain types of technologies—feelings that we need it and it needs us—even though it, of course, cannot feel (Turkle, 2012). It is evident that technology can have profound effects on the way that we interact with it, with each other and with our surroundings in many situations.

Technology is often introduced into a social system with the stated intention of making life easier for people. With the advent of technologies such as pervasive smart environments that will soon be capable of recognizing our faces and customizing their services (eg, responsive to human needs, or using laser-focused targeted advertising) (Saha & Mukherjee, 2003), holographic technologies that promise to change the way that we practice education (or at least add a new tool to our boxes) (Hassel & Hassel, 2012), the power of gamifying education (Gee, 2007), adaptive learning environments (Papanikolaou, Grigoriadou, Magoulas & Kornilakis, 2002; Wolf, 2003) and more, the technological landscape is constantly changing and evolving. It is evident from these changes that technology is growing ever more intertwined with what it means to be human, and will not likely be separated anytime soon.

While there can be no doubt that technology has greatly impacted the course of human history, it can also be seen that humans, and the organizations and societies we develop, have impacted technology. Human ingenuity, personal desires and needs, the collective talent and hard work of many individuals, macroeconomic trends and market forces, and the combined focus of organizations, governments and entire nations all play a vital role in how technologies are developed, which technologies succeed and fail, how technologies are used, and how technologies evolve and expand. Isaacson (2014) provides an intriguing example of this interplay through the history of digital technology. There is, therefore, little doubt that a codependent relationship exists between technology and humans. We are dependent on technology for virtually every aspect of daily life and that dependence will likely increase over time. Technology, for its part, is dependent on humans for its continued development, maintenance, expansion and refinement. Just as human existence is dependent on technology, so is technology's existence dependent on humans.

Theories of technological and social systems

In this section, we will provide an overview of the various perspectives about how technology and social systems interact. The paper will include a brief discussion of traditional perspectives of the relationship between technology and humanity, such as the instrumentalist and determinist views, and then move on to more current perspectives such as social construction of technology (SCOT) and sociotechnical systems (STS).

We should note here that we are going to use a very broad definition of technology in this paper. A narrow definition of technology would frame technology as an individual artifact or collection of artifacts. Under the narrow view, for example, one might look at a tablet computer or mobile communication device in the classroom and study the use or impact of that device on student learning. While the narrow definition is certainly appropriate for many situations and commonly used, we feel that a much broader definition of technology is required. Under this broader definition, we see technology as inclusive of not only artifacts, but also of the knowledge required to create, employ and effectively use those artifacts, as well as the systems and structures that enable their development and use. In the earlier example, while most would agree that a tablet computer qualifies as "technology," we would also include the pedagogical practices used by the teacher, the school and school system, and the scientific advances needed to create mobile devices in our broader definition of "technology."

Traditional views of technology and society

There are many different perspectives about the relationship between technology and society. As noted earlier, researchers, philosophers, practitioners, authors, critics and casual observers have been engaged in seemingly continual debate about every aspect of the relationship. Much of the past scholarship in the area of technology and society has framed their relationship in dichotomous terms. Technology has traditionally been portrayed as good or bad, wildly expensive or a method for drastically reducing costs, empowering or enslaving, uniting or isolating, and in other such ways. For example, there is a large body of literature devoted to the fundamental impact of technology on society. Authors in this area of the literature tend to either have a utopian perspective in which advances in technology are seen as leading to an increasingly better state for humans (eg, Johnson, 2014a; Kelly, 2010), or a dystopian perspective (eg, Forster, 1909; Huxley, 1969; Orwell, 1949; Postman, 1985) in which advances in technology are seen as leading to an increasingly worse state for humans.

One of the most enduring and popular debates about technology and society focuses on whether technology or society is the driving force in the relationship. Technology has often been seen as either the dominant force in the growth and direction of societies (Ellul 1967), or as a mere tool that societies consciously develop and employ as needed to achieve some desired result. There is even debate about the proper questions to ask about the relationship between technology and society, the most appropriate methods for conceptualizing and studying that relationship, and whether discussion on the topic should have a technical focus or a societal focus. Because there is no one universally accepted theory about the relationship between technology and society, one has to have an extremely broad frame of reference when trying to understand the relationship.

Instrumentalism and the tool metaphor

One of the oldest perspectives related to technology and society is the "technology as tool" metaphor. The Tool Metaphor sees all technology as tools that are developed and used by humans to serve specific needs (Surry & Land, 2000). In this perspective, technology is seen as value neutral with no inherent positive or negative characteristics. In the classic example, a knife can be used for good purposes, such as preparing a meal, conducting surgery or carving a sculpture, or for bad purposes, such as attacking someone or defacing a work of art. The knife itself is a value neutral tool and only comes to be seen as beneficial or harmful depending on the motives of the person wielding the knife. By extension, the application of any technology can be seen as dependent on the motives of the society that creates that technology.

The Tool Metaphor, sometimes referred to as "Instrumentalism," is appealing for a number of reasons. There is an undeniable simplicity and elegance to the metaphor. Proponents of this perspective can point to many well-known examples that seem to support instrumentalism. For example, nuclear power can be a clean and efficient source of energy or be used as a weapon of mass destruction; the Internet can be used to enhance social interaction and provide vital information during a crisis, or it can be used as a tool for increased governmental intrusion into our private lives; and new medicines can be used to combat disease and illness or they can be used illegally with often deadly results. Another appealing aspect of the Tool Metaphor is that it does seem to be useful in explaining the interaction between technology and humans, at least on a micro level. Individual decisions to employ a tool for good or bad are very common and often obvious in their intent.

There are many examples of the Tool Metaphor within the area of learning technology. In fact, on a basic level, every new learning technology can be seen as a value-neutral tool. For example, web-based instruction can be used as a tool for increasing enrollment, improving the economic viability of an organization, creating innovative new learning environments and offering flexibility to learners, or it can be used as a tool for reducing educational quality, consolidating or expanding an individual's power within an organization, adding unnecessary costs to the learners, and eliminating faculty positions. The value of web-based instruction in this example is, therefore, dependent on the motivation of the people who are using, and fostering the use of, the tool.

Despite its appeal, there are major problems with the tool metaphor (Borgmann, 2009). The most common criticism of instrumentalism is that it is too superficial to adequately account for the complexities of the human/technology relationship. On a small scale, this criticism is evident in the fact that technologies themselves can be value-laden artifacts. For example, they are often products of design processes that involve large groups of people. As such, the design products can have hidden biases, affordances and assumptions built into them. Therefore, it is especially important that these biases be taken into account when implementing technology into the learning environment (Chen, 2007). It may be even easier to see this criticism of instrumentalism when using the metaphor to explain the human/technology relationship on a large, societal scale. While it is often clear whether an individual using a knife has altruistic or malicious intent, the intent of organizations and societies is often much less obvious. The premise of technology as value neutral is also suspect in that it ignores issues such as the politically imbued nature of technology; economic and power disparities in how technologies are funded, developed, accessed and employed; and the often murky and ill-defined ethical dilemmas presented by new technologies. Using our earlier example, we can see that an organization's decision to move to web-based instruction is based on more than just a decision to use one tool or another, but also on a variety of economic, social, political and organizational issues. Also, such a move would likely result in both positive and negative outcomes, some of which are unforeseeable and often will occur after a long period of time has passed. As a result, it is often impossible to link specific outcomes of technology use, either good or bad, to specific human or organizational decisions. Given these considerations, reaching a consensus and judging the ultimate value of a technology to an organization or social group as being positive, negative or neutral is a complex effort, perhaps one that is impossibly complex.

Technological determinism

Technological determinism is another long-standing and widely held perspective of the relationship between humans and technology. It is the belief that technology is the dominant cultural, societal, technical and economic force in human history. Determinists believe that technology, while it may once have been under direct human control, has become so large, so complex, so integrated and so pervasive that it has gone beyond direct human control and become autonomous (Ellul, 1967). To use a colloquial phrase, determinists believe technology has "taken on a life of its own." Determinism is usually thought to have two theoretical "camps"—hard determinism and soft determinism. Hard determinism discounts any meaningful control of technology's effect on the human condition and views technology as a monolithic force that cannot be satisfactorily understood through the analysis of small parts or localized impacts. Soft determinism agrees with the basic premise that technology is the dominant force in human society, but assumes that humans still have more or less control in the development and impact of technology.

While technological determinism is not currently a prevailing view among scholars in this area (Jones & Bissell, 2011), it endures as a strongly held perspective among certain groups (Wyatt, 2008). Determinism continues to be an influential perspective for understandable reasons. For one, it seems to effectively explain the impact of technology on human societies, especially on a large-scale, macro level. It is easy to view the modern world as driven by technological developments. We can see many examples of how technology is shaping human needs and desires, growing so large and complex as to defy micro level analysis, homogenizing historical cultural differences, and moving beyond the direct control of any one organization or nation. For example, the automobile in its earliest days could have been seen as a technology under direct human control, but over time, the widespread use of the automobile has altered nearly every aspect of human life worldwide, changed the way cities are designed and evolve, created some industries and professions while virtually eliminating others, and shaped our views on a number of key human activities ranging from dating to family dynamics, to clothing styles, to career and educational planning. Most would agree that studying the impact of one car or one part of a car, decontextualized from the massive physical infrastructure, economic impact and societal trends that surround the automobile would result in a relatively superficial understanding of the situation. Another reason for determinism's enduring appeal is that many who have a dystopian view of technology are drawn to determinism's depiction of technology as an autonomous force, beyond human control.

Viewing the field of learning technology from a deterministic perspective can be a useful activity. When looking at one classroom or training facility, it is possible to view the technologies in use as the result of individual human or organizational decisions. For example, an interactive white board might be purchased by an individual, perhaps on the recommendation of a committee. That interactive board is then used on a routine basis by various instructors and learners in a rational, useful manner. However, a broader perspective would reveal that interactive white boards, and the software and associated technologies needed to use them properly, were developed and marketed by large teams of people in diverse locations over time. The choices of the committee or person responsible for purchasing the interactive white boards were made possible by national, state or local budget priorities, and were no doubt molded by their experiences with other technologies, the use of technology by their competitors, the cost, power and functionality of various technology options and, at least in part, by a desire to stay current with technological trends. It is easy, therefore, to see that the choice to purchase interactive white boards was not only an instructional decision but was shaped to some extent by technology itself and by a number of other social and technical factors. Determinists would argue that all decisions about learning technology, in fact, at least to Hard Determinists, all human actions are shaped by the power, pervasiveness and influence of technology to some extent. The extent to which one believes technology shapes human and social actions places one in either the Hard Determinist camp or the Soft Determinist camp.

The main problem with the deterministic perspective, especially Hard Determinism, is that is seems to discount the obvious role that people play in the development and use of technology. While technology can at times seem to be too large and complex to be under human control, all technologies were conceptualized, designed and development by humans. Also, there are times when societies and governments act to limit or alter the scope of technology's use. For example, a city can ban or limit the use of automobiles in certain conditions or a national agency can limit the application of controversial biomedical or manufacturing technologies. Also, while on a macro level technology can appear to be autonomous and to have moved beyond direct human control, the same phenomenon can be viewed as the accumulated result of numerous individual human decisions over time.

Emerging views of technology and society

While traditional perspectives of the relationship between technology and society, such as Instrumentalism and Determinism, are still widely held, in recent years, several newer perspectives of the relationship have emerged. We will discuss three of the more widely held newer perspectives in this section. Perhaps the most widely held current belief about technology is SCOT. This can be seen as a response to, and the opposite of, determinism. SCOT has its foundation in the tool metaphor but expands upon it by seeing technological development and use as the result of extremely complex social conditions. Social constructivists believe that it is impractical to study technological developments independent from human activity (Pinch & Bijker, 1984), and believe instead that technological developments are inherently human and social in nature. Social constructivists focus their analysis of technology on the social, economic, human and organizational conditions that lead to the development, growth, success or failure of a particular technology. They also believe that trying to judge if a particular technology is "good" or "bad" is a moot question as different stakeholder groups will interpret the value of a technology differently.

SCOT is a powerful and useful theory because it provides a much more in-depth analysis of technological development and use as well as a more nuanced view of the concept of human control. Rather than seeing a knife as a simple tool to be used for good or evil, social constructivists view the development and use of certain types of knives as being the result of a long series of human, economic and social processes. They would also view the application of the knife for any purpose as something that could be interpreted as good or evil depending on which stakeholder group is in a position of power at the moment. This is often referred to as “interpretive flexibility” and is one of the key characteristics of the SCOT approach (Park & DeLong, 2009).

A social constructivist perspective of the introduction of a learning technology into an organization, for example, training delivered to mobile devices, would look at the power structures within the organization, communication channels, organizational culture, and other social and economic factors that resulted in the adoption and utilization of one technology over competing technologies. Social constructivists would also be interested in analyzing the way different stakeholder groups within the organization view the new learning technology and their reactions to the process by which the technology was adopted and diffused throughout the organization.

Critics of SCOT often point to several weaknesses in that perspective (Park & DeLong, 2009). The main criticism is that SCOT seeks to maintain the value neutrality of technology. By viewing technology as value neutral and open to interpretation, social constructivists are often criticized for failing to account for the power disparities inherent in technological development and for minimizing the impact of technology on disenfranchised or marginalized groups. Another criticism is that SCOT often discounts technical advances that enabled new technologies or inspired new technological directions without being specifically created by social processes. A third common criticism of SCOT is that is places too much emphasis on the role social interactions play in technological development while diminishing the role physical and material properties of technology play (Dery, Grant, Harley & Wright, 2006).

Co-Construction of Technology (CCOT) (eg, Oudshoorn & Pinch, 2003) is another emerging perspective of the relationship between people and societies. CCOT is an attempt to merge elements of determinism and social construction. A co-constructivist would attempt to understand both the human and technical conditions in place that lead to the development and use of a new technology. The advantage of this approach is that it places equal value in human and technical forces that interact to create new technologies. The primary criticism of co-construction, like any attempt to find a middle ground, is that it fails to adequately describe the impact of either human or technical aspects on the development of a new technology.

Closely related to the idea of co-construction are sociotechnical views of technology. The STS perspective sees all human activities as taking place within a system in which the social groups and various technologies interact in extremely complex and subtle ways (Klein & Kleinman, 2002; Pinch & Bijker, 1987). Social groups and technologies are seen as being in a continual state of tension. The needs, desires, goals and preferences of people within an organization or society drive the types of technologies that are developed and used by the group. At the same time, the power, cost, utility and perceived value of any technology drive the desires, decisions, activities and imagination of the people within a social system. Under this perspective, human activities and technical developments are in a constant spiral with advances or changes to one impacting the direction of the other. Sociotechnical theorists discount the social/technical dichotomy and prefer to think of humans and technologies as both parts of a larger system.

Viewing a university or any educational or training organization as an STS can produce interesting insights. Rather than viewing an educational organization as a static collection of separate parts, STS theory would view the organization as a dynamic, evolving and highly integrated system in which learning technologies, organizational structures, and people interact and influence each other. A new group of learners, for example, might express a desire for a certain type of learning technology which would, in turn, necessitate organizational changes.

STS theory is the basis for other emerging theories, most notably the ecological perspective of technology. The ecological perspective sees all people and technologies as existing in a manner analogous to an ecosystem, with each person or stakeholder group and all technologies occupying a certain niche within the system (Adomavicius, Bockstedt, Gupta & Kauffman, 2007). Within the larger ecosystem, stakeholder groups and technologies interact; their various niches expand, contract and evolve over time; and various groups and technologies compete or cooperate in numerous profound and subtle ways. The introduction of any new technology into a social system or organization is likened to the introduction of a new species into an ecosystem with all of the changes brought on by the new technology as being impossible to predict or control. The unpredictable, indirect and often delayed impact of any new technology will likely result in both desirable and undesirable unintended consequences (Tenner, 1997).

As with every theory about the nature of the interaction between people and technology, there are criticisms of the sociotechnical or ecological view (Clegg, 2000). The main criticism is that STS theory is too vague or ill defined to serve as a useful analytical tool. Other criticisms are that STS is too conceptual, offers little in the way of practical application, and focuses too much on the social aspects of the human and technology relationship.

Other newer theories about the interaction between technology and humans include Giddens's Structuration Theory (Jones & Karsten, 2008), Actor Network Theory (ANT), Activity Theory and Communities of Practice (Oliver, 2011). While a fuller discussion of those theories is beyond the scope of the present paper, they each provide interesting insights into the ways that technology and social systems interact.

Practical aspects of technology and social systems

To this point in the paper, we have provided a fairly theoretical discussion of the relationship between technology and social systems. The various traditional and emerging perspectives of technology and society create a fascinating spectrum of viewpoints. Because there is no single, widely accepted perspective, and because many of these viewpoints are contradictory and incompatible, it is easy to discount or ignore certain perspectives. It is also easy to dismiss the entire discussion as irrelevant, pedantic and abstract with no "real world" application. However, dismissing the discussion as academic or impractical would be a mistake. The various perspectives are all present in any organization or social system. These perspectives drive decision making and influence the direction of any organization, including educational organizations, in direct and tangible ways. In this section, we will describe a few of the key issues for learning technologists to consider and offer some recommendations on how to use the different perspectives of technology and society to enhance practice and research in the field of learning technology.

Considerations for learning technologists

The adoption, implementation, diffusion and evaluation of new technologies are important factors in the success and growth of any organization. Like organizations in other fields, schools, universities and other learning organizations are constantly trying to identify and acquire new technologies in order to provide a better product, access and serve new markets, and increase profitability. Learning technologist and other professionals within a learning organization play a vital role in ensuring the effective use of new technologies. This role has traditionally included such activities as identifying technological needs, securing funding, selecting among competing technologies, and supporting the installation and use of new technologies. While all those activities are important, the learning technologist must also understand and account for the complex relationship between technology and people within the organization. In this section, we will provide six important issues related to this relationship that learning technologists should consider.

Finding the proper balance between maximizing the power and potential of technology while maintaining the human and interpersonal aspects of learning is a key issue for learning technologists. Aristotle's dichotomy between "natural" and "technological" can still be seen today in many of the debates related to learning technology. Many people claim that learning is an inherently natural and human process in which technology is at best an unnecessary and expensive addition or at worst a major obstacle to learning. There is a small but growing number of schools that seek to eliminate or at least minimize technology's role in the learning process (Kang, 2012; Richtel, 2011). Technology can be seen as a dehumanizing, isolating and debilitating force that limits creativity and disables authentic communication and expression. A crucially important issue for all learning technologists to consider is what differences, if any, exist in processes and outcomes between learners in natural, human, "non-technological" learning environments and learners in technology-rich learning environments.

A second key issue for learning technologists to consider thoughtfully is the value neutrality of tools used for learning. It is easy to simply view new hardware and software tools for learning as value neutral. A new interactive white board is, on one level, just an inanimate object with no values or morals. However, when viewed from a larger perspective, every learning technology came into existence as the result of a large number of value-laden actions. In the most obvious example, new technologies cost money—money that is often taken away from some other technical or nontechnical area of the budget. Decisions about what types of technology to purchase or not purchase, how money is allocated, which projects are made priorities, which content areas are targeted for technology use and which learners are given access to technology are all deeply value laden and directly linked to the moral, ethical, political and financial views of stakeholders at various levels of the decision-making process. Even those who argue for the value neutrality of technology often concede that on a macro level, social and technological forces prevent us from employing technology in a truly value-free manner (Sundström, 1998). Learning technologists have a moral responsibility to ensure that technologies are acquired and used in a manner that considers traditionally underrepresented, powerless and marginalized groups of learners. It is also important to consider the interpretive flexibility of learning technologies and to try to understand new technologies from multiple perspectives. While some groups may welcome a new technology, others may see the technology as threatening, dehumanizing and ineffective.

Third, learning technologists should also consider the driving forces behind the adoption and implementation of technology. When making design and engineering decisions, there is often some level of tension as to whether technological desires, organizational factors such as financial considerations or human needs will be the central driving focus (Boy, 2013). These focal tensions lead to trade-offs that are often evident in the design and implementation of various technologies, and can have a tremendous impact on the acceptance and use of those technologies.

Fourth, learning technologists have to understand and account for the issue of ultimate control of technology. As discussed in this paper, there are long-running discussions and debates as to whether technology is even controllable, and if so, whether humans possess that control. In a more practical sense, it is vitally important to think about how the acceptance and use of any given technology limits the possibility of making alternative choices. Vendor lock-in is a good example of this. For example, an organization's adoption of a Learning Management System from a given company may prohibit the later consideration of other, possibly better, alternatives due to costs of switching, skill deficiencies, sunk costs in implementing the original system and so on. This can lead to an organization continuing the use of an inefficient system even though it may be aware of a better system. The acceptance and use of various technologies can also set powerful, and often unseen, limits that control what performance options are available for use. Many technologies are reductionist by default because they simply are not capable of enabling the full range of actions, emotions or capabilities that humans can perform (Lanier, 2010). Adopting these technologies means giving up some portion of the previously available actions in exchange for using the technologies. Therefore, in deciding which technologies to adopt, it is vitally important to consider the trade-offs and constraints that come packaged with each.

Fifth, there are many possible unanticipated and unintended consequences of learning technology that are important for all learning technologists to consider. For example, the evolution of glass from its discovery as a desert phenomena until its use in powerful space telescopes has impacted everything from literacy and fashion (eg, spectacles) through to unlocking the secrets of disease and space (eg, microscopes and telescopes) to enabling global interconnectedness of the Internet (through fiber optic cables) (Johnson, 2014b). The discovery of glass and the analysis of every technology subsequently developed from that discovery provide a nearly limitless set of examples of how one new technology leads to a myriad of unintended consequences, both good and bad. The shift to online and hybrid learning as a dominant model of education has, and will continue to have, a tremendous and unpredictable impact on a wide range of possible areas. For example, the shift to digital learning has broadened the reach of education, highlighted new questions about societal obligations and ability to provide a free universal education, sparked dialogue over which literacies will constitute minimal competence in the future, created new pressures and questions of ethics on academic labor, enabled the mass distribution of open educational resources and massive collaborative learning, boosted open accessibility to research, and much more. People have a natural tendency to look at the short term, positive potential of technology without necessarily considering the long term or potentially negative results of such technologies. Critically considering the consequences of technology is essential, as many of the consequences of its use are unintended, unseen and impossible to fully predict.

A final issue for learning technologists to consider is the ultimate impact of technology on learning. Technology can be seen as having a positive or negative impact on society as a whole. Few would argue that new technologies for learning are impacting people and organizations around the world. The real debate is whether technology is making the learning experience better or worse for those people. Are new technologies actually helping people learn, do new technologies enrich the lives of learners, do new technologies connect people and foster more authentic interactions or do they isolate people and force superficial interactions, do new technologies liberate or enslave learners and if so, in what ways? These are just a few of the vital questions all learning technologist must consider.

Recommendations for practice

Our first recommendation is to be aware of the complex relationship between technology and people. We often think about amazing technological advances and begin to plan for using the latest technology without pausing to consider how the technology will impact people and learning. Technology planning should be expanded to include not only the traditional questions related to cost, infrastructure and support, but also discussions of the way technology will impact the organization, whether technological or learning goals are driving decision making within the organization, and whether all stakeholder groups are given an adequate opportunity to provide input into the process of technology adoption and use.

One practical way to accomplish this would be to establish a rigorous technology adoption process that seeks input from all possible stakeholder groups, intentionally looks for nontechnological alternatives and searches out other possible options that could fulfill the need that adopting a given technology would accomplish.

Our second recommendation is to consider, account for and, when possible, anticipate unintended consequences of learning technology. If we view all people and technologies within an organization as part of a larger complex system, we can see that any new technology will result in changes throughout the entire organization. Some of these changes will be direct and expected while others will be indirect and unexpected. The adoption of a new learning technology should not be viewed as the end of a process, but the beginning of an often lengthy process in which changes to the organization, modifications to the technology, and new interpersonal and social dynamics will take place. One way to start approaching this issue would be to begin the practice of concept mapping the technology, tying it to all other parts of an organization and its larger system while performing a "what-if analysis" where dynamic interdisciplinary teams brainstorm possible consequences (perhaps starting with the extremes) of implementing a technology.

Our third recommendation is to constantly ensure the focus of any learning technology is on learning and those who will be the end-users of a new technology. Technological determinism cautions us that technology can sometimes become autonomous and cause us to frame human and organizational decisions in technological, rather than social terms. The power, convenience and capabilities of new learning technologies can often cause organizations to focus more on the technology itself rather than how the technology will be used to foster learning and improve the lives of the end-users. This focus on end users could be approached by adopting technologies primarily based on how well they fulfill the needs of the users, and establishing periodic evaluations of how well the technology continues to meet those needs. This could also be supported through creating anonymous feedback mechanisms that give the end-user a meaningful voice to report their experiences and shape future decisions. Yet another approach to focusing on the end-user is to create an organizational culture of technological literacy. This approach would require an incubator of sorts where everyone becomes involved in activities designed to increase technological capability, and then participate in some type of forum to share their experiences and develop new ideas and practices. This makes everyone an end-user and enables dialogue from multiple perspectives.

Our fourth recommendation is to consider the ultimate value of learning technology within an organization from multiple perspectives. It is very unlikely that the decision makers within a school, university or other learning organization will purposely purchase or implement a learning technology they believe will make the organization less effective or cause the organization to have a negative impact on its community. However, it is important to remember that technology can be seen as value neutral and that different stakeholder groups will likely view any technology from very different perspectives. A technology that is seen by one group as powerful, empowering and liberating could well be seen by another group as counterproductive, overly complex, unnecessary and enslaving. Seeking out, valuing and accounting for the multiple perspectives, especially the perspectives of traditionally powerless or marginalized stakeholder groups, when considering a new technology will not only facilitate implementation, but is also an ethically sound practice. The creation of a technology committee with representative membership from all possible stakeholders (ie, customers, students, managers, users, financers, community members, suppliers, etc.) could prove valuable for understanding the varying perspectives toward different technologies.

Recommendations for research

If we accept that technology and people have a complex, interdependent relationship, we must agree to avoid simplistic or superficial methods to study that relationship. Future research in this area should seek to have a holistic, long-term and contextualized focus. Research that examines the immediate impact of one technology on one small group within an organization is, in our opinion, inherently flawed. Longitudinal ethnographic studies that examine the complex interaction between people and technologies within educational organizations offer the greatest promise for future research. Case study research is another method that seems to offer a great deal of promise in this area. We especially recommend case studies into the implementation of new technologies, the impact of new technologies on end-users, the inclusion or exclusion of various stakeholder groups in technological decision making, and the response to any unintended consequences that might appear.

Because we know that there are differing philosophical stances about technology and humans and that the philosophical stance of a person or group can have a dramatic impact on which technologies are adopted and used, it is imperative to study the philosophical stance of various stakeholder groups. These groups include learning technologists, managers, learners, technical staff, and community and governmental leaders. More research into which perspectives are predominant among these different groups, how those perspectives influence practice and technology planning, how people with various perspectives interact, and which perspectives, if any, are minimized or excluded from technological discussions would likely result in important insights into our field.

Given the varied and sometimes incompatible perspectives about technology, it is also important that researchers sharing their findings own up to their own beliefs and biases in their writings. There is already a strong precedence for this in qualitative research, and it is especially important for consideration in writings about technology. It would also be fruitful for researchers to perform a series of content analyses on existing writings on technology to take stock of what has been written, what perspectives of technology exist and what gaps may exist in the literature on the topic. With the active and sometimes intense dialogue about technology that has existed for centuries, it is very likely that there is a good deal of overlap and forgotten nuances that could inform current perspectives in meaningful ways.

Conclusion

Technology plays an important role in learning. Even before the rise of the Internet, computer-based instruction and various digital tools, it was hard to conceptualize human learning without thinking about tools as an inherent part of the process. Books, chalkboards, pencils, desks, globes, maps, flash cards, manipulatives, pointers and projectors are just a few of many physical technologies that have been closely associated with learning for many years. Other "soft" technologies such as theories of learning, instructional techniques, administrative practices, the importance of education, the organization of curricula and methods of assessment have their roots going back hundreds, if not thousands, of years.

Many of the same issues and concerns that accompany the relationship between technology and society as a whole also exist when technologies are used for learning. The philosophical perspective of learning technologists and other stakeholders within an organization can have a profound impact not only on learning but also on the lives of the people who use the technology, the overall health of the organization and society as a whole.

As we have seen, there is no widespread agreement about the relationship between technology and society. While there is a natural human tendency to view any relationship in simplistic and superficial terms, the relationship between technology and society is much more confused, serendipitous, recursive, contextualized and ecological than can be represented by even the most detailed philosophical perspective. Some perspectives view technology as the driving force in human history while others view technology as a tool that people create and use.

The relationship between technology and society is best described as codependent where the very existence of either depends on the other. In addition to being codependent, the relationship between technology and society can be seen as complex, imperfect and profound. As a result, societies and organizations often develop and use technology in an extremely reactionary, ill-advised and counterintuitive manner. Meanwhile, technology's impact on society is often unpredictable, far reaching and insidious. All technologists have a very real moral obligation to at least try to think about the impact of technology on people. Learning technologists, we believe, have an even greater obligation to consider and control, to the extent possible, the relationship between technology and people in order to maximize technology's potential to enhance human capabilities and potential.

Statements on open data, ethics and conflict of interest

No empirical data were collected from individuals or groups during the development of this conceptual paper. As a result, data cannot be accessed and there were no ethical issues related to the selection and treatment of subjects associated with this paper. The authors had no conflicts of interest during the development and publication of this paper.

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