Abstract
This position paper explores the ambiguity of technology, toward refined understanding of Educational Technology. The purpose of education is described by John Dewey as growing, or habitual learning. Two philosophical conceptions of technology are reviewed. Dewey positions inquiry as a technology that creates knowledge. Val Dusek offers a “consensus definition,” a systems approach to technology that merges into social construction theory and actor-network theory, both of which emphasize complex relations between humans and technology. Using Dewey and Dusek as reference, literature related to Educational Technology is reviewed. A history of its definitions and conceptions of hard (material) technology and of soft (process) technology are examined. Three brief case studies reveal a bias toward hard technology in contemporary discourse. A misconception that soft technology begins with pre-authenticated knowledge is identified and shown to obscure the reciprocity between technology and the intellect.

Key words: educational technology, inquiry, technological systems approach, technology, tolerance of ambiguity

Résumé
Introduction

The purpose of this position paper is to explore the ambiguity of the “Educational Technology” (ET) concept, specifically, the meaning of the word “technology.” At its simplest, ET appears to pertain to the application of mechanical and material tools (especially, computers and computer programs) to problems in education. A more complex conception of ET includes immaterial tools, such as processes and ways of thinking, and it addresses the causal interdependence between intellectual growth and technological growth, whereby technology is not merely processes and tools, but is understood systemically.

In part one of this paper, I offer a functional meaning of the term “education.” John Dewey (1916/1944) provides a comprehensive and versatile description: the ultimate end of education is habitual learning, characterized as intellectual growing (p. 53). For Dewey, knowledge is continuously and interactively transformed, learning takes place in experience, and ideas are understood as temporal, not final. In part two of this paper, I consider two complex conceptions of technology. In Dewey’s theory, productive inquiry can be understood as a technology that produces and transforms knowledge, which challenges the apparent ontological superiority of intellect over technology. Val Dusek (2006) claims that the “consensus” definition of technology is characterized by a systems approach, as opposed to a tools or a rules approach. Dusek’s definition implicates human and non-human actors and emphasizes relationships. In part three, with Dewey and Dusek serving as reference, I review literature related to ET. I begin with a brief history of the field, including its evolving definitions as provided by the Association for Educational Communications and Technology (AECT). The AECT distinguishes between hard and soft technology. Conceptually, hard technology identifies mainly with computers and material tools. Soft technology includes immaterial resources, such as processes and rules. With three brief cases studies of contemporary academic and political discourse related to ET, I find a bias of attention on hard technology. Furthermore, I detect a lack of impact of Dewey’s insistence on the continuous reconstruction of knowledge through technology and of Dusek’s insistence on the complex relations between various actors within a system. I conclude with thoughts about contemporary interpretations of ET.

My goal is to use Dewey and Dusek to critically evaluate existing theories of ET. The main issues that I consider are: (a) limited interpretations that restrict ET to applications of hard technology and (b) a misconception that technology always begins with pre-authenticated knowledge, which de-emphasizes the situation of the human in the system and the reciprocity between technology and the intellect. I advocate sensitivity to broad interpretations of technology. Working with its ambiguity potentially invigorates ET theory, dispels myths that limit ET to matters of hardware, challenges the concept of pre-authenticated knowledge, and demystifies human-technology co-evolution.
Education and Growing

I choose Dewey’s theory of education because it is comprehensive and generalizable. Dewey’s theories share similarities with many other philosophers’ theories. For example, Jerome Bruner emphasizes experience in the construction and reconstruction of a learner’s world; Paolo Freire dismisses the “banking” concept in education, wherein facts are deposited into the learner; and Lev Vygotsky insists that practical activity directly contributes to learning and development. Likewise, Dewey had concerns about experience, facticity, and activity. In the following paragraphs, I briefly explain his position on growth and its relationships with habitual adaptation to experience, evolution of knowledge, and the act of inquiry.

Dewey (1938/1997) writes, “The educative process can be identified with growth when that is understood in terms of the active participle, growing” (p. 36). In general, growing means continuous physical and intellectual evolution and adaptation. Continuity implies that deliberate, intellectual operations emerge from organic activities, “without being identical with that from which they emerge” (p. 19). The intellect grows out of biology: our earliest habits are biological; we use our organs and appendages for inquiry. However, the environment in which humans live is both biological and cultural. While biological growth has concrete consequences, intellectual growth allows for the symbolic representation and rehearsal of consequences, which gives experience another dimension: the ability to learn and to pass customs and traditions across generations. Thus a society reproduces itself, which leads us to the purpose of education.

Education cultivates a habit to learn. To be clear, Dewey (1916/1944) differentiates between two aspects of habit. Habituation refers to “a general and persistent balance of organic activities with the surroundings,” while habitual adaptation refers to the plasticity of an organism, its “active capacities to readjust activity to meet new conditions … The former furnishes the background of growth; the latter constitutes growing” (p. 52). As an example, “for the child to realize his own impulse by recognizing the facts, materials, and conditions involved, and then to regulate his impulse through that recognition, is educative” (Dewey, 1956/1990, p. 40). Capacities to readjust activities deliberately in order to develop future experiences may appear to be teleological, yet not in the popular sense of reaching for final ends, but in the sense of searching for and testing “ends-in-view,” ideas about the future. Learning reflects this ongoing, purposeful evolution of knowledge.

Echoing Darwin’s theory of evolution, Dewey (1910) preferred examining change rather than permanence. He preferred “treating the forms that had been regarded as types of fixity and perfection as originating and passing away” (p. 1). For Dewey, education is not about conveying a fixed set of ideas, recipes, or tools. Knowledge is not intrinsic, not discovered, not absolute. Rather, knowledge is applied, tested, and subject to transformation. To create a capacity for knowledge, the security that one seeks in final certainty must be transformed “from inert dependence upon the past to intentional construction of a future” (Dewey, 1929, p. 290). With inquiry serving as a means, learning becomes an end in itself.

Dewey (1930/1999) championed inquiry because “a program of ends and ideals if kept apart from sensitive and flexible method becomes an encumbrance” (p. 82). While ideas, recipes, and tools do serve a purpose (warranted by situations), Dewey’s instrumental philosophy emphasizes acquisition and exercise of ideas above ideas themselves. Rather than dislocate ideas from practice, Dewey stresses the continuity and interactivity of experience. He sees ideas as
instruments of discovery both for individuals and for society at large. Pragmatically, what an idea does constitutes its meaning. Ideas thus function as malleable tools of inquiry – ends and means – for the development of further logical and ethical ideals. In effect, knowledge is practically organized for the liberation of human intelligence. Inquiry challenges intellectual and cultural limits, ad infinitum.

**Conceptions of Technology**

In this section, I introduce the AECT’s conception of technology, then, I examine two philosophical conceptions of technology. Primarily, I turn attention back to Dewey. His insistence on the inseparability of means and ends lead to a discussion of inquiry as a technology that produces knowledge. Secondarily, I review Dusek’s theory of technology. Dusek provides a consensus definition of technology that treats technology systemically. It is his position that technology is constructed within a relational network of many types of actors.

The AECT, in their 2008 definition of ET, includes both hard technology and soft technology. Specifically, by soft technology, the AECT means “intellectual processes” – transformative methods or actions that facilitate learning and performance (Januszewski & Molenda, 2008, p. 196). As an intellectual process, technology is thought to mediate between inputs and outputs (see Figure 1). By focusing on “human made processes that systematically apply scientific knowledge,” the AECT intentionally neglects “nontechnical processes, such as cognitive processes, biological processes, and spiritual processes” (p. 197). The AECT’s demarcation between “technical” and “nontechnical” processes is interesting. It attempts to delineate which processes belong in the field of ET and which do not. However, this demarcation appears subjective; the boundary between processes that are intellectually intentional and those that are not can be blurry. That the intellect must inform technology presupposes the existence of a pre-authenticated intellect. One might ask: Where does the intellect come from? Dewey and Dusek suggest that not only does the intellect give rise to technology but that technology also gives rise to the intellect.

![Figure 1. The AECT’s Input – Process – Output paradigm. Adapted from Educational Technology: A Definition With Commentary by A. Januszewski and M. Molenda, 2008, p. 196.](image)

The AECT’s demarcation of “technical” versus “nontechnical” processes can be challenged. Dusek suggests that technological processes exist in a system that includes but is not necessarily dominated by the intellect. This approach places humans, organizations, skills, and tools within complex systems. Dusek also evaluates the neutrality of technology, and he points out the
inextricable feedback between technology and society, which can be disproportionate in either direction. For Dewey, technology includes inquiry – an interactive, experiential process that habituates intellectual adaptation. Here, prioritizing intellect ahead of technology is illusory: knowledge itself is understood as a technological artefact.

Dewey’s Conceptualization of Inquiry as Technology

Dewey (1938) defined inquiry as “the directed or controlled transformation of an indeterminate situation into a determinately unified one” (p. 117). Inquiry, or questioning, provides interactive recourse to situational dissonance. Productive inquiry adjusts prior experiences to future experience. It yields resolution: warranted assertions. These assertions act as regulative tools. Dewey’s emphasis on the interactive nature of tools provides relief against the view of tools (including knowledge) as separate and objective artefacts; his emphasis on the continuity of experience provides contrast to the idea of discrete moments, which, aside from their sequence, may appear disjointed. Dewey instead suggests that tools are carried into the continuity of experience and transformed through controlled inquiry. Knowledge itself, including conceptual definitions, can be seen as a tool that comes alive through the process of inquiry. Furthermore, the process of inquiry can be understood as technological in that it utilizes, activates, and refashions prior knowledge.

Unlike habituation, whose blind allegiance to impulse rigidly assumes one situation to be essentially the same as the next, Dewey’s (1916/1944) principle of knowledge rests on the freedom of prior experience to be subject to, and informed by, new experience. According to Dewey (1956/1990), experience is educative to the extent that an individual can realize his or her impulses by recognizing the conditions involved, and then regulate those impulses intentionally through that recognition. For example, a mechanic who understands a machine only by virtue of habitual repairs will find himself lost when an unexpected situation arises, whereas a mechanic who understands the machine “knows the conditions under which a given habit works, and is in a position to introduce changes which will readapt it to new conditions” (Dewey, 1916/1944, p. 340). This general pattern of productive inquiry – goal-oriented thinking and regulated action, where theory and practice merge – is “in its robust sense” a technology (Hickman, 2001, p. 181). The process of inquiry utilizes and produces material and immaterial technological artefacts (including knowledge), and the artefacts themselves can be viewed as technologies (recursively emerging). Critically, this general pattern applies to all types of inquiry, “cases that involve what we would call hardware, and it also fits cases that are patently conceptual … it applies to logical and mathematical proofs, and it applies in social and political inquiry” (p. 33).

Knowledge clearly enters into the process of inquiry. Yet knowledge is also a product of inquiry – a technological artefact. By placing knowledge in both positions, as input and as output, knowledge ceases to be stuck in the position of an a priori (before experience) object of reflection. Knowledge, evolved, can be conceived as an a posteriori (after experience) result of reflection. Based on this appraisal, science could not be ontologically superior to technology: the tool of inquiry creates knowledge, as opposed to a unilateral view that knowledge creates the tool (Hickman, 2001, p. 10).

Dewey (1916/1944) questions the precedence of science to technology. He favours continuity over discrete dualisms, deploring the false dichotomy of ends versus means (p. 333). While acknowledging that abstract intellectualism promotes clarity, consistency, and much-needed
relief from superstition, he also writes of its “formal and empty nature”; “bare logic, however important in arranging and criticizing existing subject matter, cannot spin new subject matter out of itself” (p. 299). Inquiry is deemed technological precisely when it regulates the ongoing development of knowledge. This learning process, Dewey says, is based in continuous and interactive experience. Reducing the educative wealth of experience to a formal process of applied intellect, as the AECT definition might imply, could promulgate an unfortunate illusion. Ambiguously, the intellect must also be viewed as a product.

**Dusek’s Systems Approach as a “Consensus” Definition**

Dusek (2006) examines various definitions of technology. He suggests a systems approach as the “consensus” definition of technology. According to Dusek, the consensus definition is “the application of scientific or other knowledge to practical tasks by ordered systems that involve people and organizations, productive skills, living things, and machines.” (p. 35). Dusek distinguishes this conception, which combines both hard and soft technologies, from other definitions of technology, as hardware or as rules. He says that the hardware definition is most obvious – tools are literally graspable – and this “lies behind much discussion of technology even when not made explicit” (p. 31). For example, technology is routinely symbolized by icons such as rockets, factories, microscopes, and computers. However, this “hard” definition of technology fails when one claims that a technology does not use either tools or machines, such as Dewey’s inquiry and the psychologist B. F. Skinner’s behaviour technology, conditioning. The definition of technology as rules refers to “patterns of means-end relationships,” or goal-directed methods (p. 32). This approach better accommodates Dewey’s and Skinner’s theories. However, it must be noted that, for Dewey especially, “ends do justify the means, but not every end is sufficient to justify its means. Ends and means must be fitted to one another” (p. 58). In the systems approach, technology can be understood to have “a life of its own” (p. 36).

According to Dusek (2006), “Advocates of the technological systems approach have recently begun to ally with or even fuse with the social construction of technology approach” (p. 36). Social construction of technology implies that technological artefacts, including inventions, devices, and concepts, are made and remade not by individuals but by people working together. The construction involves current and historical social context, power relations, and systems of meaning. In this analysis, technology means different things to different people, humans and technology are deeply interrelated, and technology ceases to be understood as neutral. “The technological system cannot be neatly separated off from the rest of society or nature” (p. 208).

Closely related to the social construction approach is actor-network theory (ANT). According to Latour (2005), ANT is a theory “about how to study things, or rather how not to study them – or rather, how to let the actors have some room to express themselves” (p. 142). The actors, or participating agents in the network, may be human or non-human, living or inanimate. The main thrust of ANT is that relationships must be examined. ANT denies any division between social and material worlds; it does not privilege the human. The main criterion for the inclusion of things to be examined within the system is that the things (human or not) do something. “If they make no difference, drop them, start the description anew. You want a science in which there is no object” (p. 154). In other words, ANT wants to relinquish attention from symbols and objects, and focus instead on the role of the thing in relation to the rest of the system. ANT is not exactly an easy theory, because it requires us to rethink the world, including: our belief in an essential nature of things; our habitual separation of sociology from technology; and our de-emphasis on
non-human agents in the system. It is akin to Dewey’s emphasis on change. What effect a thing has (and will have), as opposed to what a thing is, is significant.

How might these insights inform ET? In the following section, I will examine what educational technologists propose is the meaning of technology and I will compare and contrast popular definitions with Dewey’s and Dusek’s theories. We will find that there are voices actively promoting soft technology and a systems approach; however, there is also a dominant voice that holds that technology exists materially and objectively, separable from its social relations.

Educational Technology – Literature Review

“Technology” refers to applications, methods, theories, and practices that are used to reach desirable ends, especially industrial and commercial ends (The American Heritage Dictionary, 2009; Collins Dictionary, 2003; Random House Kernerman Webster’s College Dictionary, 2010). I refer to this type of dictionary definition as inclusive of soft technology, which the AECT defines as “human made processes that systematically apply scientific knowledge” (Januszewski & Molenda, 2008, p. 197). This soft conception approaches but may not meet either Dewey’s theory of inquiry, which is explicitly interactive and continuous, or Dusek’s technological systems approach, which emphasizes networks of relationships. More commonly, technology suggests a subordinate entry in the dictionary: “electronic or digital products and systems considered as a group” (The American Heritage Dictionary, 2009). This popular conception of the equivalence between technology and electronic tools greatly diminishes the scope of technology: it ignores methods, theories, and practices; it downplays technological-social relations; and it focuses mainly on computers. I refer to this exclusive conception of technology as hard technology. This hard conception sharply contrasts with Dewey’s and Dusek’s conceptions.

In my review of literature related to ET, I find a common divide between proponents of hard technology and proponents of soft technology. The first part of this review provides background with a brief history of ET, including evolving AECT definitions. I find that those who have worked over the years to define ET often write in favour of recognizing the relevance of soft technology. Despite their efforts, I find bias toward hard technology within contemporary ET research and literature. In the second part of the review, I present this bias, discernible through three brief case studies: an analysis of two recent U.S. government publications related to national ET implementation; a search across current peer-reviewed journal articles indexed under the ET keyword in the Education Resources Information Center (ERIC); and an appraisal of “technology knowledge” within the popular Technological Pedagogical Content Knowledge (TPACK) framework. Next, in the third part, I review more generalized conceptions of technology. While broader interpretations represent an improved recognition of the potential of technology in education, some soft technology conceptions still limit our understanding of the term because they prioritize intellectual knowledge over technology, thereby de-emphasizing the role of technology in the cultivation of the intellect, in contrast to Dewey’s inquiry as technology. I offer explanations for the existence of these biases in the conclusion of this paper.

A Brief History of Educational Technology and its Evolving Definitions

According to Alan Januszewski (2001), former chair of the Definition and Terminology Committee (DTC) for the oldest professional and academic association related to ET, the AECT,
ET has invested more time and energy trying to define itself than any other field. Januszewski and Molenda (2008) suggest two primary reasons for this investment: practitioners’ desire to stake out a professional niche and desire for legitimization through “certainty in the meaning and use of terminology in our field” (p. 348). By the strictest of standards, Januszewski (2001) acknowledges that no dictionary definition meets its formal criteria, that is, the inclusion of everything that belongs in its description and the exclusion of everything else. Luppicini (2001) and Januszewski agree that the creation of an authoritative ET definition appears to be a political act. Definitions are not value-neutral. Definitions are socially constructed, reflecting choices and circumstances.

Theories of ET emerged early in the twentieth century, alongside improvements in industrial efficiency, developments in audiovisual equipment, and growing interest in instructional psychologies (Januszewski, 2001; Luppicini, 2007). The application of science to education was viewed from at least three different perspectives: some chose to agree with G. Stanley Hall that curriculum research should occur in natural environments to better align with children’s natural behaviour; some followed Dewey, modelling science as an active process of reflective inquiry; and some adopted a scientific approach primarily as a means for precise standards and measurements (Januszewski, 2001).

James Finn, an early proponent for a professional field of ET, advocates a systems approach to instructional problems (Beckwith, 1988; Luppicini, 2008; Reiser & Ely, 1997). Finn (1962) echoes Dewey’s sentiment that “ends and means are inseparable … ends become means to further ends” (p. 32). This thesis of inseparable ends and means can be bewildering. For example, Januszewski (2001) questions Finn’s non-intuitive description of “automation”: Finn ambiguously suggests that automation is technology and also includes technology. The idea that technology (i.e., automation) includes itself (i.e., other technology) requires contemplation through a systems approach. Finn describes “automation in education” not as “a manless, machine-operated production,” but instead as a systemic “way of thinking involving patterns and self-regulation” as well as containing further technologies, such as “long-range planning” and “wise decision-making” (Januszewski, 2001, p. 23). In other words, technology, as an apparent end, can be recast as an apparent means within a broader technology. Recall Dewey’s distinction between habituation and habitual adaptation: automation, interpreted weakly, suggests habituation (learned repetition); in contrast, Finn’s strong interpretation of automation suggests habitual adaptation, which involves the recognition of impulses and conditions (here: recognition = ends) and regulation through that recognition (here: recognition = means).

Finn’s emphases on processes and systems theory influenced the first formal definition of the field, which was attributed not to ET but to “Audiovisual Communications” (under the auspices of the Department of Audiovisual Instruction, DAVI). The 1963 DAVI definition reads: “Audiovisual communication is that branch of educational theory and practice concerned primarily with the design and use of messages which control the learning process’’ (Ely, 1963, p. 18, as cited in Reiser & Ely, 1997, p. 65). The next definition referred explicitly to ET as the AECT came to replace DAVI in 1970. Here is an excerpt of the 1972 AECT definition of ET: “Educational technology is a field involved in the facilitation of human learning through the systematic identification, development, organization and utilization of a full range of learning resources and through the management of these processes’’ (Ely, 1972, p. 36, as cited in Reiser & Ely, 1997, p. 67). The full definition includes several themes: human-centred instruction (as
opposed to controlled), a continued emphasis on a systems approach, and a greater emphasis on physical resources in comparison to processes-as-resources (Januszewski, 2001, p. 67). According to Januszewski and Molenda (2008), this de-emphasis on processes – a setback for the profession – was motivated by the 1970 Presidential Commission on Instructional Technology, which primarily attended to the role of media in instruction.

The 1977 AECT definition of ET reads in part: “Educational technology is a complex, integrated process, involving people, procedures, ideas, devices and organization … involved in all aspects of human learning” (AECT, 1977, p.1, as cited in Reiser & Ely, 1997, p. 68). Januszewski and Molenda (2008) suggest that, by re-emphasizing processes, the authors of the new definition reacted against the 1970 Presidential report. The new definition suggests that ET itself is a process that includes other performance technologies (i.e., procedures, ideas, organization); and, by infusing the definition with systems concepts, the authors imply that the use of systems concepts is also a process. The complexity of the 1977 definition and the perceived need to stake out professional territory led to a focus on simplification. The 1994 AECT definition reads: “Instructional technology is the theory and practice of design, development, utilization, management, and evaluation of processes and resources for learning” (Seels & Richey, 1994, p. 1, as cited in Reiser & Ely, 1997, p. 68). Here, the authors switch labels from ET to Instructional Technology, which, while synonymous with ET, appears to be more precise, emphasizes learning with instruction (as opposed to incidental learning), and implies more settings for practice. This definition includes an explicit focus on soft technology, including techniques and strategies.

In their most recent definition, the AECT has reverted to the ET label and continues to stress soft technology. Less is said of the social construction of technology and of ANT. The 2008 AECT definition of ET reads: “Educational Technology is the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources” (Januszewski & Molenda, 2008, p. 1). Januszewski and Molenda (2008) acknowledge that other definitions and conceptions of ET exist beyond the AECT definitions, that the current AECT definition is only a “snapshot” in time, and that “when looked at from this perspective, when it comes to educational technology, we may never really know what we are talking about” (p. 349). Current chair of the DCT, Nancy Hastings, says that the AECT is beginning work on a new definition, but she “[does] not expect to see a new definition until at least 2017-18” (personal correspondence, May 27, 2014).

The evolving definitions of ET reflect a history of social change, different definitions reflecting different generations. In their commentary on the evolution of ET definitions, Reiser and Ely (1997) suggest that “continuing attempts to redefine the field are good signs; signs that as new ideas, techniques and devices come along, professionals in our field will re-examine their activities and, in some cases, adjust their efforts and their view of the profession” (p. 71). They propose that existing definitions, including those provided by the AECT, are starting points for dialogue, not end points. Lowenthal and Wilson (2010) agree with Ely that the ET definition should continue to grow through dialogue. Silber applauds the AECT’s continuing efforts “to use the correct definition of the word ‘technology,’ and to de-emphasize the ‘stuff’ of our field as the raison-d’etre of the field” (Richey, Silber & Ely, 2008, p. 24). In their response to the 2008 definition, Hlynka and Jacobsen (2009) concur with the AECT’s “sharp focus on facilitating learning and improving performance via technological processes and resources, versus products
or tools” (para. 14). They, like Dusek, lament the fact that “most often, the concepts default into issues of hardware, tools and things” (para. 1).

**Conceptions of Educational Technology in Terms of Hard Technology**

Despite the efforts of the AECT, shallow conceptions of technology prevail in contemporary academic and political ET literature. I provide three brief cases. First, in two recent U.S. government publications, all references to technology refer to hard technology. This is alarming, considering how professional associations such as the AECT have historically struggled against governmental discourse (see, for example, the 1972 and 1977 AECT definitions of ET). Second, a search related to ET within peer-reviewed articles listed in ERIC reveals a bias toward hard technology interpretations in academic research. When speaking of technology, researchers routinely mean computer systems. Third, I investigate TPACK, a framework for integrating technology into classrooms. This approach equates knowledge of technology with knowledge of hard technology. In each of these cases, I detect a neglect of softer conceptions of technology, including Dewey’s process of inquiry and Dusek’s technological systems approach.

**U.S. government publications.** The 2010 document, *Transforming American education: Learning powered by technology* (U.S. Department of Education’s Office of Educational Technology), contains hundreds of references to technology, each of which conflates technology with computer tools. For example, the authors write that outside of school, students’ lives are “filled with technology” that enables “mobile access to information and resources 24/7,” the creation of “multimedia content,” and participation in “online social networks and communities”; furthermore, “technology dominates the workplaces of most professionals and managers in business” including physicians’ use of “mobile Internet access devices to download x-rays and test results,” geologists’ use of “underground sensors along fault lines,” and filmmakers’ use of “everyday computers and affordable software for every phase of the filmmaking process” (p. 9). In a graphic illustrating “a model of learning, powered by technology,” the icon for technology is a laptop computer (predictably), which connects the student to online networks of ideas (p. 11). Curiously, ideas themselves are not recognized as technology.

A similar conception of technology is evident in a document entitled *Educational technology in U.S. public schools: Fall 2008* (National Center for Education Statistics, 2010). This document contains results from “district, school, and teacher surveys on educational technology,” which reveal “data on availability and use for a range of educational technology resources, such as district and school networks, computers, devices that enhance the capabilities of computers for instruction, and computer software” (p. 1). No mention is made to technological resources such as methods, theories, or practices. In fact, the authors provide the following succinct definition of technology:

> Technology: Information technology such as computers, devices that can be attached to computers (e.g., LCD projector, interactive whiteboard, digital camera), networks (e.g., Internet, local networks), and computer software. We specifically are not including non-computer technologies such as overhead projectors and VCRs. (p. B-11)

The fact that the U.S. Office of Educational Technology and the U.S. Department of Education refer to “educational technology” exclusively in relation to computers suggests that we need to review national conceptions of ET.

What is Educational Technology?
ERIC references. Bias amongst scholars toward hard interpretations of technology is evident in ERIC. I sampled 199 peer-reviewed journal articles published in 2012 and indexed under the ERIC thesaurus descriptor, “educational technology” (see Appendix A). I limited my analysis to a cursory search across abstracts and additional descriptors for these articles. I neglect the nuanced research efforts of these authors (I imagine that all of them implicitly or explicitly attend to the dynamic complexity of learning processes). My interest here specifically relates to their use of the term, technology. My question is: what does each researcher mean by the term, technology? Of 199 articles, I found that 166 (83%) appear to use the term in reference to the use, management, or creation of hard technology, mainly computer systems. The output of ET research underrepresents soft technology and does not appear to approach Dusek’s “consensus” definition.

TPACK conception of technology. The TPACK framework provides teachers with supplemental “pedagogical knowledge” in order to augment “technology knowledge” (e.g., Harris & Hoffer, 2011). According to one of its authors: “Technology knowledge is knowledge about standard technologies such as books and chalk and blackboard, as well as more advanced technologies such as the Internet and digital video. This would involve the skills required to operate particular technologies” (Koehler, 2011, para. 1). In this framework, technological knowledge requires supplemental pedagogical knowledge because knowledge of technology refers exclusively to knowledge of hard technologies (including the skills by which hard technologies are used). This contrasts with the AECT’s view that knowledge of technology refers both to knowledge of hard technology and to knowledge of soft technology (including the skills by which both hard and soft technologies are used). In the TPACK approach, soft conceptions of technology are ignored.

Conceptions of Soft Technology and a Systems Approach

Soft technology refers broadly to immaterial resources, which can include processes, practices, and theories. Early leaders in the field stressed that “technology is not, as many of the technically illiterate seem to think, a collection of gadgets, of hardware, of instrumentation,” rather “technology is, fundamentally, a way of thinking” (Finn, 1962, pp. 29/33). Many endorse this conception, including Dewey, Dusek, and Concordia University’s Department of Education, who write in their ET Master of Arts program booklet, “Educational technology is a rapidly growing field that generally refers to the application of processes and styles of thinking developed outside the field of education to solving educational problems” (2008, p. 1). Despite endorsements, advocates agree that soft conceptions of ET are commonly misunderstood or ignored (e.g., Finn, 1962; Hlynka & Jacobsen, 2009; Januszewski, 2001; Januszewski & Molenda, 2008; Luppicini, 2005; Richey, Silber & Ely, 2008). For example, Luppicini (2005) writes that defining ET as a process “creates dissonance between the popular notion of technology as state-of-the-art equipment and the older idea of technology as a process … [which] gives rise to definitions that are not easily understood within the field or widely embraced outside” (p. 105).

The AECT conscientiously embraces both hard technology and soft technology. As soft technology, the AECT specifies “intellectual processes” – “human made processes that systematically apply scientific knowledge” (Januszewski & Molenda, 2008, p. 197). It emphasizes an intellectual foundation for technology, which opposes Dewey’s view of the interactive nature of experience. Some argue that ET is preceded not only by scientific knowledge but also by literature and the arts (Luppicini, 2005; Solomon, 2000). Some wonder,
like Dewey, how a technology that is “pre-authenticated” by the intellect faithfully predetermines correspondence between tasks in a learning environment and tasks in a learner’s real world, a “world that is constantly being shaped and reshaped by learners working within their own experiences” (Petraglia, 1998, p. 60). Luppicini (2005) suggests as key themes in ET: adaptive, systematic, and transformative processes that facilitate human needs, as well as mental, environmental, and social influences (p. 105). Finn (1962) writes, “technology in society is an organic process” (p. 32). In an attempt to find the right words, Finn quotes Hannah Arendt who in turn quotes Werner Heisenberg: “general technology is no longer ‘the product of a conscious human effort to enlarge material power, but rather like a biological development of mankind’” (p. 32). These authors cross paths with Dusek’s technological systems approach and their interpretations extend the concept of educational technology to include processes that are intellectually designed as well as some that might not be.

Conclusion

The ET profession, field, and concept benefit from a broad appreciation of soft technology and of the technological systems approach. Human intellect plays a central role in the cultivation of technology and of knowledge, but it is not alone. Experiential and social processes can be seen to inform the technologies and ideas we create. Technology itself can be understood to influence our intellectual, experiential, and cultural capacities for creation. An ontological superiority of knowledge over technology is illusory. Our ideas, tools, and processes can both limit and liberate our next thought.

So why do limited interpretations of technology dominate? “If educational technology is a process, as the majority of the members of the AECT view it, then why does most of the history that is written about it focus on the hardware and equipment that is used in the field?” (Januszewski, 2001, p. xxiii). This dominant discourse emerges from multiple causes. First, Januszewski describes a desire for conceptual and professional legitimization of ET through an emphasis on “objectivity, permanence, and exact standards,” which bluntly opposes Dewey’s emphasis on inquiry, regulation, and habitual adaptation (p. 115). Objectivity, permanence, and exactitude insinuate the realm of the physical sciences, not the social sciences. This leads to a second reason. The desirable resemblance to physical sciences brings to mind material reality, which may reinforce hard/material conceptions and obscure alternate conceptions. As Dusek reminds us, physical things are simply easier to conceptualize, easier to grasp; immaterial resources can be tricky to grasp. Likewise, the idea that an idea is a technology – a generative and regulative tool that produces ideas – is unintuitive. This meta-idea challenges the assumption that knowledge ontologically precedes technology; it admits that knowledge might be contingent on technology. A third reason is that publications disseminated by governmental, academic, and professional authorities substantiate an equation of ET with the use of computers and other material tools. Practitioners must struggle against this hegemony.

While I commend their efforts to raise awareness, why does the AECT limit their current definition of soft technology to: “human-made processes that systematically apply scientific knowledge” (Januszewski & Molenda, 2008, p. 197)? The AECT’s distinction between intellectual and non-intellectual processes provides their audience with several benefits: a sense of clarity about the scope of the ET field, a desirable aura of scientific legitimacy for the ET profession, and an avoidance of esoteric complexities in ET theory. I look at each of these in turn.
The AECT’s definition of intellectual processes clarifies that processes within ET purview must be flexible and open, for example, capable of managing uncertainty. However, by dismissing non-intellectual processes as out-of-scope, the AECT exaggerates the importance of intellectual intention and neglects the effect of other actors on the intellect. They fail to address substantially the systemic interaction between non-intellectual processes and intellectual ones. Yet, as we have seen through Dewey and Dusek, the boundary between intellect and non-intellect is blurry, the actors interrelate, and the relationship deserves primary attention. A dualistic demarcation reflects an artificial convenience. Such a figurative dissociation deserves serious contemplation within an ET manifesto, lest it be interpreted as reality, spreading an illusion of clarity.

By circumscribing what is and is not in the purview of ET practice, the AECT attempts to legitimize the profession and claim territory. Furthermore, the story about “a systematic application of scientific knowledge” is appealing: the use of science lends a sense of control and an aura of authority to the ET professional. However, unlike the field of physics, social science lacks reliable paradigms and “History suggests that the road to a firm research consensus is extraordinarily arduous” (Kuhn, 1970, p. 15). The validity of claims in social science depends on many factors, including culturally based opinions and customs. When reconsidered, these factors can reform the validation process itself.

Some final reasons why non-intellectual processes are under-emphasized is because they are complex: they do not reflect our intentions, they can feedback unpredictably, they operate on different time scales, and their ubiquity conceals them. Intuitively, we understand that natural processes can be the objects of scientific study; however, it is less intuitive to interpret them as actors. Upon critical analysis, we see that some non-intellectual processes do affect intellectual endeavours. For example, our form of culture affects our intellectual capacity and the type of science we do. The AECT’s linear model, “input→process→output,” is easy to digest (Januszewski & Molenda, 2008, p. 196). However, it fails to account for the hidden agentive potential for processes to transform their inputs, as in Dewey’s theory. A more appropriate diagram might not only feedback on itself (connecting output back to input), but feedback also within itself: “input↔process↔output.”

Ultimately and most generally, educational technologists aim to foster growth, that is intellectual development and habitual adaptation. Ideally, with the help of technology, we enable an ongoing ability to learn. To accomplish this effectively, we must consider the ambiguity of the concept – technology means far more than computers. Technology refers also to processes and may be understood best through a systems perspective. Technology is socially constructed. Technology affects the intellect that designs it. However, by defining ET broadly we do not finalize a semantic technicality. Conceptions are technological. As ends that serve as means, conceptions lead us into the future.

Authors’ Note:

References


Luppicini, R. (2007). *A study of how the academic field of educational technology has developed in Canada*. Unpublished doctoral dissertation, Concordia University, Montreal, Quebec, Canada.


What is Educational Technology?


## Appendix A: Technology Focus of Sample ET Articles

Table 1:  
Technology Focus of Sample ERIC Articles Related to ET

<table>
<thead>
<tr>
<th>Article</th>
<th>Focus</th>
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<tbody>
<tr>
<td>1. Lazonder, A. &amp; Kamp, E. (2012). Bit by Bit or All at Once? Splitting up the Inquiry Task to Promote Children's Scientific Reasoning. <em>Learning and Instruction, 22</em>(6), 458 - 464. doi:10.1016/j.learninstruc.2012.05.005</td>
<td>S</td>
</tr>
</tbody>
</table>


<table>
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<tr>
<th>No.</th>
<th>Author(s)</th>
<th>Title</th>
<th>Journal</th>
<th>DOI</th>
</tr>
</thead>
</table>
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CJLT/RCAT Vol. 40(3)

411 - 424. doi:10.1111/j.1365-2729.2011.00445.x


336 - 349. doi:10.1111/j.1365-2729.2011.00449.x


What is Educational Technology?


33(5), 298 - 308. doi:10.1177/0741932511401037


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What is Educational Technology?

doi:10.1016/j.compedu.2011.11.008


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**Note.** This table contains a sample of 199 peer-reviewed journal articles published in 2012 and indexed in the ERIC DB. I used the following search criteria on 2012-10-07: Thesaurus Descriptors: "Educational Technology" and Publication Type: "Journal Articles" and Peer Reviewed and Publication Date: 2012-2012. I reviewed the abstracts and descriptors for the first 200 returned articles (one duplicate was subsequently discarded). I searched for indicators of what each researcher means by the term “technology.” In reference to “technology,” the majority of researchers (>80%) refer to hard technology (material resources including computers and software). Soft technology (immaterial resources) is underrepresented in this sample. The final column in the table indicates the apparent technological focus:
• “H” represents an apparent “hard technology” focus, where the term “technology” appears to refer to hardware or software
• “S” represents an apparent “soft technology” focus, where the term “technology” appears to refer to theories, methods, or processes.
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