European Journal of Social Behaviour 2 (2): 36-52, 2015
ISSN 2408-0292

Technology and the Experience of Education

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Published online: 15 December 2015

Abstract: Educational technology is often treated as a tool that can be separated from the content of education. This attempt to separate process from content fuels the tendency towards mass produced education. But process and content are intimately related: technology shapes the experience of education, the identities of teachers and learners, the structures of our institutions and the relationships between people. When technology is treated as independent and interchangeable, these impacts become invisible. Awareness of the complexity of technology as an integral part of a complex system makes it possible to consciously shape the technology to enhance human interaction.

Keywords: experience, educational technology, books.

Acknowledgement: This is an original paper that presents personal views of the author(s).

Introduction

The phrase "educational technology" is ambiguous. It usually refers to technologies employed by educators. But it can also mean the opposite: educators employed by technologies. Many administrators see technology – particularly the Internet – as a way to increase efficiency and reduce costs. Those who criticize this technocratic approach often treat technology at worst as dehumanizing, at best as something that must be applied selectively and kept under tight control lest it distract from the true priorities of learning.

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The argument is often poorly formulated on both sides for lack of understanding of the nature of technology. Many technocrats and educators share the belief that education can be decomposed into process and content. The process – the technologies used, the methods of teaching, the spaces it takes place in etc. – can be separated from the content of instruction – the knowledge, skills, habits and so on that are imparted to students. This is an attempt to institute a division of labor: process can be standardized and even automated, producing economies of scale, while content remains the same.

One example of the conceptual separation of process and content is the widespread idea that technology is simply a tool. “Technology is a tool, a means to an end, not an end in itself,” write Tony Bates and Gary Poole (Bates & Poole, 2003, p. xiv). This view was reflected by Richard Clark (Clark, 1983, p. 445) when he wrote, “media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition.” This sparked a debate with Robert Kozma (Kozma, 1994), who responded that media are more important than this, arguing that different media are better or worse suited to particular educational tasks.

For both Clark and Kozma technology is a means to achieve stable extrinsic goals. Technology may or may not affect the outcome of education (Clark does accept that it can have an economic impact), but the goals are unchanged. Though their analysis may differ in detail, the task is to pick the best technology – the best tool – for the job. Jack Wilson, former CEO of UMassOnline (Bates & Poole, 2003, p. xiii) expresses this approach clearly:

> It's about serving learners and not about using technology. First of all, designing educational experiences around technology is a foolish chase. You cannot possibly keep up with the technology. It would seem to make sense for proponents of e-Learning to begin with the students. . . . Deployment of technology then becomes an exercise in applying a rapidly improving technology to a very consistent set of goals.

Our contention is that while this instrumentalist approach may sometimes be helpful, it ultimately breaks down. The goals of education are not stable. There is an unavoidable interplay between process and content. Ignoring this interplay lessens our ability to control technology and direct learning. Furthermore, if technology is seen as given – if it is treated as a menu from which to choose a better- or worse-suited technique for a given objective – then its potential becomes invisible. When technology is instead understood as having specific impacts as well as uses, it can be consciously shaped in ways that enhance education and deepen human interaction.

Technology and Experience

John Dewey sees tools as inseparable from goals (Hickman, 1990). A physical thing can be a tool, but so can an idea, a theory, a method---or an objective. Far from being separate from tools, ends are themselves instruments for the pursuit of further inquiry: "*effective* intelligence is not an original, innate endowment"; it is dependent upon education (Dewey, 2012, p. 155). "Knowledge of the past is

embodied in implements, utensils, devices, and technologies." Contrary to dualism, what matters is "*embodied* intelligence": "Capacities are limited by the objects and tools at hand. . . . Meanings run in the channels formed by instrumentalities of which, in the end, language . . . is the most important" (Dewey, 2012, pp. 155–156).

Moreover, the goals we set in the process of inquiry are only temporary; as we work we alter our goals and select new ones, changing and refine the tools and methods we accordingly (Hickman, 1990). For Dewey, this is learning: means and ends are bound together through experience in a dance of recursive redefinition. Thus a tool is not a stable artifact: it is "an active method of generating and testing new skills, as well as reconstructing old ones" (Hickman, 1990, p. 19). The ends we pursue are affected by the technology used: not only as a result of conscious planning, but also because of side-effects in how they structure human relationships. At the same time, the technologies themselves are a product of inquiry.

To illustrate the interrelatedness of means and ends, imagine the task of traveling from one point to another in a city – Paris, for example. One could choose to drive, to bicycle, to take transit, to walk. Each of these technologies will achieve the goal. Depending on one's priorities, each has its own merits and drawbacks. The car might be the fastest way to travel, or perhaps the bicycle would be better for avoiding traffic. Transit might be fast but cost more money. Walking has the smallest environmental footprint, and there's no need to find parking. But these considerations are not the whole story – indeed they only touch the surface of the differences between these technologies.

The choice of technology shapes one's experience of the city. As I walk through the city I see and even feel the texture of the buildings. I encounter passersby on the street, see the shopkeeper sweeping the sidewalk in front of his shop, and smell the produce of the grocer or the refuse in the gutter. I guide myself by landmarks. As a driver, I follow street signs and traffic lights. I am not simply going from place to place – I am driving a vehicle that shows something about me. I am touched by its associations with status, independence, sex, and environmental consciousness – and I cannot avoid their impact on my identity. I miss some of the texture of the city, but I gain a wider appreciation of its shape as a network – how the streets connect to each other, the size and scale of the city. The city I see as a pedestrian is different from the city I see as a driver – and the destination I reach (and even the one I choose) as a pedestrian is different from the one I arrive at as a driver.

Applying this analogy to education, we discover a disturbing fact. Access to different educational technologies implies different perspectives, even different objects, just as with means of transportation. The introduction of new technical processes has encouraged a transformation of educational content, its standardization for automated delivery. Content can be packaged for reuse and propagated through different media. Personal delivery by a teacher is replaceable by online documents, videos and podcasts delivered over the Internet. The promise and threat of technology is thus the mass production of education.

Whether the aim is to save public education from bankruptcy or enjoy high profit margins, initial investment will be high, but the nth copy will be nearly free and education will finally have a serious business model.

We believe that the process of education cannot be cleanly separated from the content. How a thing is taught affects what is taught, while the material itself shapes the process. To the extent to which a mass production approach succeeds, the nature of education changes. We can ask the question: is mass-produced education still education?

The industrial factory is the model for the efficient mass-production of education facilitated by the technical division of labor. Just as the factory constructs the identities of workers and owners, technocratic education constructs the teachers and students. But it is also possible to consciously shape a different kind of educational institution, one modeled not on the factory but the city.

The city is the scene of interaction and communication. Cities are places of experimentation, not standardization, of freedom, not conformity. Control is less important than movement, efficiency less important than diversity. The city is complex and teaches the management of complexity. An educational system that reflects the virtues of the city rather than the factory is desirable (Feenberg, 2002, pp. 114–115).

The dimension of experience is forgotten when the focus is exclusively on technology as a tool. The territory is reduced to a map: and while such rationalization can be productive, something is also lost. The tool conceals from us our relationship to it and through it with other people. Disregarding what technology is prevents us from considering what it might become. We cannot control what we do not even see. The paradox is that the more one treats technology as a tool, the more one becomes the tool of the technology (Bakardjieva, 2005, p. 112).

Martin Heidegger makes a similar claim in his exploration of the relationship between technology and experience. He argues that the technology we use discloses a world: “In taking care of things, nature is discovered as having some definite direction on paths, streets, bridges and buildings. A covered railroad platform takes bad weather into account, public lighting systems take darkness into account, the specific change of the presence and absence of daylight, the 'position of the sun'” (Heidegger, 2003, p. 101). Yet while things disclose the world, tools can erase themselves from consciousness. When a tool is available for use, it is in Heidegger's term “ready-to-hand.” As we use it for a purpose we zero in on our task; the tool as an independent thing is forgotten. Nevertheless, it imposes an instrumental structure on our relation to the world. Heidegger's theory of this structure focused exclusively on the potential for exploitation and control of the objects of technology. This is relevant to attempts to automate education, but most educational technology serves rather than dominates human beings. Nevertheless, in each case the technology has some sort of structuring impact. A purely instrumental view of technology overlooks this important consequence of its employment.

Bruno Latour (2005) focuses on the structural importance of technology. He argues that groups and social structures are practices, not things composed of some ephemeral "social" matter beyond actual (ultimately physical) interactions among people and things: "if you stop making and remaking groups, you stop having groups" (Latour, 2005, p. 35).

But this raises a difficulty: how can a "social" structure (whether it be a nation, a community, or a university) continue to exist when its human participants are not actively engaged in it? How can a course persist when the students and instructor go home at night? Drawing a parallel with the dark matter posited by astrophysicists, Latour asks, where are the "missing masses" (Latour, 2001) that sustain social structures? The answer Latour (Latour, 2001) proposes is that the missing masses are things. Rather than structures composed of imaginary social matter, we have diverse networks of relationships among actors, some of which are human, some of which are not. Treating things as actors symmetrical with human beings, Latour sees technology not as an external tool to be taken and used, but a full participant in human relationships and activities. Indeed, while the networks of his theory are assembled by (human and nonhuman) actors, those actors themselves are in turn composed of further networks. In his view, it is the task of scholars to study the continual assembly and reassembly of these networks.

The practices that assemble networks in Latour's theory is similar to the iterative process of inquiry described by Dewey. In both cases there is a collaborative dance of people and things, both of which influence the path taken. But, like dark matter, these missing masses tend to be invisible.

When technology is the ever-present background it is easy to lose sight of our complex relationship with it. But when a technology is removed from our environment its place in our lives becomes apparent. Here is a particularly dramatic example. On July 28, 1976, China suffered a major earthquake centered near the coastal city of Tangshan. A quarter of a million people died. In nearby Beijing, where our co-author Cindy Xin lived and went to school, people were afraid to go indoors for fear of aftershocks. Students and teachers were forced out of their classrooms to learn in the open air. They made chairs by piling bricks and used their laps as tables. In the absence of a blackboard, Cindy's teacher told stories and sketched Chinese characters in the dirt with a twig as the students knelt around her. The teacher was no longer at the head of the class: she was there among the students, surrounded by them, sitting with them. When it rained – and it often rained hard that Beijing summer – the class huddled together beneath umbrellas and listened to the rain drops. For many children who were used to being cooped up indoors, the aftermath of the earthquake was an exciting time. (The 2005 film *Sunflower* shows some of the experience of Chinese children at the time.)

The classroom is a technology, but it is not just a tool. It’s obvious purposes include sheltering students from the elements, providing a space for them to meet and furniture for them to sit on, desks for writing and a blackboard for instruction. All of this changed after the earthquake. But there were unexpected changes too:

the relationship between the teacher and the students was transformed. The blackboard, it turns out, not only serves as a writing surface – it also creates a hierarchy, mediating between a teacher at the front of the class and the children acting as an audience. That hierarchy is not a product of the blackboard alone, but also of the desks that separate and arrange students, the individual writing surfaces, the walls that isolate them from the environment.

Our understanding of the blackboard as a tool with a purpose – a surface for writing and communication – conceals its power as an instrument of order. This relationship only becomes obvious when we remove the technology. We are not saying that the classroom or desks or blackboards are bad things. Our point is that they have many effects beyond the obvious ones for which we use them. When we recognize this, when we look beyond the purposes of the technology, then we can see that technology is part of a complex system and that if we want to change either the technology or the system, we have to take their relationship into account.

Paradoxes of Technology

Andrew Feenberg's (2010) "Ten Paradoxes of Technology" breaks this phenomenon down. Explaining that so far as technology is concerned, "most of our common sense of ideas are wrong" he details ten ways in which our common sense understandings of technology lead us astray. The key principle most relevant to this discussion is the co-construction of technology and society.

As part of a complex system, as a mediator of human relationships, and as a source of individual identity technology exists in a fluid relationship with people and things. It is produced and constantly modified by these interactions. Yet the history of how it came to be is concealed behind its appearance as a collection of static artifacts with essential purposes. In fact, those artifacts and purposes are the product of circumstances. Every purpose could have been different and every technology could have been different too. Truly, technology and society are co-constructions. We construct technology, and it shapes us: technology is constantly created and modified in a dialectical relationship with the people who use it. When we fail to see this, technology is beyond our control.

This last point is essential. Just as technology shapes human beings, so do we shape technology. By understanding our relationship to technology we can become conscious of that shaping, we can direct it. Treating technology as a tool implies that technology is neutral, based on value-free scientific knowledge: values are only introduced by the human beings who use the technology. This commonplace understanding is no longer held by those who study science and technology seriously today. Constructivist approaches in technology studies are particularly important for understanding the issues in debates over educational technology.

Constructivists argue that successful technologies are selected from among many viable alternatives that could have done approximately the same work with somewhat different consequences for different social groups. Thus technological development is not a straightforward application of science or rational invention but is relative to the social demands that prevailed in the selection process. This is

called the "underdetermination" of technology, underdetermination, that is, by pure technical considerations.

Despite being underdetermined, technology is not purely a social construction. Physical properties shape technology and determine how it may be used. This determination is not absolute, but it does mean that a technology is inherently better suited for some uses than for others.

The various alternatives among which a selection is made all have slightly different side-effects. Some alternatives may conform with a particular vision or way of life supported by a more or less influential group that strives to realize their goals in design. Others may impose costs or inconveniences that influence a group to resist that choice. Contests such as these determine the fate of technologies. What is called the "interpretative flexibility" of technologies makes for contentious beginnings as each group attempts to impose its understanding of the ideal design. But eventually a single design prevails and the technology is "black boxed," given a standard form.

The interpretative flexibility of technologies is greatest at the outset and diminishes as the competition between alternatives is sorted out. Eventually closure is achieved in the consolidation of a standard design capable of prevailing for an extended period. The standard is not chosen because it is better in some objective sense, but because it is successful with an influential group or groups. Future development focuses on the standard design, improving it and resolving many of its weaknesses relative to alternatives. Thus Feenberg writes, "efficiency does not explain success, success explains efficiency" (2010, p. 7). (Examples abound, from the dominance of DOS and Windows to the persistence of non-metric measures.) This period of flexibility followed by convergence on a stable standard is what happened to the bicycle, the automobile, and all the familiar technologies that surround us (Pinch & Bijker, 1989).

The values of one time are hardened into technology, and even as those values change in society at large, they often remain embedded in the technology for an extended period. Although standard designs can be very resistant to change, change is still possible. Technologies that have achieved closure can evolve as we are seeing with the development of hybrid and electric cars today. The purpose and ultimately the design of a technology change over time as people adapt to changing circumstances. As a result, technology is often used today for purposes different from those for which it was adopted. For example, the use of computers and the Internet in education initially focused on the dissemination of information: it was only later than the potential for social interaction and communication became apparent.

The Book

The complexity of the interrelationship between technology and education is perhaps best illustrated by the book, a technology so deep in the DNA of education that it is often not seen as a technology at all.

Imagine the academy without the book. In this situation education relies on face-

to-face interactions between students and teachers. To learn, a student must talk to someone. To be reminded of a thing she needs a good memory or she must find someone who has one. As in oral cultures knowledge is embedded in poetry and other mnemonic structures. Students are seldom able to learn in private, so teaching and learning are social activities much of the time. The scale of that activity is smaller. The very concept of the class -- a specified time for students and teachers to come together for lectures – is supplemented or replaced by a more informal interaction between students and teachers. Interaction is more dialogical, smaller in scale, with more give-and-take. As meal times are such an important moment is social life, their timing and sociability (and quite likely the food) changes in order to take advantage of the opportunity to teach and learn. The architectural shape of the institution is different -- instead of study carrels there are discussion spaces. Since the work produced by students and teachers is speech, rhetoric replaces writing, presentation replaces testing. Teachers are evaluated not by their private labors of writing, but by their public actions -- speaking, explaining, debating, presenting. The intellectual relationship between scholars is completely different in an environment structured around public speech rather than publication and citation.

In such a scenario, the culture and context of education would not be the only things that would be different. Changing the medium of education changes the nature of education. In some ways this would strengthen skills and learning: memories would be stronger, social activity and collaboration would likely be encouraged. But certain kinds of reasoning would suffer. Formal systems like mathematics, for example, would be severely limited and much more challenging to work with.

This hypothetical scenario is not the world we live in. We do have the book. Records of what education was like before it are, naturally enough, scarce. Treating a technology as a tool means focusing on its purpose. So what is the purpose of the book? Let us suggest that in education the purpose of the book is to extend the reach of the teacher to many students, to enhance memory, to allow learning in private or in the absence of a teacher, to improve access to knowledge and education. The book as a tool mediates between teacher and students so as to extend the teacher's influence.

But the purposes of the book are only part of the story. As an integral part of teaching and learning books transform every facet of education. They shape our understanding of what education is. They are central to the identity of teachers and students. They shape the culture and hierarchy of educational institutions, and they shape the physical spaces where we teach and learn.

Literacy is nearly synonymous with education today. Books are central to scholarly identity. Scholars are writers, men and women of the book. Writing is the primary measure of their output, the main criterion for their hiring and promotion, the basis for their position in the academic hierarchy and their earning power as workers. The very architecture of colleges and universities is structured around books and their use. Libraries and bookstores are dominant presences on campus.

Students' chairs have tables on the arms to write on - to create their own (note) books. They carry backpacks of books. Private study is oriented around books in study carrels and quiet areas. Public study in lecture halls with hundreds of students is possible because it is only a supplement to the primary way the teacher reaches the students - through books. Books shape every facet of education. They provide its identity and its symbolism.

Now imagine substituting computers for books. All of the same activities of reading and writing can be performed on a computer, yet again the environment would change with consequences for learning. Collaboration, copying and modifying would be more common. Learning would orient around persistent social groups. The permanence of publication would soften as continuous change became easier. These things are already happening, though they may still be overshadowed by other changes as the medium develops in unexpected ways. What is certain is that the choice of technology, no matter how it is intended to be used, no matter how successful that use, will have wide-ranging, unanticipated effects.

All of this is hidden, concealed behind our perception of technology as things. These examples illustrate Marshall McLuhan's dictum that the medium is the message. But narrow technical concerns alone do not determine all of these consequences. Other outcomes are possible. The form taken by the book, for example, could have been very different – indeed it was very different. To take only a small example, most book pages today are taller than they are wide. This vertical organization of information, usually with only a single column of text, emphasizes a hierarchical arrangement of material on the page (Slights, 2001, p. 6). Other orientations and layouts, in contrast, could promote less linear layouts with multiple voices. History turned one way, but it could have turned another. We do not see how the architecture of the university has been shaped by the book because that is the background. It is not our purpose. We do not see the historical process through which the institution and the technology developed in tandem. The book we have seems like a given.

Just as the book is fundamental to the academy, so the academy is part of the book. The book could not function as an educational technology without being integrated into a larger institution. We have libraries, and so students can find a wide range of books. We have desks so they can write. We have quiet areas so they can study. We have a class of professional experts to help them map out a field and its books, and to explain what they do not understand. The book extends the reach of teachers – but only as part of a system that it has shaped, and that shapes it. Disregarding other barriers of language and culture, airlifting books to a society without them would not produce the same kind of education that we have today. The book and the academy are children of the same history. That history could have been different. The uniform mass-produced books we have today are not the only format that could satisfy the purposes we laid out for education. The book has taken different forms in the past.

In the era of the manuscript, students wrote their own textbooks. One of the chief purposes of lectures was to disseminate a text for students to write down. Each

student wrote his own version of the book, with his own notes and annotations, perhaps his own doodles. Books were often annotated with commentaries - and those notes were understood as part of the text, so that when the book was copied (by hand), the notes were copied also, accumulating across time and transfers of ownership.

Even though movable type was the first mass-production technology, and books were the first mass-produced consumer goods, the uniqueness of individual books persisted until relatively recently. The tradition of multiple authorities and authors sharing the space of a book continued well into the print era. In early modern England the majority of books included published marginal notes [slights1997cosmopolitics, p. 202]. The idea of a single central authority - the author - developed over a period of centuries. When it did, it was not a product of the technical characteristics of a collection of printed pages, but rather of social factors, such as design sensibilities that preferred a simple page layout (Tribble, 1997), cultural trends like romanticism, and the legal doctrine of copyright. The marginal note that competed for authority with the primary text was replaced with the footnote. In the 18th century it was common for books to be sold without bindings. The purchaser would choose the binding separately. Often he would add pages - bits of manuscript, illustrations, blank pages for writing notes, and so on. These unique texts were shared. Readers would write notes in them in order to communicate their opinions, critiques, and responses to others in their social circle.

There is no technical reason why many of these practices could not have become established in the academy, why textbooks could not include materials provided by students, such as handwritten notes, or why published material could not be combined in individual ways. With the advent of photocopiers and desktop publishing this is quite practical today. Indeed, institutions regularly publish custom compilations of texts for their students. The fact that these texts are determined by teachers and not by students is a social choice, not a technological necessity. Yet we cannot simply compare these two models of the book as two technologies with their benefits and disadvantages and select the right tool for the job, any more than we can replace the literate academy with one oriented around Socratic discourse by discarding our books.

So far we have accepted the purpose of the book: to extend the reach of the teacher, to enable private study, to increase access to education, to replace memory. We are making two unwarranted assumptions here. First, we are assuming that these goals - or goals like them - are in fact the purposes for which books are used in education. Second, we are assuming that these goals are achieved.

As far as the first assumption goes, books are often used to teach for other reasons. Tradition is probably chief among them: literacy is education. Ours is a literate culture in which evidence and facts are associated with writing, not speech. Bureaucracies only recognize written documents, not the memory of words exchanged between bureaucrats and clients. Agreements are associated

with written contracts, not spoken promises; and so on. In times past books have been used as symbols of education without actually being educational: people would equip their houses with shelves of handsomely-bound but never-read volumes as indications of their status or taste. Books save money for educational institutions. When students have books fewer teachers need to be employed. As students who are obliged to pay for a slightly modified textbook each year are aware, using books in education makes money for publishers.

As for our second assumption, books do not always achieve their objectives. For example, it is true that books can make education more accessible, but they can also make it less so. They make literacy a prerequisite for learning, not only Three R's-type literacy, but broader cultural and discipline-specific literacy. They excise the dialogic character of education. Many books are incomprehensible to a reader lacking sufficient background knowledge; unlike a human teacher the book's ability to explain the missing elements is severely limited. Similarly, books can help recall information and knowledge, but as a substitute for memory they can also weaken it. These were Plato's ancient complaints about them as the shift to literate education began. He has Socrates argue in The Phaedrus (Plato, 1972, p. 158):

> The painters' products stand before us as though they were alive, but if you question them, they maintain the most majestic silence. It is the same with written words; they seem to talk to you as though they were intelligent, but if you ask them anything about what they say, from a desire to be instructed, they go on telling you just the same thing forever.

While books can extend a teacher's reach, they can also weaken her grasp: teachers whose focus is literate rather than oral may become less able to respond to students and interact with them. This affects some teachers more than others. Just as many successful actors of the silent era were left behind when talkies recorded their voices, many teachers who can speak and present well are not as skilled at writing. A related phenomenon in universities is the redirection of faculty effort away from teaching toward publication: the ecology of the book, intended to assist teaching, ends up discouraging it.

The problem is aggravated by the invention of the textbook, a standardized and simplified summary of original books by creative authors. These books can be used to impose a curriculum on professors whose job is reduced to standing in front of hundreds of students in large lecture halls repeating their content, chapter by chapter. From the textbook the students extract information, not a connection to a field through participants in its development. In sum, the book as a mode of delivery has already changed education from a personal to a more or less impersonal process, anticipating what we called the "factory model" of mass produced education.

Digital Technology

The existing structure of education is oriented around the book. If the computer is treated as a tool to be plugged into the existing system – as a multimedia substitute for the book – then it may well conform to the literary logic. The

computer may then provide some advantages, such as multimedia and scripted interaction, and some disadvantages, such as cost and complexity, but at its heart it would be a radical extension of the factory model of education in which dynamic dialog is replaced by relatively uniform individual study. Like the book before it, the computer and the process of which it is a part will mediate the relationships of teachers and students, and construct the identities of the people who use it.

The technocratic disjunction between interaction with a teacher and interaction with a computer is only one possibility. Computers do not have to replace human interaction: they can supplement it. The evidence of the Internet is that users can shape computer technology to suit their needs. As an integral part of a complex system, this is not a matter of technology alone.

Unlike the book, the Internet has not yet stabilized. Technical change of the book, such as the popularization of electronic books, is unlikely to open it up to significant reinterpretation or lead to a rapid restructuring of its relationship to education. But the Internet is in flux, the object of contestation by a variety of social groups. That contest in education is framed largely by the opposition between the advocates of automation and the defenders of tradition. The former promote online education as a cost-saving measure that can substitute for teachers, while the latter oppose it on essentially the same grounds: the technology places efficiency ahead of students and their personal contact with teachers.

Computers were developed as glorified calculators to calculate artillery ballistics and break military ciphers. This image lives on in humanist criticism and technocratic dreams of efficiency, but the determinist view of technology shared by both groups is refuted by the reality of an Internet. Its users have adopted and adapted it predominantly for informal communication. The computers of today are more like telephones than calculators or war machines. The Internet outside the sphere of education is more like the city than the factory. The adoption of information technology in education is progressing, but this is still a moment when the users of that technology can shape it, when teachers and students can choose its course.

Two examples illustrate some of the problems with the current trajectory of the use of the Internet in education. The first example is the design of course management systems, such as Blackboard (a commercial product) and Moodle (a free software project). These systems provide support for online learning with web-based discussion forums, calendars, lessons, quizzes, assignment modules, and so on. What is striking about these systems is how centralized they are. Activities and resources are created by instructors and oriented around courses, membership in classes, start and end dates, and evaluation of performance at defined tasks. The structure of the system imitates in virtual space the hierarchy and processes of traditional education, with physical space and learning materials controlled by teachers. Sometimes called “learning management systems,” such software is more accurately described as teaching management systems. The

control of the system and possession of material produced rests with the teacher or the institution.

What the technology conceals is that this structure is not a result of technical concerns. Rather it is a result of historical influences. Blackboard responds to the structures and interests of the institutions that purchase it. Moodle was initially developed by researchers and educators and has encoded their practices and priorities. Individual learners might have different priorities if they were more closely involved in the development of the software, but they are obliged to use the software chosen by their institutions or instructors.

One can imagine alternative designs that could achieve similar goals and support similar activities, such as quizzes, learning materials and discussion forums, but which structured learning around the learner rather than the institution. For example, students could maintain their own environment with their own notes, the learning materials and readings used in courses, their contributions to discussions, organized according to their own needs and interests and controlled by them and useful to them long after graduation. There has been some recent effort in this direction, such as the attempt to develop personal learning environments (PLEs), but these are not widely known or used.

The concreteness and inertia of the technology that exists conceals the history of the development of the systems in use and the possibilities that have not been realized. Effects that might be blamed on the technology and how it mediates the relationships between people (e.g. that it can distance students from teachers, that it can minimize the role of the latter or place the teacher in a role of technical and administrative support rather than a position of providing personal expertise and guidance) are not simply results of using technology or the Internet per se, but rather of the priorities of those who influenced its development and the complex system in which it evolved. A mass-production approach to education embodies itself in the structure of the technologies.

However, the particular teaching experience for which the technology was intended is not rigidly fated. Many instructors lead lively online discussions that resemble classroom learning. Other instructors use the systems to supplement the classroom rather than to supplant it. The technology itself continues to change as educators explore alternative arrangements, such as learner-centered approaches.

An example of how teachers are attempting to innovate in applying the Internet to education is provided by "open educational resources," or OERs. Inspired by the popularity and success of other open systems and movements, such as free and open source software, Creative Commons and the history of sharing and citation that forms the basis of academic research, the objective of OERs is to find a way to collaboratively develop teaching and learning materials. Individual educational resources – such as courses, quizzes, multimedia tutorials, even textbooks – are shared freely with other educators (see for example merlot.org and cnx.org). The OER Commons web site attests that "OER content is made free to use or share, and in some cases, to change and share again . . . so that both teachers and learners can share what they know" (OER Commons, 2010). Yet despite thousands

of resources, many of them of high quality, the success of OERs has been questioned (Remmele, 2006).

Despite the promising similarity to open source software, OERs exemplify the separation of process from content. The content is extracted from the process in which it was formed, packaged, and reintegrated into a different context. Inevitably, however, the content is intertwined with the process that birthed it. Integration into a different context is difficult and time-consuming. Furthermore, the OER itself is the primary point of contact between the educators who create it and the educators who use it. The resource is seldom the result of a dialog between the two. Successful open projects, such as free software and scholarly research, are embedded in ongoing social relationships. A scholarly paper's significance does not reside in the document alone, but in its relationship to a tradition and the continuing dialog of a community or public. Science is not simply facts or knowledge – it is a process and a community (Kuhn, 1970). An analysis of Connexion, an unusually successful OER repository, found that "the collaborative creation of content requires extensive communication between the interested contributors," and concluded that is success is due to "the community formed by Connexion contributors and its openness to accept sporadic and new contributors" (Ochoa, 2010, p. 21).

When one looks at the most successful exponents of free software or of scholarship what appears is not only a diversity of resources but also a focus of attention, negotiation and contestation around a relatively small number of core texts whose value emerges from the struggle to shape them. The legal technicalities of the licenses that make OERs free to use is not sufficient for their success. To make a thing non-proprietary it is not enough to make it free for the taking: ownership of it, responsibility for it and commitment to it must be shared so that it becomes integrated into the productive and learning processes of the people who use it.

Conclusion

As new and deeper understandings of technology develop in fields such as sociology and history, the field of educational technology must also change to take into account what has been learned. Educational technology is frequently developed and applied with the illusion that technology is just a tool: that the content of education can be separated from the means through which it is delivered. But education is not simply a product. It is an experience. We are not isolated from the technology of learning: we learn with it and through it. That experience shapes our institutions and identities, mediates our relationships with other people, and changes the goals of education.

Overlooking the true complexity of technology has consequences. When the focus is on content to the exclusion of the experience and relationships of education, those things appear to be interchangeable. There arises a tendency to mass produce education. This tendency is not the result of technical progress per se but a response to social forces that can be resisted. Directing the process of technological development in education toward preserving and enhancing human interaction is entirely possible. It requires acknowledging the integral role of

technology in education: taking the technology into account means taking people into account also. Doing so requires imagination and effort to redefine the direction of progress. This should be the agenda of educational technology as a field.

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European Journal of Social Behaviour 2 (2): 36-52, 2015
ISSN 2408-0292

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EUROPEAN JOURNAL of SOCIAL BEHAVIOUR

www.socialbehaviour.org

ISSN 2408-0292