

THICK SITUATIONS: PATHS TOWARDS A FRAMEWORK FOR
21ST-CENTURY LEARNING DESIGN.

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This project is available on line at www.rcfouchaux.ca/mrp/, and a Compendium map of the learning situation, with link, instructions and resources at www.rcfouchaux.ca/mrp/makewebapp/.

The web app activity is available separately at www.rcfouchaux.ca/appmaker/.

In order to run the copy found on the accompanying CD it is necessary to copy the folder to a writable drive, for example a USB “stick” or a computer hard drive.

ABSTRACT: This project seeks the future of technology-enhanced design of learning experiences, documenting and demonstrating many of the ideas it exposes. A recognition emerged in the 1980s, bolstered by research into centuries of apprenticeship, that all learning is social. It was accompanied by an intuition that technology might someday accomplish that, and free it from restrictions of time and place. But who provides the software# and why? The search leads to the single most effective free tools now available to plan, organize, deliver and assess situated learning: open source mind mapping programs. I discuss tools and techniques that have proven ability to aid in taming “wicked problems.” But until users can program, and we teach programming as we do reading and writing, and unless policy overtly supports creativity and exploration in areas beyond profit-making they will remain disjointed, and education will continue to fall short of its potential for social transformation.

In part 1 of this paper I revisit the work of Jean Lave and Etienne Wenger into *communities of practice*, and of John Seely Brown, Alan Collins, Paul Duguid, and Ann Holum into *cognitive apprenticeship*. I establish the importance of *ethnography* to the search for new paradigms of schooling enhanced by technology. I describe the *cognitive apprenticeship framework* (CAF) to help the reader situate it historically and philosophically, and, I hope, holistically within the context of architecture, ethnography, psychology and computer sciences from which it comes to the design-based practices whence it leads. I explain what I mean by the term “thick situation.”

In the second part I discuss what I call the “deeper, wider document,” and show how it might be used to collect *digital thick descriptions*. I present evidence the 21st century classroom now calls on us to define new literacies for multimedia presentation and instructional design, and thicker, deeper skills for *digital storytelling*, including scripting and programming. Looking at each piece of the learning environment in turn—content, methods, sequencing, and sociology—I report on efforts, and make some of my own, to map the cognitive apprenticeship framework to real-world applications, and to name promising software. Presenting practical examples including code of my own, I relate my story—digitally, of course (see web site or accompanying CD)—and, using a deeper, thicker definition of the word informed by part 1 suggest a starter kit for a variety of *project-based learning* (PBL) “*situations*”

In the final part I discuss wider implications of the sociology of online learning and apprenticeship within the context of such situations as Twitter, the blogosphere, and such macro events as the Arab Spring, Occupy Wall St., or trends such as neo-liberal education reform movements that may place “entrepreneurship” high on the list of 21st century competencies, or presume high-stakes testing as a viable basis for policy. I find that open web technologies, particularly HTML, CSS and JavaScript, are themselves beginning to define a 21st century literature. I conclude that frameworks for 21st century schooling are inevitably transformative. Tools and literacies that empower online communities to illustrate and visualize ways of thinking, purposefully designed contexts that enable participants to visualize and illustrate their learning, create situations both meaningful and enduring.

“How can digital technology enhance learning?”

Jean Lave and Etienne Wenger were members of the *Institute for Research on Learning* (IRL), specially recruited by John Seely Brown from the fields of social anthropology and computer science respectively. When Brown asked such questions as the one above he was part of a cross-disciplinary team of researchers from anthropology, education, linguistics, computer science and psychology, that he and David Kearns, then CEO of Xerox Corporation, co-founded beginning in 1986 to study learning in a wide variety of settings, including schools, workplaces, and informal ones (Ghefaili, 2003). Prior to this most instructional design for technology-enhanced learning was based in behaviourist or cognitive theories of learning (Conole & Fill, 2005). Adopting as its main research method *ethnography*—the description of peoples’ customs and cultures—the Institute forged new understandings of how individuals enter and join learning communities, achieve acceptance,

then themselves grow and evolve as vessels of community knowledge [see Appendix A]. As they do so they often increase interaction and engagement—i.e., collaboration—with secondary networks outside their primary one (Lave & Wenger, 1991; Lave, 1996). As we'll see, this pattern is not unlike rites of passage into social networking—whether newsgroups and chat rooms of the eighties and nineties, or 21st century Twitter (Borau, Ullrich, Feng, & Shen, 2009; Dugan, 2012; Ferriter, 2010; Graham & Ferriter, 2009).

Learning is “Situated”

When someone is reading silently and then they ask you to define a word, do you ask them to read the entire sentence? This, said Brown, Collins and Duguid (Brown, Collins, & Duguid, 1989), is because “Experienced readers implicitly understand that words are situated” (p. 33). Building on Miller and Gildea’s work teaching vocabulary (Miller & Gildea, 1987), Brown and his colleagues similarly rejected “the assumption that knowing and doing can be separated,” saying it “leads to a teaching method that ignores the way situations structure cognition” (p. 32). They came to believe that all knowledge, like language, is intrinsically linked to the situations and activities that produce it—concepts (much as Web apps) are always under construction. So the *act* of constructing is “learning,” and not “*pieces*” of knowledge (Brown et al., 1989, p. 32-33). Collins and Brown, with Newman (1989, p. 456, see also p. 485) and Holum see this idea of “Situated Knowledge and Learning” as akin to the traditional apprenticeship of ancient times—a master practitioner showing the apprentice how something is done in the *context* of actually doing it, and then helping them to do it too (*coaching*), and to do it better (*scaffolding*) (Collins, Brown, & Holum, 1991, pp. 2-3; (Brown, Collins, & Duguid, 1989, pp. 39-40).

Modern schooling, by contrast, has amassed great bodies of conceptual knowledge, yet at the same time hidden or removed the thinking behind it from the situation of would-be learners (Dewey, 1933). These researchers proposed a synthesis of schooling and apprenticeship they call *cognitive apprenticeship*. The fundamental goal of cognitive apprenticeship is to “make thinking visible.” (Brown et al., 1989, Collins et al., 1989, Collins et al., 1991, Miller & Gildea, 1987).

If the IRL and its associates looked to computer scientists and advances in the field of artificial intelligence to guide them in implementation, they looked to paradigms of ethnography to inform their methodology. A successful ethnography “...can communicate the rules for proper and predictable conduct as judged by the people studied” (Sanday, 1979, p. 3), subsequently we “...use the ethnography's statements as instructions for appropriately anticipating the scenes of the society” (Frake quoted in Wolcott, 1975, p. 121) or in other words, by making their thinking not only visible but *accessible*, too. In the pages ahead I'll look more closely at the role of ethnographic descriptions in illuminating the interactions that take place in electronically enhanced learning situations.

The Learning Environment

Collins et al. define a learning environment as “the **content** taught, the pedagogical **methods** employed, the **sequencing** of learning activities, and the **sociology** of learning” (Collins et al., 1991, p. 1) [See *Appendix B*]. It’s my assertion that the browser-based web application permits a fresh joining of these four elements, perhaps even beyond the intuition that instigated the IRL. I further suggest that an updated understanding of the categories, strategies and insights Collins et al. put forth in the eighties and early nineties combine with technology and current practice to form a potent framework for understanding what is already happening in 21st century learning and instruction.

The World Wide Web happened when it occurred to researcher Tim Berners-Lee that “hypertext markup language” (HTML), which had already been used in standalone documents for several years, could be engineered to link computers and data across networks widely separated in time and space. Hypertext is a “plain text” markup language, which means it’s easily readable and writable by humans. In the first days of the Internet many people taught themselves how to write a Web page by reading instructions written by others who had already started figuring it out. I was one of those people. There was a great deal of informal learning taking place, and a great deal of disruption. The IRL and those who framed cognitive apprenticeship were not alone in the quest to apply computers to teaching and learning. I find their framework remains concise while being comprehensive, which I feel should help keep it practical. In light of the explosion in social media it now seems inevitable that social anthropology and ethnography would inform the methodology, but their foresight I find especially intriguing. I’ve already catalogued the 4 elements of a learning situation above. See [Appendix B] for further components within each element. Collins et al. stressed they were seeking a framework, not delivering a formula (1991, p. 17). We’ll see this framework is quite suitable for mapping to software and digital pedagogies on Internet-based platforms, and that some notable beginnings have already been made [Appendices C-D].

Situating Cognitive Apprenticeship

The context in which cognitive apprenticeship itself is situated deserves consideration. We can start by considering some of the contemporaneous nomenclature: the “edubabble” of the day. Some biggies of the era are still with us; here are four examples.

The adjective *experiential* is paired with learning since the 1970s or earlier (Keeton, 1976, Weil & McGill, 1989). Mark Smith (2001) provides a very helpful summary of the literature and reports there are two general descriptions being applied: ‘direct encounter with the phenomena being studied...’ (para. 1, see also Borzak, 1981, p. 9 quoted in Brookfield, 1983). and ‘...direct participation in the events of life’ (Smith, 2001 quoting Houle, 1980, p. 221). Perhaps that directly parallels Vygotsky’s (1979) *zone of proximal development* vis à vis Freire’s (1970) *praxis*. Traditional apprenticeship certainly presents us with both opportunities, but does Collins et al.’s cognitive? I think we’ll find it does when we *design* for it.

“Authentic learning” always struck me as an imprecise term. Learning is not a noun¹ (Silvers, 2011, para. 6) and shouldn't be indiscriminately paired with adjectives. When Collins et al. (1989, 1991) use the word they really refer to authentic *contexts*. I mean in no way to dismiss the school of thought the name represents; practitioners who embrace the concepts and techniques seem to interpret it as something more akin to *“enabling learning within authentic contexts,”* (mine) or verb adverb: *learning authentically*. I believe it has the same meaning as *situated learning*, another term used with cognitive apprenticeship (Brown et al., 1989; Collins et al., 1989; Collins et al., 1991; Ghefaili, 2003; Lave, 1996). In that spirit and looking through its lens, throughout this project I'm using the word **situations** to mean the kind of elearning environment that “capture and represent practice,” “provide scaffolding,” yet can sustain the innate complexity, contextualization and sheer messiness of experiences where learning happens. I showcase my own attempt at designing such a situation at the end of section 2.

In fact for many decades educators have observed a gap between life within and outside of schooling (Boud and Miller, 1997; Dewey, 1916, 1933; Dimmock, 2002; Mims, 2003; Piaget, 1974). I share an antipathy towards uncritical use of the phrase “real world” (and the advice of those who use it loosely) with John Shindler who warns, “...a) the real world is rarely defined by adages that include the phrase the “real world,” b) the use of the term the “real world” usually indicates a world-view that has been jaded and is fundamentally dysfunctional, and c) students are likely paying the price for it” (Shindler, 2009, Appendix J). I believe point “c” is a common destination, if by other paths, with at least one of Freire's who, having said “...Knowledge emerges only through invention and re-invention, through the restless, impatient, continuing, hopeful inquiry human beings pursue in the world, with the world, and with each other” (Freire, 1970, p. 72) said elsewhere, “The educator with a democratic vision or posture cannot avoid in his teaching praxis insisting on the critical capacity, curiosity, and autonomy of the learner.” (Freire, 1998, p. 33).

The ideas of multiple intelligences (Gardiner, 1983) and learning styles (Kolb & Fry, 1975) are related. While it's impossible to ignore their effect on teaching over subsequent decades they have naturally both been criticized at very deep levels. Again, Smith (2001, drawing on Jarvis, 1987, and Tennant, 1997) summarizes those critical of Kolb very well, they centre around extravagant claims and lack of empirical evidence. The latter flaw is also claimed of Gardiner's theory, along with disconnect from findings from the field of psychology (Gardiner, 2006; Visser, Ashton & Vernon, 2006a; Visser, Ashton and Vernon, 2006b; Wellingham, 2004), yet the ideas persist and some practitioners attribute successes while passionately defending their use in the classroom. I ask, might the social setting of classrooms, and the sociological aspects of learning, account for such alleged results, where strict neurological science finds no correlation?

1 « Somewhere along the journey, as we became focused on making these models and standards more efficient and effective, “learning” went from being a verb to being a noun. If you actually think about what learning is and that it is intrinsic to the individual, how could it possibly be delivered? But that's precisely how learning is perceived by those buying “learning” and, hence, influencing how it is designed, developed, and “delivered.” » —Aaron Silvers (2011a).

Ethnography: the “thick” view of Learning Communities informing praxis

As Peggy Reeves Sanday (1979) tells us, "Ethnography ...is as least as old as the work of Herodotus. With great and sometimes disdainful zest, that ancient Greek ethnographer recorded the infinite variety and strangeness he saw in other cultures" (p. 527). The qualitative methodology we see today developed in the 20th century with work such as that of Boas² (pp. 527-530).

I strongly suspect treating cognitive apprenticeship as a framework for experience design sidesteps much of the conflict. Cognitive apprenticeship's heritage, as the others', traces back to activity theorists such as Vygotsky and Leontiev but charts its course via the social anthropology of Jean Lave and socially situated, community of practice-based learning she explored with Etienne Wenger (Brown et al., 1989, p. 41, fn. 1; Lave, 1996; Lave & Wenger, 1991; Ghefaili, 2003). Apprenticeship in general, and cognitive apprenticeship by design, attempts to make thinking visible, often illustrated by the use of exemplary case studies (Collins, Seely & Holum, 1991; Ghefaili, 2003; Conole et al., 2008). These are quite like *ethnographies*³ (see for example, Wenger, 2003).

Qualitative “sciences”

Social and cultural anthropologists during this period were engaged in an internal debate over the concept of *thick description*, an interpretive, qualitative practice of a type that caused discomfort amongst many pure and applied scientists (as it does to this day) who may have thought there was “no common ground between art and science, between intuition and rigor” (Scheff, 1986:408). Clifford Geertz, credited with developing a philosophical motif of Gilbert Ryle⁴, himself said of thick descriptions, “what we call our data are really our constructions of other people's constructions of what they and their compatriots are up to...” but argued nonetheless that this “[leads] to a view of anthropological research as rather more of an observational and rather less of an interpretive activity than it really is” (Geertz, 1973:9). Indeed, observation is the primary source of ethnographic data. An ethnography is “...both a qualitative research process or method (one conducts an ethnography) and product (the outcome of this process is an ethnography) whose aim is cultural interpretation,” says Brian Hoey. “...To develop an understanding of what it is like to live in a setting, the researcher must both become a participant in the life of the setting while also maintaining the stance of an observer, someone who can describe the experience with a measure of what we might call ‘detachment’” (Hoey, 2012). Isn't an engaging teacher in a classroom engaging in similar role swapping?

It's a truism amongst educators that we learn as we teach. “When we are engaged in learning projects we teach ourselves. In all of these roles we are also likely to talk and join in activities

2 Sanday refers to Wallace (1972) “As Wallace (p. 469) points out, although Boas was not the first to do fieldwork and his fieldwork did not meet all the standards of his own paradigm, “he did effectively establish the fieldwork paradigm for American academic anthropology.”

3 I grant it's rare, but not unheard of, that a case study used in a classroom contains all the elements of the “thick descriptions” I describe below.

4 Hoey, 2012; Geertz himself explained it was derived from the philosophy of Gilbert Ryle (Geertz, 1973:6)

with others (children, young people and adults). Some of the time we work with a clear objective in mind... At other times we may go with the flow - adding to the conversation... or picking up on an interest” (Jeffs & Smith, 1997, 2005, 2011). Cognitive apprenticeship models reject models that value the results of traditionally formal learning (e.g., schooling) over informal ones (e.g., observation, trial and error). From an apprenticeship perspective, “...the assumption that teaching necessarily precedes or is a precondition for learning, or that absence of teaching calls learning into question, is a false one” (Lave, 1996:151).

I argue that informal learning can be orchestrated in group situations using visualization software and social platforms, accessed by web browser. Every object a participant “touches” is a transaction, so with design, planning and the right tools feedback and assessment can be built in (Smyth, 2009).

Learning assessment—quantifying the situation

In ‘learning management’ models of online education, paradigms of assessment—diagnostic, formative, summative—are reflected in tools and protocols such as SCORM. Mainly put to summative purposes, SCORM “...governs how online learning content and Learning Management Systems (LMSs) communicate with each other.⁵”. Looking forward, the TinCan project has produced the ExperienceAPI, an approach named after the tin can and string telephone many of us built as kids. TinCan employs a semantic paradigm:

At the core of Tin Can API is a simple sentence structure... “Jack completed safety training.” “Christie experienced the Berlin Wall in Second Life.” These statements can be simple or complex. The actors, verbs, and objects can vary widely... Actors/learners can also be described in various different ways... An actor doesn’t have to be a learner — it can be an instructor... content becomes part of a larger superset that we call “activities.” Content creators will be more like “activity providers.”

Neither do the actors necessarily need to be situated at a computer. An LMS could be set to respond to the scanning of a QR code at a particular exhibit at a museum and record that a participant had been there (Silver, 2012).

Adoption of TinCan/ExperienceAPI has begun but is probably proceeding more slowly in the open source community. There is interest, as shown in a Drupal developer forum discussion. Noteworthy commercial adopters include Articulate and Blackboard⁶.

Digital storytelling is a rich area with a long and well-documented history in both instruction and assessment. Rubrics have formative value (Matthews-DeNatale, 2008). Teachers who want to excel at creating and using rubrics can find an online community of practice at RubiStar (rubistar.4teachers.org). I'll discuss digital storytelling at greater length further on.

The cognitive apprenticeship framework encourages “...integrated assessment of learning within the tasks.” Assessment within authentic situations leads to “greater levels of retention and transfer” (Ghefaili, 2003). We'll see it's also more difficult to separate learner and program or process evaluation when environment and context play such an integral role in the learning

⁵ See scorm.com <http://scorm.com/scorm-explained/>

⁶ Per TinCan web site tincanapi.com/what-is-tin-can/adopters/ , accessed 2012-12-21

situation's design (Rittel and Webber, 1973; Conole, 2007; Smyth, 2009). We'll also see an open source *Issue Based Information System (IBIS)*, originally designed to solve *wicked problems*⁷ (Rittel & Webber, 1973) by *dialog mapping*, where the object is to create “a shared display for collaborative thinking and group memory” (Conklin, 2006), adapted specifically to the design of learning situations (Conole et al, 2008; OULDI-JISC, 2012).

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⁷ A wicked problem is one for which each attempt to create a solution changes the understanding of the problem. The term was originally coined by Horst Rittel. (<http://www.cognexus.org/id42.htm>).

Making thinking visible: from theory to practice

Knowledgeable folk who wish to share their knowledge can make their thinking visible in a great number of ways (Reiser, 2004), so I will set some boundaries: I am interested in Web browser based online learning, i.e., learning situated, at least in part, in virtual space and viewed using a Web browser, whichever Web browser that happens to be, running on whichever device the visitor happens to be using, including assistive technologies. I'm

interested in the software, mainly open source software, that supports collaborative networks and collaboration, and ways the three main document types of the World Wide Web—HTML, CSS, JavaScript—can be leveraged to support learning.

I begin with an underlying assumption computers and mobile computer technology are being used to create, present, and/or support the resources and activities I'll discuss; equitable access is an important dimension, but immense, so I'll elaborate on only briefly, in section 3.

First I will argue that designers of learning activities must become better drivers of the vehicles we'll be travelling in, even if we see our main role as navigator, even if most of the real driving will be left to professionals. Knowing the rules and what the vehicle can or can not do, being able to explain clearly the route to be taken, plan logically the sites to be seen, sense when to fuel or schedule pit stops, are all key to being a successful navigator; in the world of rally car driving the navigator is usually called the *co-driver* (Inak, 2009).

“there is a gap between the potential of technologies to support learning and the reality of how they are actually used and that this is due to a lack of understanding about how technologies can be used to afford specific learning advantages and to a lack of appropriate guidance at the design stage”

(Conole et al. 2007a).

“One of the reasons that there is so much dispute about interpretation may be the divorce of theory from practice. The theorists of interpretation explicate methods only conceptually, without applying them... The practitioners... do not explicate their interpretive methods; ... Since theory and practice illuminate each other, more rapid progress could be made if theory and practice were integrated...”

—Thomas Scheff (1986)

Learning designers should not be looking to IT *directors* to tell us what tools we must use, but engaging with IT *facilitators*. All *collaborators* share a common goal: to create environments not merely supportive but *conducive* to the activities we imagine, to assure they provide rich opportunities for learning. Bridging the gap between technology's *potential* and its *current state* of

employment will require teachers and other designers to learn more about the hardware, the software, and the components and programming languages that make them work. By collaborating with educators IT facilitators will inevitably learn more about pedagogy (Conole et. al., 2007).

This may seem daunting, and yet I will assert it need not be, and furthermore that there's no better time to begin than now⁸. I will present activities that are engaged using a modern Web

⁸ HTML5 less strict with more tags; CSS hugely expanded; JavaScript libraries explicitly enable coders to “The Write Less, Do More”

browser and a text editor. I'll constrain the detailed discussion to three technologies⁹—HTML(5), CSS(3) and JavaScript(1.8)—attempt to map some uses of them directly to the 4 elements of learning environments according to the cognitive apprenticeship model, and recount some results I've been able to accomplish almost entirely by using informal learning strategies and the Internet. I'll begin though by laying out one last theory of my own, which I feel is demonstrated within the activities that follow. I am suggesting that, when combined in the form of a Web browser-based application, the three aforementioned technologies supplant the role formerly played by documents and manuscripts. As suggested by such terms as “the semantic web¹⁰” they form a grammar.

Web “apps¹¹” are wider, deeper documents, suited to presenting “thick descriptions”

Written communication developed from glyphs and ideograms that are essentially an attempt to collect, condense, organize, and display thought. Alphabets, it is generally believed, evolved from the Phoenician practice of using the first sound of a well-known Egyptian hieroglyph, an ideogram, to name the symbols we now understand as consonants and vowels, a process called *acrophony*, that I argue achieves even greater consolidation of information. In a blog post [November 1, 2012] I elaborated on how authors and editors have for centuries used techniques such as footnotes (Grafton, 1999), structures of headlines and teasers to be “*continued next page*,” and graphic organizers such as symbolic icons in what are in essence attempts to extend the ability of the finite document to contain and convey information (see Fig. 1). Here I further suggest that the motive behind this incessant drive to pack the written page with more information than it can physically hold is to *illustrate the communicator's thinking*: to make thinking—including the thinking behind the choice and sequencing of the *particular* information—visible. These techniques have all migrated easily to the World Wide Web and the three *free, libre, and open* (FLO) technologies that underpin it—hypertext markup language (HTML), cascading styles sheets (CSS) and JavaScript (JS)—have extended exponentially our ability to pack content.

“If HTML and the Web made all the online documents look like one huge book, [the semantic web] will make all the data in the world look like one huge database”

Tim Berners-Lee, Weaving the Web, 1999

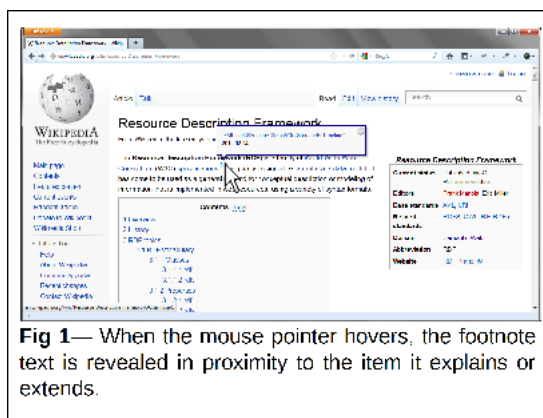


Fig 1— When the mouse pointer hovers, the footnote text is revealed in proximity to the item it explains or extends.

9 ...although I'll also mention two *platforms*—WordPress and Drupal—and their underlying languages, *PHP* and *SQL*.

10 Tim Berners-Lee defined this succinctly as, “The Web of data with meaning in the sense that a computer program can learn enough about what the data means to process it” (PBS/MIT, 2000). For slightly more detail on its components (RDF, schema, and inference languages) their meaning, implementation, and the challenges involved and I suggest the w3schools Web Primer. For the full specification visit the W3C site (links to both are in the bibliography).

11 built on free, libre, open principles

Web designers extend the width and depth of documents in a number of ways, many of which are analogous to older practices from the print world, or attempt to enhance and extend them¹². Wikipedia footnotes¹³ appear at first as normal footnotes, but there's no need to seek fine print at the bottom of the page because when your mouse hovers above the familiar superscript number, the footnote text is displayed in a “popup,” very near the text or idea its purpose is to elaborate (see Fig). This aspect strongly reinforces what Richard Mayer called the *spatial contiguity principle*: people learn better when corresponding words and pictures are presented near rather than far from each other on the page or screen (Mayer, 2005).

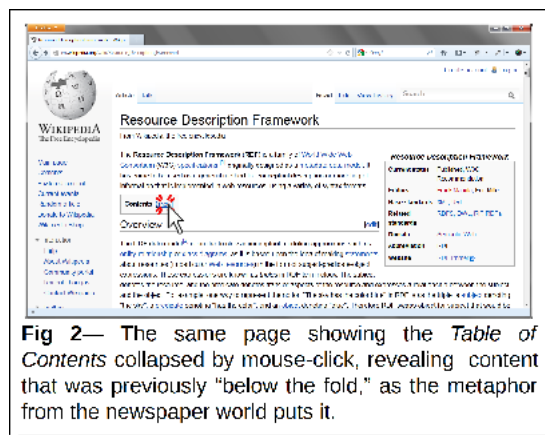


Fig 2— The same page showing the *Table of Contents* collapsed by mouse-click, revealing content that was previously “below the fold,” as the metaphor from the newspaper world puts it.

When enhancements take the form of interactions and the visitor can make choices that affect the content she's interacting with we should perhaps begin to question how appropriate it is to call these “documents” (Finlay et al., 2004). Many web sites we encounter nowadays look and behave as desktop applications, and we increasingly refer to them as “*web applications*.”

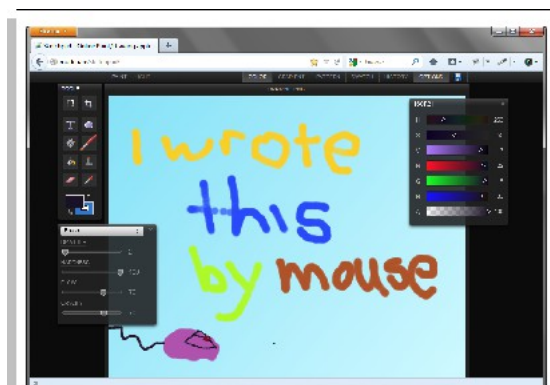


Fig 3— A full-featured paint program written entirely in HTML5, CSS and JavaScript. mudcu.be/sketchpad/

We're beginning to acknowledge how such technology impacts traditional views of schooling, but I suggest have yet to fully appreciate how it affects traditionally accepted *literacies*. Can we still get by with only the “3Rs?” Beyond the “...gap between the potential of technologies to support learning and the reality of how they are actually used...” (Conole & Fill, 2005) is a gap between how we define *literate* when we are preparing to read and write documents, and the literacies we'll require if we hope to read and write applications. I'm not advocating that every classroom teacher become a programmer. I'm arguing that familiarity

with web application programming and the common vocabulary it promotes will be increasingly essential to effective collaborations between instructional designers and the extended networks with which they will inevitably engage in the process of delivering learning experiences (op. cit.; Conole, 2007). Cousin (2010) refers to the “informed amateur.”

How might Web apps align with the framework?

In this section I lay out the four main elements of learning environments according to the

¹² Some useful paradigms I'll expose you to in the pages that follow, the “accordion widget” and the “show-hide” link or button, perhaps more closely resemble labelled drawers on file cabinets. The motive is always to indicate there's more information available than would conveniently fit the space without wholly obscuring the purpose of that information.

¹³ ...and perhaps also footnotes in the program you are reading this with now; I composed this in OpenOffice Writer, which also has this feature.

cognitive apprenticeship framework with their components [Appendix B], and offer Web-based technologies that can drive, support, or enhance their role in designing learning experiences. This list is not meant to be exhaustive, only to start us thinking. Some of the suggestions can easily be applied to more than one stage and element, but further below I'll discuss software that offers other ways to depict such connections without cluttering the list or repeating items¹⁴.

Content

Domain knowledge, say Collins, Brown and Holum (1991), is the collection of concepts, facts and procedures pertaining to a specific topic, and as the word “domain” conveys, these are situated in a community or culture of practice. The learning experience must in the design stage consider, and in the execution stage convey, the *heuristic*, *control*, and *learning* strategies that accompany this particular knowledge in this particular domain. Heuristic strategies are “tricks of the trade;” control strategies help us choose between alternative solutions; learning strategies underlie them both.

Social networks, chat rooms and online meetings¹⁵ can connect people who physically may be in widely separated locations. Web applications can incorporate technologies such as RSS and ATOM to *aggregate* relevant material from anywhere on the Internet and place it in your learning environment. Many sites now follow YouTube's lead and allow you to *embed* their content in your own site. Twitter, for example, provides a “widget” that can collect “Tweets” of people and search terms, which updates in real time.

Methods—strategies with technology

Collins et al. (op. cit.) list the following strategies, which provide a helpful checklist. As a designer at the brainstorming stage you can aim to include multiple examples of each. Aziz Ghefaili (2003) has a comprehensive and tabular rendition of mappings [Appendix C] which is remarkably consistent with today, considering the 10 years that have transpired since.

- **modelling** can often be done with video, web cams and screencasts.
- **coaching** has been accomplished in a variety of ways on line, from the forum or conferencing to webcasts and self-paced tutorials.
- **scaffolding** is expert support. The Internet offers many ways to permit guest participation in a forum, for example, in real-time chat sessions, or by video conference. Popular blogging and content management platforms such as WordPress and Drupal, both with large developer communities, provide easy ways to set these up. But this is not a trivial

¹⁴ See Appendices B-C for examples from the referenced studies. Some of the software shown is obsolete, however I believe the illustrated discussion of interface design concepts and their pedagogical connections still has great value.

¹⁵ Not all of these run well or efficiently in apps written only in HTML, CSS and JavaScript; two other technologies; *Hypertext Preprocessor (PHP)*, an HTML-embedded server-side scripting language) and *Structured Query Language (SQL)*, a programming language that communicates with databases, often used in Web sites in tandem with PHP to write HTML “on the fly”) are FLO often used to fill such gaps. WordPress and Drupal content management systems (CMS) both use PHP with MySQL, probably the best-known open database management system (DBMS).

arena, it is rife with conceptual thresholds yet to be crossed (Meyer, Land, Baillie, 2010). There is still much need for research and what is already known has a long way to go to reach ubiquity. Quintana et al., (2004), and Reiser, Brian J. (2004) are among those who have explored digital enhancements to scaffolding. “The aim of scaffolding design is to find ways to use the nature of learners' interactions with the tool to help shape their thinking in productive ways... Attempts to provide structure may focus attention and highlight critical features, but the problematizing is only effective if the students can make the connections in bridging from their own intuitive strategies to the structures enforced by the tool” (Reiser, 2004; Quintana et al., 2004). [Appendix D]

- **articulation** and **reflection** are about the participants' chances and means to reflect and verbalize their learning, in the experts' presence and/or amongst peers. Online forums and conferencing are useful. An idea for an authentic means of articulating that emerged from a workplace conversation I had involves the use of the “versioning” software Git¹⁶, which is used in multi-programmer software development environments was the following, which can be adapted beyond software development to any computer based project wherein files in a directory are changed and worked on over a period of time.
- **exploration** can be made possible in some technology enhanced learning environments by making specific software available, and in others by granting permissions that are sometimes, mistakenly I would say, reserved for the instructor. Granting all participants the abilities to create and arrange things in an online environment can be risky but also rewarding. If the topic is Web design using JavaScript, HTML and CSS then jsfiddle.net provides a secure “sandbox” setting in which you can fiddle with scripts and play with ideas without having to commit them to files or transfer them to a web server, and there are analogous tools for other disciplines.

WordPress is ideal for a single user blog, or an educator with a classroom. I believe anyone who can use a common word processor can learn to install their own WordPress and learn to administer it¹⁷. Drupal is especially good at forums, but its vastly more powerful architecture and capability comes with a vastly steeper learning curve I'd urge novices to delay until late middle school or high school. If your school or organization has something already, why would you bother with either? You learn more. You'll teach in new ways. You can get away with breaking things. You can set permissions to allow collaboration to draw out local experts. They're authentic; both can lead to viable, marketable skill sets.

Penn State University is highly active in Drupal development. Their eLMS learning management system runs on Drupal (elms.psu.edu/), they've contributed a MOOC module (see drupal.org/project/mooc) and Project Ulmus (drupal.org/project/ulmus), a project

¹⁶ Git software is a kind of backup software that takes a snapshot of the states of files and folders. At any point in time the developer can “commit” changes, and attach a message which could just as easily be comments or questions, then push them to a repository, which could be a teacher or resident expert.

¹⁷ I have a series of original video describing the process of setting up the site for this project at rcfouchaux.ca I plan to release there before spring 2013.

designed in part to make Drupal easier to use for course management.

Program assessment

It is a curious criticism that in their early work Collins and company do not say all that much about assessment. In an earlier section I said I believe there's an implicit understanding that certain tasks require demonstrating mastery of prerequisite skills, and a strong implication that *formative* assessments can be embedded and injected into *control strategies* (Collins et al., 1991, pg. 13), but not until later work on *Design Research* (e.g., 2007, p. 21, pp. 26-27, 29-30, 34-36) is assessment discussed in all its variances—formative, summative, self-, peer-, etc., along with evaluation (and redesign) of theory, program, and process—and with practical examples. Bass and Eynon (2008) suggest challenges to traditional assessment may be inherent in digital learning situations and that, "...faculty who design for this kind of development in new media environments have found that they have to create new ways to stimulate and capture artifacts of student learning that reflect expert processes that are different from traditional summative assessments" (Pedagogies of Adaptive Expertise, para. 2). Smyth (2009) has raised similar flags, as well as concern about time and staff transitions required for adoption and their impact on institutional norms (pg. 123).

I submit that the messy and iterative nature of situated learning environments contribute to liminality (Cousin, 2006, 2010; Meyer, Land, & Baillie, 2010) pointing to a need for alternative assessment repertoires to apply to both student and program performance, and that reciprocal teaching, assisted by technology, can be leveraged to focus the search. Research and personal experience suggest there are further opportunities to draw out local expertise using videography, podcasting, and digital storytelling (Barrett, 2005; Smyth, 2009). These typically require greater hardware and technical support.

Lizotte, Harris, McNeill, Marx, & Krajcik (2003) report on their research applying base rubrics to assess explanations as a way to knowing:

Student explanations in two successive enactments of our chemistry curriculum were analyzed using explanation rubrics aligned with key learning goals emphasized in the instructional materials. Data from the first enactment revealed specific student competencies and difficulties with components of explanation. These data were immediately usable as feedback for revising the instructional materials to better align with assessments and learning goals. In the second enactment, following curriculum revisions, students' explanations demonstrated greater pre-posttest gains relative to the first enactment. (p. 2).

I don't know that this specific two-for-one instance offsets all Smyth's concerns, but it seems to indicate there are potential gains that likely can be leveraged to motivate uptake. Lizotte et al. conclude:

We presented data garnered through use of a base rubric for one way of knowing, explanation. The base rubric offers a number of advantages:

- 1) An instrument for breaking down student “knowing” to reveal key student competencies and difficulties with ways of knowing science content.
- 2) Provides data about student performances that are immediately usable to teachers and researchers for revising curriculum and instruction.
- 3) Adaptable to any science content via specific rubrics, promoting consistent assessment of ways of knowing demonstrated by students across content and over time (in this case, over two enactments).
- 4) Alignment of assessments with instructional materials and learning goals derived from content and ways of knowing, providing sensitive measures of what students understand.

We hope to extend these conclusions to other ways of knowing shortly, and offer a set of base rubrics to the science education community. (Lizotte et al., 2003:12)

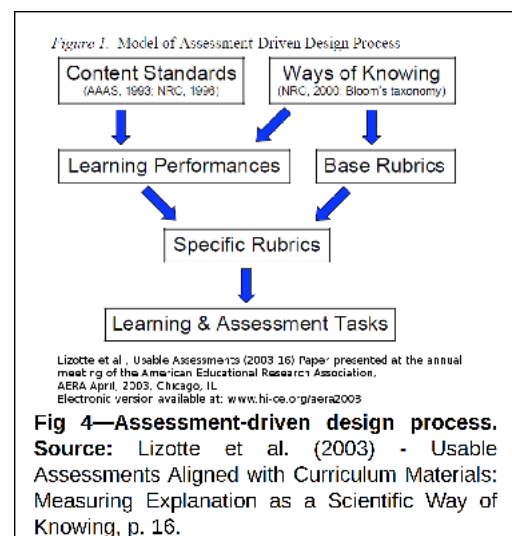
In the figure we see Lizotte et al.'s (2003, p. 16) graphic depicting an assessment-driven design model using base rubrics. Barrett's (2005) Digital Storytelling Research Design Literature Review compiles specific rubrics (pp. 3-4). Smyth's (2008) specifically recommends further research into ways of knowing via learner to learner interactions using video to elicit “deep” change (p. 125).

One might have participants reflect often and provide opportunities to share what went on “behind the scenes” of their learning, perhaps by emulating “The Making of...” ones many of us are familiar with from DVDs. Turn that data back on itself utilizing rubrics and the learners' own impressions. This model “...deliberately prefaces the learner and the learning design with a view to refocusing the emphasis of online and distance pedagogy away from the affordances and on to the learners” (Smyth, 2009, p. 124).

Each of these researchers implicitly acknowledges a basic fact of digital learning: the central importance of the story, narrative, dialog—the narration—to which everything else is synchronized. This, I believe, is why commercial elearning production tools like Adobe Captivate centre around the timeline.

With only an Internet connection it's possible to create “*mashups*” from diverse sources, as for example popcorn.webmaker.org/, which uses only HTML5, CSS and JavaScript to create an environment similar to Captivate on a creative social network model that you can sign into for free. Thanks mostly to the open source community it is increasingly true that there are solutions for every budget and comfort level.

As my aim is to push the reader to push your own comfort level further, in the section immediately after this I'll present a simple Web app project you can do. But first I'll describe a



more advanced project in which I created a “jQuery Plugin,” an HTML5 tool to control events on a web page by synchronizing to audio and video, even as I direct you to popcorn.js, the plugin mine really wanted to be all along. Popcorn.js “...is Mozilla's HTML5 video and media library for the open web. It allows web developers, filmmakers, artists, designers and others to easily create timeline based web productions. Popcorn.js helps simplify media API and implementation differences between browsers and includes a powerful event system and a rich plugin architecture and plugins...Anything you can do on the web can be turned into a Popcorn.js plugin, and become part of a timeline-based web experience.” The URL above shows people will put such tools to diverse purposes, from remixing existing material, for example a TEDNet talk¹⁸, to documenting social injustice like Stop and Frisk¹⁹ to listing 101 things they intend to do before age 30²⁰. These are engaging and creative activities, learning situations encompassing a wide range of so-called competencies, that are currently taking place outside most classrooms.

The HTML5 specification contains the <track> element, but as I write only Chrome and Internet Explorer 10 support it. This element will provide “...a simple, standardized way to add subtitles, captions, screen reader descriptions and chapters to video and audio²¹” using an external source file containing cues that will follow the time code. Tracks can have a “kind” attribute; the kinds of tracks are *subtitles*, *captions*, *descriptions*, *chapters*, and *metadata*²². My experience, which I detail ahead when I discuss digital storytelling, suggests we will need tools to facilitate the creation of timelines, to generate these cue tracks dynamically. The Popcorn.js project recognizes this with the parallel project Butter.js²³.

In the next section I look at sequencing in the digital age. So much of what we do as educators, and in life, is linear, yet we must now also prepare for the asynchronous and divergent. Our tools and pedagogies must accommodate.

18 Beau Lotto at TED, TED, layering links, quotes, articles, and maps popcorn.webmaker.org/templates/basic/?savedDataUrl=tet.json

19 Stop and frisk, WNYC Radio Rookies, layering images, maps, links onto Soundcloud audio popcorn.webmaker.org/templates/basic/?savedDataUrl=projects/stop-and-frisk.json

20 101 things to do before you're 30, Schmittastic, an under 30 bucket list popcorn.webmaker.org/templates/basic/?savedDataUrl=/api/remix/775

21 HTML5Rocks, Getting started with the HTML5 track element, www.html5rocks.com/en/tutorials/track/basics/, accessed 2013-01-27.

22 W3C, HTML/Elements/track, www.w3.org/wiki/HTML/Elements/track, accessed 2013-01-27.

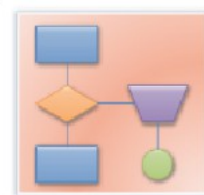
23 Popcorn and Butter: Powering HTML5 video experiments, CreativeJS, creativejs.com/2011/07/popcorn-and-butter-powering-html5-video-experiments/

Sequence

I've seen no evidence the most widely used tool for sequencing long-range plans, unit plans, lesson plans and the daily schedule is not the same one it was throughout my teacher training, the word processor, emulating the typewriter that preceded it, modelled after the beautifully hand-written ones Mrs. Wiegner used when I was in 6th grade, kept on her desk in a large weekly planner she let us to check for ourselves when in doubt about homework and test schedules: a list. By the end of each week she'd written all over it, and started filling every margin.

The authenticity we're courting is better achieved by using day-to-day tools people a) own b) are likely to encounter and c) may at any time use in the course of school, work and play. Calendar software can push important dates to web pages, cell phones and other mobile devices.

In workplaces we encounter scheduling and work-flow software. The latter most often help us visualize the thinking behind a plan or process using symbols that indicate steps, milestones and alternate paths or choices.



Basic Flowchart

Fig 5—A basic flow chart. Shapes and colors may have meaning.

Henry Gantt designed project management charts that have been with us since the early 20th century (Gantt, 1919). Project

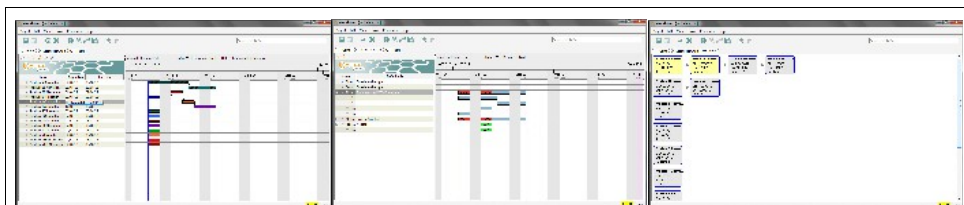


Fig. 6—GanttProject open source project-management tool, 3 different views.

management software may be useful for planning all or part of so-called *project-* or *inquiry-* based learning experiences. The features are available from makers of most commercial



Source:
Laxton, R., and Applebee, A. (2010).
Developing Communities of Practice around e-Learning and Project Management.
Journal of Distance Education 24(1) pg 132.

Fig 7—Developing Communities of Practice around e-Learning and Project Management. The process of knowledge sharing between the practitioners in the project team and the broader communities of practice at Australian Catholic University. (Laxton & Applebee, 2010, pp. 131-2).

office software and several open source projects exist. I've used one named Gantt Project, and I'm aware of another called Open Workbench. They allow you to add tasks and resources (including human ones and their schedules) to a calendar. At least one university has studied applications of project management to elearning and found a concept-map-like “Matrix Organization” to foster favourable situations for learning, concluding “...the project management processes provided the means for knowledge sharing and knowledge management within the areas of eLearning and Project Management” (Laxton & Applebee, 2010i, Quality Management, para. 2).

Audio and video can be timed to trigger events. At the end of this section I'll describe such a tool I created, and a site

based on some open source projects that extends this idea to let visitors create their own *mashups* of content from all over the Internet.

Sociology

Social-networks as learning tools: connecting people

Blogging software has found a dual role in content management. Popular free accounts can be easily obtained at wordpress.com and blogspot.com, the teacher-centred **edmodo** platform combines Facebook-like look and feel with features especially for teachers and recently marked a 15 million user milestone²⁴. WordPress is reasonably easy for any fairly computer-savvy individual to install and manage, and as I'll develop further below, I believe do-it-yourself is a step towards developing 21st century literacies. Drupal is a powerful open source system that can support large multi-user communities, blogs, forums and an immense amount of customization.

Such sites and platforms support thousands of words, multimedia, collaboration and interactivity yet they seem to lack something only the “*micro-blogging*” platform Twitter provides. Research is nascent, but

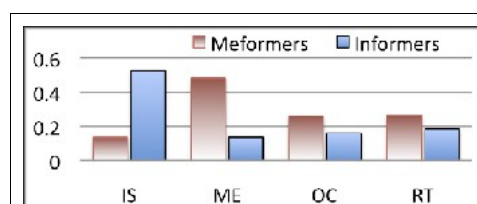


Fig 8—“Meformers” and Informer on Twitter

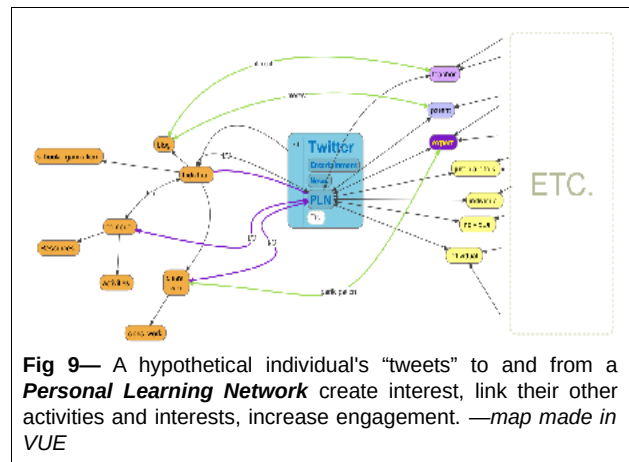
Source: Naaman, M., Boase, J. & Lai, C. (2010) Is it really about me-Message Content in Social Awareness Streams. CSCW 2010 pg 192.

24 Posted by: Lucia Giacomantonio December 11th, 2012, <http://blog.edmodo.com/2>

Naaman et al. (2012), describing what they call “social awareness streams,” showed that only about 20% of tweeters are rightly characterized as “*informers*,” those who post and follow for purposes of sharing information. The other 80% of Twitter activity they studied inspired another new term, “*meformers*” those who post “Me Now” messages. “Indeed, the figure suggests that while *Meformers* typically post messages relating to themselves or their thoughts, *Informers* post messages that are informational in nature” (pg. 192). But if as reported at www.statisticbrain.com/twitter-statistics/ September 5, 2012 there are 100 million active Twitter users monthly that's still 20 million people from which to build a PLN. The element of self-promotion that motivates many Twitter users should not be ignored, however.

Twitter's place is at the hub

So-called “*authenticity*” in learning can be understood as the extent to which the learning is *situated* within a community of people who share some united interest in the knowledge being sought or produced, or common idea of its value. (Kolb, 1984; Lave and Wenger, 1991) Sociology is an integral element of the authentic learning environment (Brown et al., 1989; Collins et al., 1991).



There is now plentiful evidence that a growing number of educators, and many more who think of themselves as stakeholders in education generally, are using social networks (Lowe & Lowe, 2012). More than a few sites and software applications have emerged to compete for parents', students', teachers' and administrators' attention, seemingly from everywhere, all at once. There are powerful new ways to create, manage and share your own resources and an overwhelming number of great resources available from others. (Wenger, 2006a; Collins et al. 1989a;). But while site like Pinterest may drive a great deal of traffic to blogs, the micro-blogging tool Twitter's unique feature set has helped establish its role at the hub.

Social networking platforms and tools are already impacting and supporting learning in at least three ways. First, social networking itself is a tool or skill set for learning. Social networking can be used to deliver curriculum. And social networking can be utilized in collaboration to create learning experiences. Teachers seem to find articles such as *30 Twitter Hashtags For Science Lovers*²⁵ and *50 Ways to Use Twitter in the Classroom*²⁶ immensely helpful, but they do add up. Most of probably hundreds of such no-doubt wonderful ideas that appear on a person's timeline often get swept away in the "digital noise" (Ferriter, 2010). A classroom teacher's bookmarks may include Edmodo, YouTube, and Facebook, Teachhub, PBL-Online and Edudemic, but it's increasingly clear that Twitter has emerged as the hub at the centre.

25 <http://edudemic.com/2012/09/30-twitter-hashtags-science-lovers/>

26 <http://www.teachhub.com/50-ways-use-twitter-classroom>

Teachers use Twitter to plan field trips, chat with industry professionals, connect classrooms, facilitate research, post supplementary materials, to engage students in the classroom, parents outside the school, and colleagues and administrators in networks they can design according to need and interest. Researchers and practitioners are testing strategies and we see best practices and other trends emerging. Successful networks start with a vision, create trust and build consensus, support internal development, evolve mechanisms to deal with inevitable conflict and frustrations, connect data analysis and instructional improvement, and build a knowledge base (Wenger, 2003; Graham & Ferriter, 2009; Junco, Elavsky & Heiberger, 2012).

New Twitter users commonly describe an experience curve that travels from scepticism, trial participation, conversion (getting it), dramatically increasing usage and connections (Levine 2007, Stevens 2008, Seimens 2008, Shepherd 2009) through to potential overload (Sierra 2007).

—Tweed project literature review, (Lowe & Lowe, 2012)

It's not surprising to learn that "design of teaching strategies and practices related to virtual engagement and collaboration is instrumental to achieving positive educational outcomes," but some early research suggests not all are equally ready, that students may need "...to improve their capacity to initiate self-directed, collaborative practices as a means to more effectively take ownership of their learning" through incorporating new technology. Early research also suggests that successful classroom Twitter use requires that professors must participate, and Twitter use must be both structured and *required* (Junco, Elavsky, and Greg Heiberger, 2012; Collins, Joseph, Bielaczyc, 2004).

Learning to use Twitter to grow an effective Personal Learning Network (PLN) is not the same as learning to use it as a tool in a learning situation. What you tweet, when you tweet it, the length of your tweets, whom you retweet and who retweets you are all factors in getting established on Twitter (@shoq, 2009). You can over-use hashtags or under-use them, and good use of images in tweets can make your tweets twice as engaging. (tracksocial.com, 2012). My personal experiences in now almost two years on Twitter can be described as trial and error.

Using Twitter

I've described joining Twitter as walking into the woods and venturing into the trees. You pick a handle and write a "bio." My lifelong nickname, a not unreasonable 7 characters, was taken, so I hastily opted for a 12-character variation a former roommate invented, not foreseeing how often I'd miss those 5 extra characters. For the first few weeks I simply walked about my piece of forest tweeting to the folks who happened to be nearby. I soon discovered how to use hash tags to locate like-minded individuals. Your Twitter network is the list of other Twitter users whose "Tweets" you "follow." There is prestige and credibility associated with having larger numbers of followers, which usually goes with a high ratio of "followers" to "following." As I contributed and engaged my acceptance by others also grew, and was reflected in a growing list of followers. As I learned my way around I ventured into other parts of the woods, made new contacts and shared different kinds of information with my network, or our

information with other networks. So goes Twitter apprenticeship.

I didn't warm to Twitter instantly. My first genuine engagement, when I dropped the last of any scepticism, was outside any of the interests I stated in my bio. The two "hash tags" that first revealed the power of Twitter to me and I'd wager a good number of others were "#Jan25" and "#Tahrir." I was seeing cell phone pictures in the morning of events sometimes barely minutes after they occurred that wouldn't appear on traditional news outlets until that night, if at all.

Celebrity seems to guarantee followers, but everyday people do a number of things to attract and keep followers. These can include social niceties, such as tweeting "Welcome new followers!" or "Thanks for the Retweet" at appropriate times and "Follow Fridays" when people share and recommend their favourite "follows" accompanied by the culturally recognized hash tag, "#FF."

TweetStats is a service that reveals a great deal of information about how people actually use Twitter. One tab shows how many Tweets happened, when, in reply to whom, from what kind of device, and top retweets for a particular user. On another you can visualize the data as a word cloud²⁷ (called a TweetCloud, naturally) of top mentions and topics, and once you've done so for an account you can track "follower" and "unfollower" statistics from that point forward. If you have an idea of a rubric²⁸ demonstrating engagement and on-task behaviour, or other standards you wish to establish in your environment, either for your personal learning community or any experience you design using Twitter, TweetStats can already report some enlightening information. It seems to me this is a direction in which educators can push for further development or show initiative with their own open source projects. [www.tweetstats.com, accessed 2011-2012]

From my unscientific survey of my own TweetStats and "timeline" I've come to sense a great deal about what I can and can't do to maintain my followers list. An important aspect appears to be listing your interests accurately in the "bio" and sticking to tweets that reflect them. I experimented with posting highly political tweets reflecting a single political point of view and lost many education-centred followers, but gained large numbers of others. By contrast, many who seemed to follow for political and ideological reasons don't seem to flinch after days of education-only tweets. I tried creating other accounts for specific topics, and that practice seemed to have some merit, but using a pseudonym seems to have both positive and some negative effects. All of these aspects merit further research in light of Twitter adoption. Research is still limited (Lowe & Lowe, 2012), requiring larger more inclusive studies and more diverse methods (Junco et al., 2012).

Business is also driving a great deal of research into social media, its usage, and ways to

27 From visual design, a **word cloud** is a form of **weighted list**, a visual representation for text data. Usually the importance of each tag, word or phrase being highlighted is represented by variations in font size or colour.

28 A **rubric** is a measuring tool that experience designers can use to assess participant learning and engagement. Using a set of criteria and standards directly tied to the stated learning outcomes, educators can assess each student's actual performance. When a rubric is agreed-upon and communicated prior to the student's work being completed, it serves as a model or exemplar, and makes the grading process clear and transparent.

track, analyze, anticipate and ultimately to monetize people's behaviours on Twitter and other social networks (Christensen, Johnson, & Horn, 2008; Lowe & Lowe, 2012; Thomas, 1992).

Putting it all together: design research, learning design; 21st century competencies, or literacies?

In the preceding paragraphs I've followed each branch of the cognitive apprenticeship framework proposed by the ILR, mainly in the 1980s, to forge paths to what I am calling computer-assisted learning situations, I've named software and general classes of software that are available to us today. Google is a good resource for wire-frame and storyboard sites and applications. As a designer, even when you believe that you have a full inventory of content and methods, that you've charted a complete itinerary of your story's plot, sequence and setting, and you have as overall an understanding of your audience's sociology as one can have, execution remains abstract until it actually takes place. Designing contexts is creative, but above all, design is purposeful (Hoadley, 2002).

Design learning "...is a creative process that offers new ways of thinking and sharing ideas in a group. ...design is a process in which problems can be discussed and solved; the educational atmosphere is open to new ideas and design is seen as a generic cultural activity. [The] ...aim is to research how to understand people's creative mind in the design learning processes and how to learn, develop and practise it in the learning environments of teacher education, schools and day care centres..." (Ruismäki & Ruokonen, 2011). The goals of design learning are iterative, transformational and process focused (Seitamaa-Hakkarainen, 2011).

The next section looks at efforts to put these findings into practice in two areas. The first example is the story of an open source mind-mapping program that has been adapted to learning design. The second introduces *digital storytelling*, and I'll point out the role of synchronized narration in common training modules, with examples including a tool of my own, some open source projects that get it as well, and some ideas to situate these for learning.

Introspection and iteration

At the *World Conference on Educational Multimedia, Hypermedia and Telecommunications* in Vienna in the summer of 2008, Conole et al. (2008) referred to a 2007 internal report of the Open University, a review of forty-four case studies made up of interviews with teachers across different subject disciplines within the Open University focusing on how they were using technologies in their courses, how they designed the courses and what support mechanisms they used (if any) and concluded that design is "inherently... messy, creative and iterative" (p. 5).

Elsewhere Conole has said educational textbooks leave the impression design is linear, but in practice designers "...juggle a range of questions, focusing on different aspects of the design

process at different points in time... Therefore any form of support or tool for the design process needs to be cognisant of this messy, multifaceted and iterative approach.” (Conole, 2007 draft). Andreas Harrer (2008) concurs. Noting methods of software engineering are seldom used in learning system design, he thinks combining different software engineering approaches—example architectures (e.g., reference architectures, architectural patterns, and frameworks), implementation-oriented approaches from the field of software engineering (e.g., patterns, component-based design, and re-factoring), and formal tutoring process descriptions, and then relating them to each other creates a pattern language that can tidy up the corresponding messiness within tool design (Harrer in Pahl, 2008).

The goal of learning design research and the objective of tools such research inspires is to “capture and represent practice” while “making effective use of tools and pedagogies.” Innovative taxonomies and matrices were among representations uncovered at Caledonian Academy (Glasgow) by the Models for Learning project (Mod4L). Narrative case studies emerged as a popular means of analysis, and a sequencing strategy, “temporal sequences,” was outlined. A design concept borrowed from architecture, *pattern languages*, has also been explored (Schmidt et al., 2000; Finlay et al., 2009). The Pattern Language Network for Web 2.0 in Learning (Planet) project “...aimed to develop and demonstrate an effective community-based mechanism for capturing and sharing successful practice, based on the pattern approach. A pattern describes an effective solution to a recurrent problem embedded in a specific context and is characterised by being drawn from successful practice rather than from theory, ...however, the process of eliciting and capturing patterns from authentic practice is not trivial and is rarely an inclusive community-based activity. It is this problem that Planet has sought to address.” say Finlay et al. (2009). Harrer has looked at the intelligent tutoring system (ITS), also often called intelligent tutoring system [ITS]) through this lens, but “the pure architecture description does not provide guidance in software development...” and so “...from the perspective of computer science—ITSs are hardly comparable” (Harrer in Pahl, 2008).

Guided support—scaffolding—in the form of toolkits and planners, have been conceived and created to facilitate the design of learning activities (2007 draft:2-3). Conole et al. caution the latter can be too prescriptive and the former too abstract.

C21 & P21: A 21st Century Learning Framework for Canada, and a Partnership for 21st Century Skills;

Canada and the US are both engaged in efforts to improve education, and both countries have identified goals and objectives. In Canada *Computer*

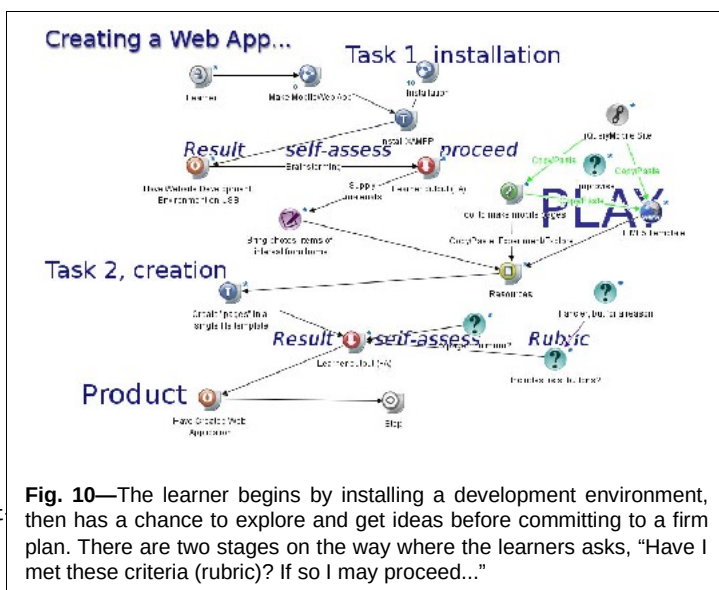


Fig. 10—The learner begins by installing a development environment, then has a chance to explore and get ideas before committing to a firm plan. There are two stages on the way where the learners asks, “Have I met these criteria (rubric)? If so I may proceed...”

and *Digital Technologies* are a 21st Century Competency because “The 21st Century is a technology and media driven environment and digital literacy is an essential competency for both learners and teachers” (C21, 2012:10-11) [Appendix E]. In the US they've identified *21st Century Skills* because “...we live in a technology and media-driven environment, marked by access to an abundance of information, rapid changes in technology tools and the ability to collaborate and make individual contributions on an unprecedented scale” (P21 2-pager:1-2). In both countries we do this for nation building “Effective citizens and workers must be able to exhibit a range of functional and critical thinking skills, such as: Information Literacy, Media Literacy, ICT (Information, Communications and Technology) Literacy...” (pg. 2). Canadians believe “Public education is a community and societal enterprise where all Canadians share both the responsibility for and benefits of providing high quality and modern learning opportunities” (C21, 2012:4). Both initiatives use the word “authentic” to describe the kinds of situations we need to create in order to nurture 21st century skills. Both initiatives are led and financed by the world's largest corporations and are steeped in neo-liberal free-market rhetoric and values (Apple, 2006; Raduntz, 2005; Reid, 2005).

Creating a mobile Web app is an authentic 21st activity with a certain allure. I've developed an approach to this that requires almost no prior knowledge, provides short term gratification and opens the door to much deeper engagement.

Digital storytelling

“Storytelling and learning are inextricably intertwined because the process of composing a story is also a process of meaning-making,” says Gail Matthews-DeNatale (2008, p. 2). While any story delivered by any digital means meets the generic definition, work at the Center for Digital Storytelling has refined that to “a 3-5 minute video produced by someone who is not a media professional, typically constructed as a thought piece on a personal experience that is important to the author” (p. 4, see also Dr. Matthews-DeNatale's “Webology,” 2008, my Appendix H).

I've suggested storytelling has a role in assessment of both the learner and the learning situation (Ghefaili, 2003; Smyth, 2009). But I sense the role of storytelling is much “thicker,” if you will. The idea of *narrative* has thoroughly entered the public lexicon, we hear it regularly in newscasts. I've taken a course entitled “*Discourses of Race, Racist Discourses.*” We ask, “So what's *your* story?” We stick to our stories. Stories compel us. “I'm not sure I believed her, but I gave her 10 bucks for a cab—she sure told a good story!”

In teaching, storytelling has been used to “...enhance self-esteem, develop critical thinking, model behaviors, and to teach cultural sensitivity and communication skills” (Davidhizar & Lonser, 2003, p. 217). Baldwin and Dudding (2007), have compiled 44 pages of compelling evidence of the practical applications of storytelling in their online reference, “*Storytelling in Schools: Quantitative Studies, Innovative Projects - A Reference Guide.*”²⁹, and powerful statements from groups like the Youth, Educators and Storytellers Alliance (YES! Alliance;

²⁹ www.storynet-advocacy.org/edu/booklet.pdf

[Appendix F]). Digital storytelling can “[encourage] a historian, for example, to delve into multimedia applications while exposing a computer scientist to the ideas of narrative through family lore. Creating and watching digital stories has the potential to increase the information literacy of a wide range of students.” (ELI, 2007, p. 2. para. 8). I believe the fundamental centrality of the narrative—the story—to any learning situation is why multimedia content creation tools from PowToons³⁰ to Captivate³¹ are designed around a timeline interface that permits the synchronization of audio or video to other events and objects' appearances, timed to emphasize the story being told. I wanted to do that with a Web app. I found that with Google and my well above average but completely unschooled familiarity with JavaScript I was able to make a simple presentation tool that runs in a Web browser. I'll share the code and concept here, and suggest it as an eventual extension to the Web app project I sketch out more completely below.

jSyncWithMedia: an HTML5 “jQuery plugin” to sync page elements with media

JavaScript is technically a scripting language, it's typical role is to enhance interfaces and create interactions on Web pages. jQuery is a JavaScript framework, a library of prefabricated constructs and conventions that allows coders to “write less, do more” (jQuery motto; see Web-site). Programmers don't know every language; they know what syntax is, they know where and how to look things up. Programmers are very often experts at *learning how to learn*. If you want to make something for the first time with HTML5 audio or video and jQuery you can start by reading the Application Programming Interface, or API.

Time code

Google “HTML5 audio and video API” and you will get over a million results, but I chose the 3rd one from the top when I searched it, the W3C's “HTML5 Video Events and API³²”. In object-oriented programming I want to know what *properties*, *methods* and *events* the *object* “*exposes*.” Properties are characteristics like `width` and `height`, `currentTime` or `paused`. Methods are also called *functions*, which means they get parentheses after their names, and are mostly commands, like `play()`, `pause()`, or `mute()`. Sometimes you can make the command more specific by putting something in the parentheses to *pass* to it. Events will happen, are happening, or happened, e.g., `ended`, `loadeddata`, or `timeupdate`. When I thought about it a bit I realized for my main purpose I only need to know one property, the `currentTime`, and one event, `timeupdate`. I didn't worry about any other events until I wanted to roll credits, then I started “listening” for `ended`. As it happens, the audio and video elements have almost identical methods and events and many of the same properties. The full jQuery API is at api.jquery.com/.

jQuery gets its name from its ability to ask questions, but it's more like x-ray lenses; give an element a unique id and jQuery will find it, tell you what it's doing, reveal its inner workings,

30 “Do-It-Yourself animated presentation tool” www.powtoon.com/

31 “helps you rapidly author a wide range of interactive eLearning and HTML5-based mLearning content” www.adobe.com/products/captivate.html

32 HTML5 Video Events and API www.w3.org/2010/05/video/mediaevents.html;

steal its identity, ...even clone it! There are many places to apprentice informally in jQuery on line. *jQuery for Designers*³³ and the tutorials there, made by Remy Sharp, are superb examples of instructive digital storytelling based on *thinking out loud*. jQuery is really just a command to give the unique object(s) or class(es) you pass it the extensive set of enhanced properties, methods and events the imaginative jQuery community has rolled in³⁴.

The next most important thing to know about jQuery is that it supports community-contributed “plugins.” A jQuery plugin typically focuses a specific set of jQuery tasks on an object or class of objects for a specific purpose, like setting cookies, or transforming a list of images into a slide show. jQuery uses CSS and HTML to find things. In CSS, unique objects start with a “#” Classes start with a dot “.” Generic HTML tags have neither. To do something with all the paragraphs (<p></p>) on a page you say `jQuery('p')`, to get paragraphs you've styled to contain quotes (<p class="quotes"></p>) you say `jQuery('p.quotes')`, if it's the unique paragraph you said was for the Einstein quote (<p id="AlfredE" class="quotes"></p>) you don't need to remind jQuery it's a paragraph or a quote, just call `jQuery('#AlfredE')`. jQuery is so valuable to programmers they gave it a shortcut, “\$” so you can just type `$('#AlfredE')`.

I wanted to sync items to my media, so I created a class of items I called `.syncItem`. As quick as jQuery is, you only want to send it searching once, so you copy it as a *variable* and work with the copy. The statement: `$media = $('audio,video');` gets all the audio and video elements on your page (I use the dollar sign to remind myself it's media with jQuery superpowers). `$syncItems = $('.syncItem')` gets every image (), div (<div class="syncItem"></div>) or other object I designate a `syncItem`. The only other thing I need is a way to tell when something is supposed to be on or off. HTML5 knew I might ask something like that, so it gave me a customizable `data-` attribute. I can put anything I want after the hyphen, e.g., `data-on`. I was courteous though, and put “`jswm`” in between, in case another plugin wants to turn something on or off.

```
/* Check items' on/off as media plays */
$media.on({
  timeupdate : function(event)
  {
    var cT = this.currentTime, cTd = cT.toFixed(1) ;
    if ( DEBUG ) { console.log('Syncing items... '); }
    /* The each() command runs other commands on each item in a group */
    $syncItems.each(function(i,item){
      var neg1, on, off, turnMeOn, turnMeOff, n, msg, theTxt = $(item).text() ;

      /* I break the logic up so I can visualize and understand it:
       * give variables meaningful english names, then I lay them
       * out in a line and try to account for all possibilities.
       * How would a programmer do this?
       */
      neg1 = parseFloat(-1.0); /* just being clear */
      /* Get the value of the on and off attributes */
      on = parseFloat( $(item).attr('data-jswm-on') ) || neg1 ; // if there's no on, set -1
      off = parseFloat( $(item).attr('data-jswm-off') ) || 0 ; /* Set data-jswm-off="-1"

```

33 “Learn how easy it is to apply web interaction using jQuery” jqueryfordesigners.com

34 It's not my intention to teach jQuery in this short space; it would be more precise to say jQuery attaches mostly methods that manipulate the target's properties, and/or listen for and react to its events.

```

    * for a "The End" or credits screen
    *
    * I gave variables names that tell what they do ...and that I can remember.
    */
    turnMeOff = ( off <= 0 || ( off > 0 && cT >= off ) ) ? true : false ;
    turnMeOn = ( ( on <= 0 && on > -1 ) || ( cT >= on && cT < off && turnMeOff === false ) ) ?
true : false ;
    n = i + 1 ;
    // This logic should be looked at for ways to improve.
    if(turnMeOn === true && turnMeOff === false)
    {
        $(item).attr('aria-expanded','true');
    }
    else if (turnMeOn === true && turnMeOff === true || (turnMeOn === false && turnMeOff === false) ||
(turnMeOn === false && turnMeOff === true ) )
    {
        $(item).attr('aria-expanded','false');
    }
    };/* ^end $media.on */
} /* ^end $media.on */

```

This is not finished code, it contains flaws. Would a formal computer class find any value in fixing it, or start over from scratch? I didn't know all the `data-` attribute could accomplish, so I read it from the elements themselves in the `each()` function, which can't be optimal. The program attempts to read this information for as many items as I mark `class="syncItem"` as many times per second as the `timeupdate` event fires. Scalability, the ability of a program to continue working well under increased load from more users and data, is one of the main things Tantek Çelik said separates programmers with computer science backgrounds from “jQuery plugin monkeys” like me (Fouchaux, 2011 blog post³⁵; Miraglia, 2010a). That said, I've placed as many as 45 “syncItems” on a page and the program still runs well and catches the timings. The end user's browser and system make the most difference in this regard, as JavaScript runs on the “client side,” not the server. The “*JavaScript engine*” under Google Chrome's hood is their “V8 JavaScript Engine” and is said to execute code more quickly than other engines³⁶. A quickly-emerging JavaScript technology that has a built-in V8 engine is “node.js” and it's already changing the way developers think about Web applications (Miraglia, 2010b)

Timeline interface

So far the only way to set the timings is to hard code them in. How do we get from listening, jotting down timings with pencil on paper then typing them in and fine tuning, and I soon found I wasn't prepared to work so hard... Adobe Captivate's timeline is so advanced compared to anything I was ever going to do myself.

I did come up with something, and again it was largely the result of informal learning and intrinsic motivation. But this one falls back on job training I had years earlier in XML and CFML (ColdFusion Markup Language.) Audacity is an open source audio format that generates files with the .aup

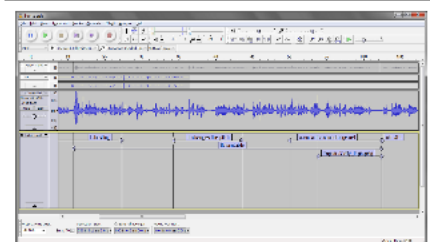


Fig 11—Audacity labels as Timeline interface.

```

<labeltrack name="Label track" numlabels="11" height="253" minimized="0">
-  <label t="1.69726544" t1="11.83946136" title="li:woodshed"/>
3  <label t="11.92225480" t1="27.32183391" title="li:busting"/>
3  <label t="20.79346939" t1="62.46764754" title="li:turntable"/>
  <label t="34.31787926" t1="43.54934739" title="li:changes the pitch"/>
  <label t="50.00723540" t1="62.46764754" title="a:audacity.soundforge.net"/>
  <label t="53.85713018" t1="62.50904425" title="img:audacity.logo.png"/>
  <label t="62.46764754" t1="62.55044097" title="off:ALL"/>
  <label t="76.70811855" t1="91.03138299" title="img:copy paste.png"/>
  <label t="91.11417643" t1="109.90828642" title="li:copy menu item"/>
T  <label t="110.15666673" t1="114.79309915" title="li:easily practice"/>
  <label t="114.79309915" t1="123.81758369" title="li:Save Project As..."/>
</labeltrack>

```

Fig 12—The beginning and end times are stored as plain text in XML.

s.com/2011/12/22/on-webmasters-and-jquery-plugin-monkeys/
 Explorer), SpiderMonkey (in Firefox), and JavaScriptCore
 is executed and the nature of that JavaScript."

ing design.

extension and subfolders filled with raw audio output. For reason I don't recall I opened a .aup file with my text editor one day, and noticed it's really an XML file that stores all the information about the raw audio in the subfolders as text.

XML, as I like to say in presentations, is like the Universal Translator in Star Trek, it allows applications to “talk” with each other in their own language. Many programs, including ColdFusion, have XML libraries and can easily read and manipulate the data within XML files. I was able to use the label feature from Audacity to set start and end times, read the file with ColdFusion and generate the HTML code I needed in a fraction of the time it took to do it manually. Figures 11 & 12 show the interface in Audacity and its output; Fig 13 shows a test page with code generated from the audio file “labels” track. The details and code can be found on my blog³⁷.

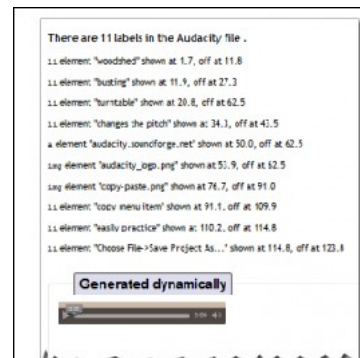


Fig 13—Outputs HTML

Mozilla's Popcorn.js project is a robust, collaborative open source project that accomplishes elegantly what my project attempts to do. They've built an all-HTML5 media mashup tool at popcorn.webmaker.org/ I feel has great potential to engage people in situations where learning can't help but take place.

Open University Learning Design Project, complemented the theoretical/analytical side of their research with the development of a learning design tool and workshops to support its adoption. The tool is an adaptation of an open source “mind-mapping” or brainstorming tool, Compendium. (pp. 4-5).

In the next section I'll discuss this category of software that makes thinking visible by allowing the user to label and annotate objects that represent ideas, goals, or arguments and draw links between them or to resources that relate to them and indicate the relationship or connection. There is now a good selection of *mind-* or *concept-mapping* software educational experience designers will find very helpful in making their thinking visible, by offering ways to illustrate the connections between the four main pieces of every learning environment. Nearly all of these programs are built with Internet collaboration in mind. Such software can find a role in lesson planning (Conole et al., 2008), lesson plans (I'll offer an example of my own), and as John Budd (2004) and others have found, in the lessons themselves.

³⁷ Audacity files are just XML documents, sooo... Posted on September 2, 2012 <http://www.rcfouchaux.ca/blog/2012/09/02/audacity-files-are-xml-documents/>

Fig 14— A map of this paper & project made with VUE, a project at Tufts University “In addition to adding considerable value by making both meaning and data accessible, visualization tools allow end users to personalize or take ownership of data.” (ELI, 2009). The colour groups can be isolated as layers, and the tool includes a presentation mode that zooms and focuses.

Fig. 15—Mapping the Cognitive Apprenticeship Framework in Compendium
 Trying to cover all the bases: making thinking visible while designing a lesson. Icons, positioning, colours, arrowhead direction have meaning, follow the designer's logic...
(cont...)

use colour-coded arrows to indicate relationships between them. In the software these objects can all be opened as dialog boxes, which can store further details. “Mouseover” or “rollover” effects (anything the software does in response to a user placing their mouse pointer over something on the screen) let you peek inside.

Two close-ups of the maps within:

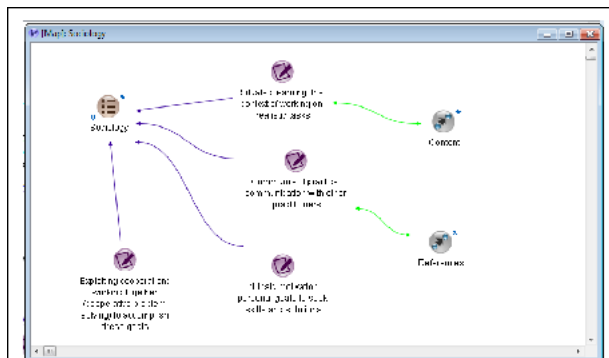


Fig. 16—Sociology general priorities and strategies unfold: coloured arrows illustrate relationships to and between the ideas; each item can become a map of future brainstorming. Big questions asked here, “Have I planned for this?” “Who are my experts?” get deep answers at the next level (cont)

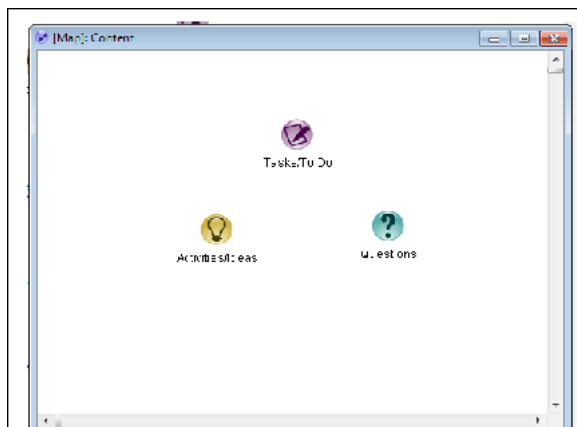


Fig. 17—Content ...where you can be clear and specific about content, methods, and activities. Compendium and similar software let you add lists, links, video, documents, and to publish the results.

The maps above list the parts of the framework. In Compendium you can draw additional items as you brainstorm and you can put terms “inside” other items, for example double-click the Content->Questions icon and find the actual questions stored inside. You can label the lines, change the directions of the arrowheads or put arrowheads on both ends. You can also export an interactive version in HTML³⁹ and other formats.

Gráinne Conole of The Open University, UK has researched the use of Compendium specifically as a tool for the design of learning experiences, and they have developed a branch of the application known as CompendiumLD, for “Learning Design,” (Conole, 2007draft, 2007a, 2008) and a recent report has discovered many benefits of this tool's visualization abilities to the process of designing learning experiences (Cross, Galley, Brasher, and Weller, 2012).

I learned on December 15, 2012 in Compendium Institute Newsgroup Digest #1389, that Compendium itself will receive a long overdue overhaul, and the source code

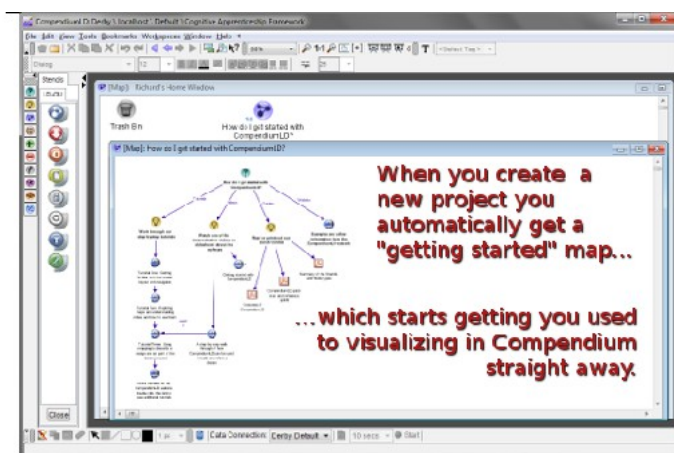


Fig. 18—CompendiumLD user interface showing map The example lays out all the tasks and resources you need to get started and this designer's idea of the connections between them. You can also choose your own path, just double-click to open.

³⁹ Example maps generated by original Compendium: a) Cognitive Apprenticeship; <http://www.rcfouchaux.ca/ideamap-ca/> b) Idea: an online tool; <http://www.rcfouchaux.ca/ideamap/> c) Pros and cons of a blog platform <http://www.rcfouchaux.ca/ideamap2/>.

seems to be finding its way to more friendly repositories. A recording of a Compendium developer meeting⁴⁰ contains details, and may also be of interest to see how Compendium is used to add idea-mapping to the task of recording minutes⁴¹.

Visual Understanding Environment (VUE) is another idea-mapping tool, with a highly intuitive interface and some features that make it very convenient for presenting the maps you can make as presentations. Like Compendium you can stuff the nodes with lists and documents or link to outside resources. It has a feature for connecting to shared repositories. VUE can perform Connectivity Analysis of the links in complex maps, revealing thick connections. VUE uses *OpenCalais*⁴², a meta-

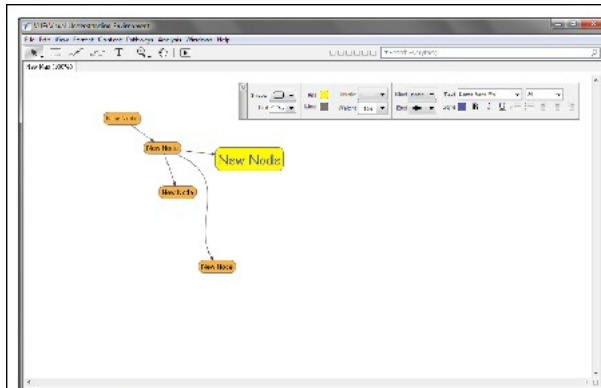


Fig. 19—Visual Understanding Environment (VUE)

data web service that connects similar types of data by category and context. There is work under way to integrate these features with Drupal⁴³ and WordPress⁴⁴. The result for designers of Internet learning situations are expanded immensely with quick access to a global database of related resources to import into projects, and a greatly expanded audience for the resources and situations we create. Wikipedia has lists of free and proprietary mind-map and idea mapping software. I'd like to try it all at some point but thus far I looked at "VUE," or *Visual Understanding Environment*, a project at Tufts University. I found it to be very intuitive, it has a large and versatile set of features, produces a result similar in many ways to that of Compendium, and it can be used as a unique and powerful presentation tool. Also like Compendium they have a user community and a gallery that will tell you far more than I possibly can.

Budd points out some very significant differences between the mind map and the traditional, linear outline and states these have powerful implications for learning:

...note that each branch is captured by a single key word, not a phrase or sentence. Using single words reduces ideas to their core. Important ideas are not obscured by extraneous words, and new associations are not limited by more specific phrases. ... The central point in the Mind Map must always be an image because the brain is drawn to an image more ...differences in the size of the branches and the associated words are used to reinforce associations and to add emphasis. ...the use of color is important in creating Mind Maps. ...many Mind Maps use one color for each major category to aid in organization. ...These differences can make Mind Maps powerful tools. ...Research on memory and learning emphasizes the importance of associations, and the radiant

40 WMV audio at http://www.cognexus.org/Compendium_Futures/2012-12-12_C_Developer_Meeting.wmv, accessed 2012-12-16.

41 The recorded meeting demonstrates another technology-based approach to making thinking visible (and audible).

42 Per the project Web site, Map Based Semantic Analysis: <https://wikis.uit.tufts.edu/confluence/display/VUEUserGuide/Map-Based+Semantic+Analysis>

43 Drupal Module gallery: <http://www.opencalais.com/category/gallery-tags/drupal>

44 WordPress Plugin gallery: <http://www.opencalais.com/category/gallery-tags/wordpress>

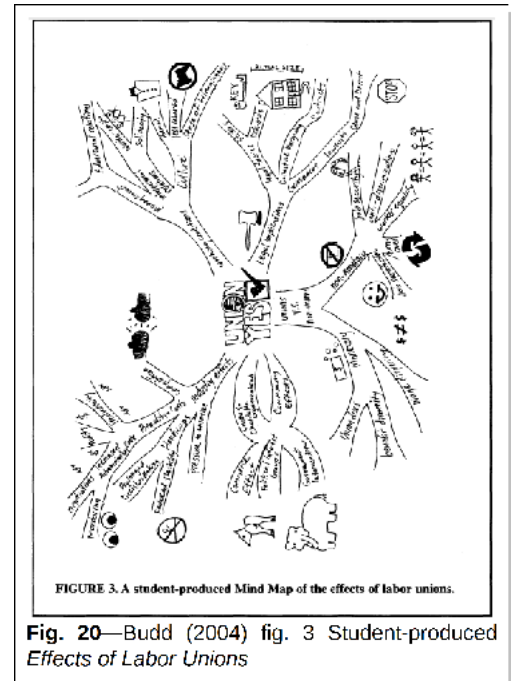
structure of a Mind Map with explicit branches promotes associations. The use of color for different categories can also make more powerful associations. The use of emphasis in a Mind Map, for example with thicker main branches and larger printing, can also help the recall of information. The focus on using single key words can foster more expansive connections, and confining the entire Mind Map to a single piece of paper allows one to see the entire picture at once and perhaps stimulate additional associations. (Budd, 2004, pp. 37-8)

John Budd's article is accompanied by samples of hand-drawn maps that, in my opinion, also reveal how far technology still has to go to match humans' capacity for expression. Neither Compendium, nor from what I've seen so far VUE, has the ability to vary the width of connecting arrows, let alone supply the "branches" of a map with bark [n.b. Since first writing that sentence I've seen many others that do thicknesses (still no bark). See "Vic's list" at the end of this post]. Educators can do much to influence the design of software by engaging directly with software developers and designers on social networks like Twitter. You do not need software to use mind maps in lesson plans.

Mind Maps can be used to add active and collaborative learning to courses. Students are engaged in active learning as they wrestle with ideas, associations, and categories in creating a Mind Map—they are creating their own Mind Map, not simply looking at one created by the instructor. The exercise is collaborative because the Mind Maps are created as a small group effort. A collaborative relationship between the instructor and students can also be established as the instructor helps with the constructions of the Mind Maps, but as a "guide on the side" not as the "sage on the stage" (Budd, 2004, p. 42).

Because of the reliance on hierarchies, says Budd, concepts or classroom exercises that do not fit traditional outline structure are probably not good candidates for the creation of a mind map. Even in early explorations of collaborative concept mapping software I've noticed, in forum discussions and newsletters, a common motif that points to another criticism: mappers often say things like "this works for me" while maybe the internal logic isn't quite as apparent to everyone. I believe such criticism can be overcome by perseverance, collaboration and openness to feedback.

The American Association for the Advancement of Science, "Triple A-S" (AAAS), maintains The Strand Map Service (SMS). This service includes a JavaScript API for developers⁴⁵. As the site tells us, "The SMS JavaScript API lets Web developers insert interactive AAAS Strand



⁴⁵ The Strand Map Service (SMS) provides an interactive graphical interface that helps K-12 teachers and students understand the relationships between science concepts. <http://strandmaps.nsdl.org/cms1-2/docs/index.jsp>

Maps into Web pages using JavaScript and place custom content into the bubble inside the maps.” See Appendix G for an example showing how AAAS uses mind maps to display connections between outcomes and strands across grades, or browse The National Science Digital Library (NSDL) HTML/CSS/JavaScript version on line <http://strandmaps.nsdl.org/> (AAAS, 2012).

I’ve experimented using Compendium to take notes in meetings, for sorting research, choosing between possible software solutions, and for planning. I’m now very interested in presentations using VUE. When it comes to mind mapping software I now often find myself saying, “This works for me.”

Mind-mapping software is recommended at the 8th grade level by the United States' *Partnership for 21st Century Skills* (P21 Common Core Toolkit, 2012). The Canadian parallel, *C21 Canada: Canadians for 21st Century Learning and Innovation*, speaks of ubiquity of WiFi and mobile devices. Both projects speak of new literacies, but neither speaks explicitly of programming, let alone informal learning. In the next section I'll outline a project in which participants who may start out with minimal or no programming skills create a Web app suitable for a mobile device. I'm presenting this project-based approach to acquiring 21st century competencies as a mind map. As you will see, I found VUE very easy to begin using quickly for an overall picture of the elearning situation, but I believe the learning-design-specific features of CompendiumLD might present a clearer picture of the task itself for users when I master both equally (see accompanying CD or www.rcfouchaux.ca).

Project: Creating a mobile Web app⁴⁶

Hypertext Markup Language (HTML) is now in version 5, and for the first time in many years the upgrade comes with greater freedom (Berjon, Leithead, Navara, O'Connor, & Pfeiffer, 2013). In the activity I've designed a single participant can work alone to create a shell that can be used as a show & tell about an interest or hobby, a wrapper to hand in assignments in a variety of classes, or could house a tool to assist with some other task, for example a word or character counter.

My first attempt at using CompendiumLD was actually to describe this activity, which I had in mind for some time even before my awareness of CompendiumLD. It's a PBL situation in which participants create a web app they can access from their smart phone. It looks and behaves like a sophisticated app, and as a project has as many options and extensions as a situation designer can imagine and pull resources together to execute. At its most basic it consists of 2 tasks a single person can complete in about 30 minutes, but if you had 30 people they'd work in groups and extend the project accordingly—in other words this project *scales*⁴⁷ well. The first task is to download and install the server environment, and the steps are:

46 A “Web app” differs from a “native app” in that it runs in a Web browser. You can make Web apps into native apps using intermediary software, such as PhoneGap, but the community has cautioned that jQueryMobile is not the ideal route to go for that.

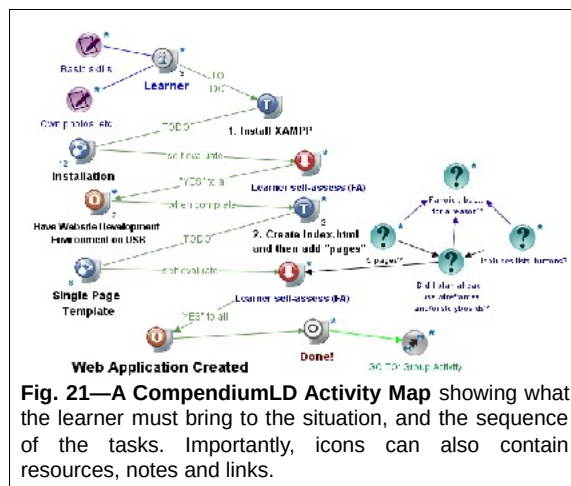
I recommend Stark (2010) jonathanstark.com/iphone-book and jqtouch.com for more information..

47 This means it works as well with many simultaneous users as well as only a few.

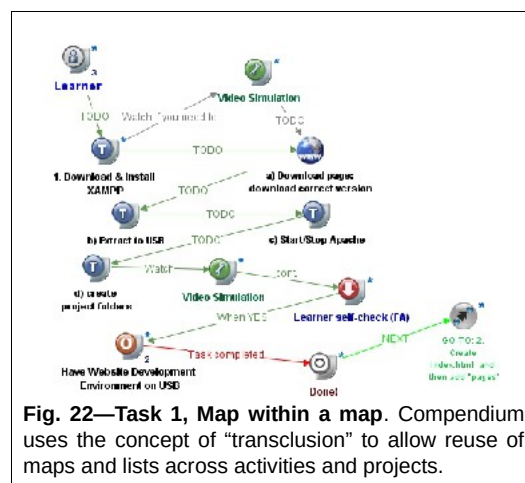
1. Install a well-known portable web development environment,
2. learn to start and stop the web server,
3. learn what and where the *root folder* is and create a sub-directory to hold a personal project,

The second task is to create a basic 3 to 5 page web app using a template provided in advance. This stage has opportunity for play, experiment and improvisation. In a classroom setting groups may well start healthy competitions.

1. Copy the template from the Web based tool into a plain text editor,
2. customize it with information related to your idea and save it as “index.html” in the personal Web folder created in the first task,
3. create at least 2-4 other “pages” and link them with each other. At this early stage be sure to use lists and buttons to set up navigation,
4. explore the jQuery Mobile site and see what is available. Try copy/pasting some of the items you find there into your application⁴⁸.



The concept map in Fig 14 was made with the Tuft University *Visual Understanding Environment* software, and appears in interactive form on the accompanying CD and at www.rcfouchaux.ca. Unfortunately when I pasted HTML code directly into VUE's information dialogs it was interpreted literally, breaking the exported image map⁴⁹. These can be fixed manually by someone with adequate knowledge of HTML, but it would be frustrating for the average user. While the learning curve seemed steeper and the interface somehow more “dated” I found CompendiumLD, from The Open University UK, to be a robust and powerful planning tool, with features I suspect may correlate with the Guidelines and Strategies for scaffolding design discussed above [Appendix D], as well as Gráinne Conole's (Conole & Fill, 2005; Conole 2007; Conole et al., 2008) research, that guided its development. Fig. 21 shows icons



48 A good question for group reflection is, “What is the difference between adapting your project to use the fanciest widget you see on the mobile site and choosing the most appropriate widget to serve a purpose?”

49 Especially noticeable are the overlaps it causes. Changing e.g., > to > and so on, solves this problem but creates others. As it is open source, the community can fix something like this readily.

I think use “representations” to bridge *user* understanding. This use of icons demonstrates a way to “...provide visual conceptual organizers to give access to functionality” (Quintana et al., 2004). Figs. 22 and 23 show tasks recast as activities within the larger activity. Arrows can be color-coded and labeled, and might indicate progression through steps or another relationship, depending on the types of nodes being joined.

I hope the individual track can be accomplished quickly by anyone interested in the idea. You can put together “snippets” of code from the lesson plan and the Web resource and alter them to get the hang of it, but you'll need a good idea, wireframes and storyboards up front to make a truly meaningful app.

The full scope of a group project is not fulfilled here —practitioners and designers should know their audiences and add details accordingly. I recommend extending the individual activity with a Human Rights, Our Community or About Me theme, which contain intrinsic motivations and are open to participant interpretation. Designers should know up front who'll be available as experts (e.g., friends and family, community, local businesses), and in what capacity (online? In person?), and set up a small-working-group jigsaw. Groups should do a lesson in making storyboards and wireframes, and follow up with a well planned project brainstorming before actually building their application. Find the project on line at www.rcfouchaux.ca and accompanying CD.

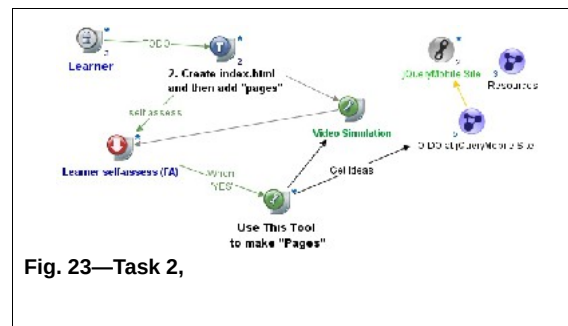


Fig. 23—Task 2,

Critical questions: globalism, ethics, internet freedom

Ursula Franklin, in her famous 1989 Massey Series lecture, noted the changing role of technology and important ways it was changing the role of technologists, distribution of labour, and the balance of power, while in her view shrinking the public sphere.

The situation in the classroom at the interface between the biosphere and the bitsphere is but one facet of the situation in the workplace within the same realm. In fact, often even the designation of workplace is no longer appropriate. Not only do new technologies, new ways of doing things, eliminate specific tasks and workplaces... but the remaining work is frequently done asynchronously in terms of both time and space (Franklin, 1992, p. 172).

The Public Sphere

Franklin's distinction between what she identified as prescriptive approaches⁵⁰ versus holistic⁵¹ ones led to a concern that not working together in the same space causes "opportunities for social interactions, for social learning and community building [to] disappear." (Franklin, 1992, p. 172). Freire anticipated reformers "using science and technology as unquestionable powerful instruments for their purposes" [to] "...transform everything into objects of their purchasing power; [...] Money is the measure of all things, and profit the primary goal" (2006, p. 58), and so disrupting class becomes a venture undertaken by "heavyweight teams" (Horn, 2009) wielding "power tools" (Christensen et al., 2008). A neoliberal market model of education is paired with a neoconservative social model that work together to "change people's understanding of themselves as members of collective groups" (Apple, 2009, p. 23), a course at odds with public education's heritage of citizenship-, character-, and democracy-building. In models often touted as providing greater choice, "students are viewed as human capital in schools that are to be administered by market-driven forces" (Giroux, 2012, para. 1). An aggressive and well-funded movement is under way that "supports marketisation through its clear preference for incentive systems in which people are motivated by personal, not collective, gain rather than by the encouragement of social altruism. Yet, the tradition of social altruism and collective sensibilities has roots just as deep in our nations, and its expression needs to be expanded, not contracted." (Apple, 2009, p. 24)⁵².

Implications of applications as literature: technology as a discourse

Still others suggest "it would be useful to look beyond old barriers that have separated citizenship education and global education and to form a new global citizenship education"

50 See for example, Harvard Business School's aggressively disruptive, top down, market-model for education reform in Christensen et al., 2009

51 See for example, Harvard Graduate School of Education's "Beyond the Bake Sale: A Community- Based Relational Approach to Parent Engagement in Schools," (Warren et al., 2009), PDF available from The Logan Square Neighborhood Association <http://bit.ly/nYwbjK> accessed 2012-11-03

52 See my essay (Fouchaux, 2012), "The 'principle of self-interest rightly understood' based on (Gordon, 1720) (Otis-Warren, 1805) (de Toqueville, 1835) <http://bit.ly/Qhpy6p>

(Davies, Evans, & Reid, 2005). Neither Apple or Franklin in any of the works cited alludes to what I believe can only be described as a new literacy for the 21st century: fluency in coding and code.

At Occupy Wall St. the techies “[built] websites, put out messages, manage[d] the ebb and flow of information about the occupation on the Internet.” (Judd, 2011, para. 10) A year later “TechOps,” as the New York contingent of web-developing occupiers call themselves, built and maintained the website for the Sept. 17 anniversary events. They put together a whole host of other underlying

“Global education emphasises rather more noticeably political activity as opposed to political science or community involvement. Global education searches more obviously for issues that require immediate and perhaps radical attention.”

—(Davies, Evans and Reid, 2005)

technical infrastructure... TechOps-built database software sits behind a system to match people who needed a place to stay during the demonstrations with people who had space to offer [...and built...] what has become a broad suite of web tools built specifically for Occupy activists. Using their own flavor of WordPress’ multi-site functionality, TechOps can facilitate sites like S17NYC.org and allow individual movement groups to maintain their own web presences themselves.” Those who code may have a special understanding of the saying “free as in beer, but not free as in speech” (Judd, 2012, para. 6).

WikiLeaks “[blew] a hole in the framework by which states guard their secrets” (Jenkins, 2010, para. 13). The fight for freedom and democracy has become the fight for *Internet* freedom and democracy. According to Dominic Basulto, writing about the January 2013 suicide of 26-year-old Internet activist Aaron Swartz, society is becoming ready to embrace the “hacktivist hero — the technologist who uses his or her coding and programming skills to make the world a better place.” Aaron wished to “challenge the status quo of corporate welfare copyright laws that restricted the free flow of information” so he hacked into JSTOR and ‘liberated’ millions of documents (Hartmann and Sacks, 2013, para. 18). The outpouring of sympathy for his suicide is in stark contrast to calls for Julian Assange’s execution (see for example Bass, 2011). Basulto thinks that’s because Swartz was able to “exist both inside and outside the system,” and goes as far as to suggest “...the power of coders and programmers is beginning to catch up to that of lobbyists and politicians” (Basulto, 2013, para. 4). The Washington Post also reported, on the day Swartz hanged himself, that an online petition had appeared to “[ask the] White House to make DDoS attacks a form of protest” (Kelly, 2013). Regardless of issues of politics and criminality it is impossible to ignore the importance of code literacy and Internet savvy in our global society’s future. In their public education and outreach flyer, “What is Free Software?” (FSF, 2006) the Free Software Foundation gives a brief history and makes the following points:

“Free software is software that respects our freedom. To use free software is to make a political and ethical choice asserting our rights to learn and to share what we learn with others.

“Usually... we don’t actually buy ownership of the software. Instead, we receive a

license to use the software, and this license binds us with many fine-print rules about what we can and can't do. [...]

"What if there were a worldwide group of talented ethical programmers voluntarily committed to the idea of writing and sharing software with each other and with anyone else who agreed to share alike? [...] The free software movement was started in 1984 by Richard M. Stallman, when he launched a project called GNU, ... that would respect the freedoms of those using it. Then in 1985, Stallman started the Free Software Foundation, a nonprofit with the mission of advocating and educating on behalf of computer users around the world. [...] Stallman and the FSF developed a specific legal document called the GNU General Public License (GPL)... Instead of restricting what we can do with software the GPL encourages us to learn and share, so it is called a "copyleft" license. [...]

"It takes knowledge to make this technology work. People who hoard this knowledge, punishing and threatening others who try to obtain and share it, are not doing so in order to preserve it, despite what they may claim. Instead, they are preserving power for themselves at the expense of others' freedom. [...]

"...which software to use is a political choice for all of us, not just the people who program and sell it. We can click our freedoms away by signaling OK in the Microsoft or Macintosh window after squinting through their thirty pages of restrictions, or we can click CANCEL, and see instead if there is a piece of free software that does what we need.

"We should click CANCEL when we can because that's the more ethical choice. This means we'll have to learn a new program, and sometimes the free program might not work as well. The ethical choice is not always the easy choice." -FSF, 2006

Neither is the pedagogical choice always the easiest. It seems clear there are very high stakes at play in education reform. Teaching not just end-user skills as competencies, as the corporate-supervised P21 and C21 [Appendix E] have advocated, but programming as a literacy, is a political and ethical choice that asks the same fundamental questions about the role of education: Who benefits? Who doesn't? How is that decided?

Roles for educationist-ethnographers

It was understood in the early days of the digital revolution, as it is now, that the availability of digital networks, advances in hardware and software, existence of "free, libre, open" source software, foreshadowed fundamental structural change at the organizational and societal levels (Apple, 2008; Cross et al., 2012; Franklin, 1992; McLuhan, 1964; Reid, 2005). The ethnographer must be attentive to the *process of achieving* change that technology brings, not only to the impacts, otherwise we merely entrench the disconnect between technology and its social context. Descriptions of technological change in organizations that don't include "the problems or perceived pressures which lead organizations to change in the first place"

(Thomas, 1992, p. 443) can not be thick. We must expand the meaning of process to include “embedded interests that shape thinking about what problems can or should be solved by technology and what solutions fit prevailing patterns of thinking. [...] to understand what technology *is* or *does* to organizations, we must pay greater attention to what technology *means* to organizational members” (p. 443). Three key dimensions to the process of choice are:

1. the choice of what technologies will affect organizations precedes their being affected;
2. resources limit choices that can be made from a now overwhelmingly wide array of available alternatives; a filtering method is unavoidable;
3. organizational structures often create large gaps between where decisions are made and where they are implemented (pp. 443).

By asking the right questions, examining selection methods, asking how objectives are interpreted and how interpretations manifest in practice, we deflect lingering notions of technological determinism and arrive at a thicker description of context, activities, participants and their participation (pp. 445). Reiteration is key to transformative *praxis*. Reflection without action is merely “verbalism” and action without reflection is only “activism.” (Freire, 1972, 1995).

Edreform and the Global economy

Freire in 1972, Franklin, in 1989, were perhaps just a bit too early to fully anticipate the complex socio-politico-economic forces that would result in Twitter, a commercial start-up, helping to empower the Arab Spring; they'd perhaps see no benevolence there, only the inevitable advance of the market on the back of democratic yearnings. Apple's 2009 essay describes in full the motives and methods we see manifesting in high-stakes testing and redistribution of public resources to private concerns that are part of many ed “reform” efforts.

I believe there's a need for further research into the roles of social networking within emerging communities of practice, but also its influence on communities of practices' emerging. Evidence abounds that new directions in schooling can be transformative. In their design experiments Brown and Campione (1994, 1996; Brown, 1992) found growing esteem and regard for diverse expertise and the notion of community.

“...more important social goals had also been achieved by the design. Students came to value the expertise of other students; not just content expertise, but sometimes expertise in using computers or in keeping the group working effectively toward their goal. It became clear that students worked together better when they appreciated others' contributions. This is how the idea of diverse expertise took hold, with its emphasis on respect and listening to others” (Collins, Joseph, Bielaczyc, 2004, p. 24).

Both Freire and Franklin asked an essential question Henry Giroux sums up eloquently in 2013: “...how do power, politics and knowledge connect in creating the conditions for the production of knowledge, values, subjectivities, and social relations in both the school and the

classroom?" (in Tristan, 2013, para. 5). Giroux concurs with Apple and explains a resulting "deskilling" of teachers he sees taking place.

"At the current moment, it is fair to say that the dominant mode of power shaping what counts as knowledge takes its cue from what can be called neoliberalism or what can be called unfettered free-market capitalism. ...Free market fundamentalists now wage a full-fledged attack on the social contract, the welfare state, any notion of the common good, and those public spheres not yet defined by commercial interests. ...Since the 1980s, right wing and conservative educational theorists have both attacked colleges of education and called for alternative routes to teacher certification. ...According to conservatives, the great sin teachers colleges have committed in the past few decades is that they have focused too much on theory and not enough on clinical practice—and by "theory," they mean critical pedagogy and other theories that enable prospective teachers to situate school knowledge, practices, and modes of governance within wider historical, social, cultural, economic, and political contexts. ...the insistence on banishing theory from teacher education programs, if not classrooms in general, while promoting narrowly defined skills and practices is a precursor to positioning teachers as a subaltern class that believes the only purpose of education is to train students to compete successfully in a global economy." (Giroux quoted in Tristan, 2013, para. 5).

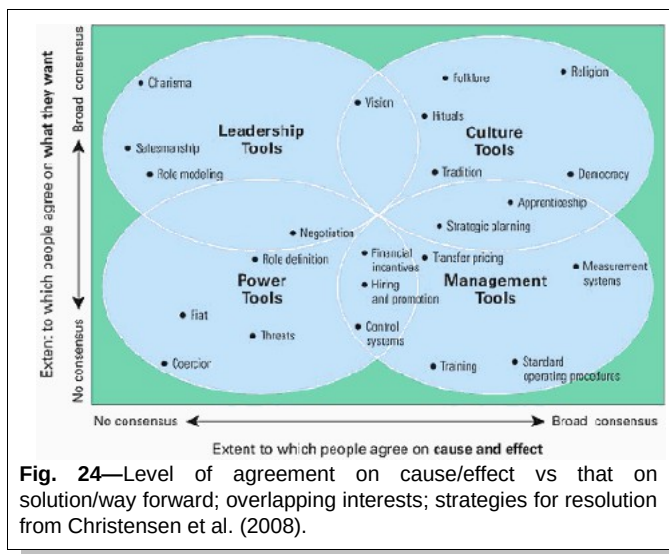
We euphemistically laud "character" education but allow it to foster narrow policy that actually "...encourages students to acquire specific values, behaviours, and interpersonal skills rather than conceptual or situational knowledge," says Sue Winton, who concludes that character education as interpreted in the southern Ontario board she studied closely supports "...citizenship education that adopts an assimilationist conception of social cohesion and/or social initiation as its purpose(s)" (Winton, 2007, p. 2). Narrow versions of character education have dominated the field and are too often accepted uncritically (Glass, 2005 ; Kohn, 1997). Laura Servage is similarly troubled by the well-named scholarship of teaching and learning (SoTL) "movement" (her quotes) in higher education she finds "inextricably tied to the entrenchment of neo-liberalization" (Servage, 2009, p. 25). If "critical thinking" is to be a genuine outcome of 21st century pedagogy definitions and policies need to be as "thick" as the situations we design to nurture it. I'm reminded that beginning in grade school I learned musicianship, not to become a professional musician but ultimately to better love and enjoy music. Forces outside pedagogy may influence the relative importance of such newly embraced subjects as entrepreneurship, which should initially be approached with similar generality.

Education reform is a "wicked problem."

Christensen, Johnson, & Horn (2008), of Harvard Business School, include this representation of how the different aspects of a wicked problem interact, how many simultaneous actors and scripts may be at play, and suggests strategies—"proven in business"—to deal with such a problem (Fig. 24). They rightly note that education discourse in the USA today falls in the lower left quadrant, where fiat, threats and coercion are the

recommended strategies for change, and we see that notion realized in the types of reforms being advocated by corporate reformers such as Michele Rhee⁵³, and adopted by the US Department of Education under Arne Duncan.

What reformers such as Rhee, who profits directly from the reforms she's been given license to impose, and Duncan, who seems to have read more Christensen than Arne Duncan⁵⁴ since his Harvard days, also demonstrate is that, just as Rittel might predict, such solutions, based mainly in the experiences of one small faction among stakeholders, can only create more problems⁵⁵. Christensen et al. inadvertently establish the case for holistically building consensus, a process that everyone agrees takes considerably more patience and commitment. "Failing to recognize the "wicked dynamics" in problems, we persist in applying inappropriate methods and tools to them" (Conklin, 2010, p. 3).

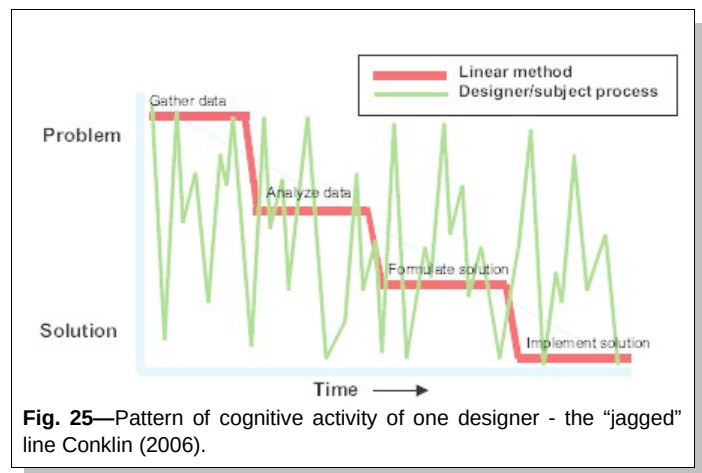


53 See Sharon Higgins: *Michelle Rhee Connection Map, A map of interlocking relationships as they relate to Michelle Rhee's appointment and tenure as Chancellor of DC Public Schools* <http://www.scribd.com/doc/80008526/Michelle-Rhee-Connection-Map>.

54 His thesis is entitled *The Values, Aspirations and Opportunities of the Urban Underclass* (Duncan, 1987).

55 See for example, Duncan: Change Bush 'No Child' law, By Russell Berman - 03/09/11 07, The Hill: <http://thehill.com/blogs/blog-briefing-room/news/148541-duncan-says-82-percent-of-schools-could-be-failing-under-no-child-left-behind>

Twenty-first Century Teaching is a wicked problem. Technology is often touted as a great equalizer, but we've all seen how total dependence on it can ruin your whole day if it fails, and we all know it's not often equitably distributed. Giving technology centre stage, claiming it's a panacea, ignores the *social complexity* of learning environments. Jeff Conklin (2006) defines *social complexity* as "the number and diversity of players who are involved in a project." Social complexity leads to *fragmentation*, his word for the lower left quadrant where no one agrees on where they are, how they got there, or where to go next. Conklin goes on to describe a 1980's study at the Microelectronics and Computer Technology Corporation (MCC) that looked into how people solve problems, an experiment in which the exercise was to design an elevator control system for an office building.



In the figure (Fig. 25) the green line shows how a typical designer was actually observed to operate while solving the problem and the red line shows the traditional, top down, prescriptive approach sometimes described as a “waterfall” approach.

Each peak in the green line can be understood as heading “back to the drawing board,” yet each return to the drawing board carries all the experience of the previous attempts. By contrast the Christensen/business school strategy of breaking out the *power tools* (the book’s euphemism for threats, fiat and coercion) is an admission of failure to understand the problem that is doomed to never find a solution. The only cure for fragmentation is *coherence*. Coherence is a fundamental quality of *communities of practice*: shared understanding and shared commitment (Conklin, 2010; Smith, 2003, 2009).

Christensen et al. are quite right when they tout the virtues of a shared language, and I still believe educators should learn the meanings of their entire vocabulary, not just “power tools.” But they fail to evolve past that point. The Ethiopian alphabet has over 200 characters, but it’s an entirely phonetic system. I memorized their forms and names at age 11 and discovered that if I said them quickly enough so that they flowed together it sounded as if I was speaking Amharic—yet I understood not one word. Shared understanding and shared commitment are exponentially more advanced than mere word recognition. There seems to be a faint understanding of this in the Christensen /Harvard Business School model, indicated by use of the term *Culture Tools*, but the list of tools disappoints, and the apparent relative importance of democracy is downright alarming.

But even more alarming are the ways we traditionally approach wicked problems.

1. **Lock down the problem definition.** Develop a description of a related problem or a sub-problem that you can solve, and declare that to be the problem.

2. **Assert that the problem is solved.** Since a wicked problem has no definitive solution, the whole point of attempting to tame it is so that a solution can be reached.
3. **Specify objective parameters by which to measure the solution's success.** This is the measurement approach. For example, to find out if we have solved the problem of school violence, we might count the number of deaths and injuries on school property – if this measure drops to zero, then we have solved the problem.
4. **Cast the problem as 'just like' a previous problem that has been solved.** Ignore or filter out evidence that complicates the picture. Refer to the previous solution of the related problem: "It's just like that problem. Just do the same thing again."
5. **Give up on trying to get a good solution to the problem.** Just follow orders, do your job, and try not to get in trouble.
6. **Declare that there are just a few possible solutions,** and focus on selecting from among these options. A specific way to do this is to frame the problem in 'either/or' terms.

Because of social complexity, solving a wicked problem is fundamentally a social process. Having a few brilliant people or the latest project management technology is no longer sufficient. (Conklin, 2010).

Whether your objective is to teach "21st-century skills" to "digital natives" in a mutually engaging manner, or to reform the education system of an entire country so that such teaching and learning can become the norm you must start seeking shared understanding. If consensus building is "too difficult," or "takes too long" then you are not a wicked problem tamer—you should put down the whip and leave the ring. You will never achieve shared commitment by coercion, and if you think you have you will soon be proven wrong. Resorting to power tools—seizing school boards, mass firings of teachers, replacing schools, and removing "bad" students who skew your faulty measurement system in ways you've defined as disadvantageous to your agenda—indicates you have already failed. Such tools are themselves problems, not solutions.

Roles for educationist-programmers

Conklin, through the CogNexus Institute, markets a strategy branded *Dialog Mapping*⁵⁶, described as "a powerful approach for addressing the problem of fragmentation, as it allows a diverse group of people to generate *coherence* around wicked problems." Coherence is not the solution—remember wicked problems have none—but it is the precursor of dialog and the prerequisite of progress towards shared commitment.

Teachers can change the world of their classrooms to reflect 21st-century realities by rethinking rules around cellphones, opening up planning to parents and students, venturing into digital realms of social media where many (not yet all) of their students live—but they can't do it alone. Governments must abandon and forswear top down "power tool" usage and

56 See: A Tool for Wicked Problems: Dialogue Mapping™, <http://www.cognexus.org/id41.htm>

fiat, hand over the keys and let the educators pack the car and begin the drive afresh. Educators must remember the journey is long with no “stopping rule” and therefore not expect to do all the driving, all the time. Business and curriculum designers must surely make time for entrepreneurship, as C21 and P21 have both identified, but also musicianship and sportsmanship—not because there's an economic or financial need, or to create pro athletes and rock stars, but because it's part of character, citizenship and a well-rounded education. Indeed, there may be many other “ships” the next generation might wish to sail, which we can not foresee. Blame and finger pointing are sure signs of failure—dead ends. Success begins with dialog, inspires compassion, and brings about commitment (Conklin, 2010; Raduntz, 2005; Rittel & Webber, 1973; Wenger, 1999, 2003).

Code literacy — “Every student in every school should have the opportunity to learn to code⁵⁷”

In the meantime, some high profile entrepreneurs, musicians and sports stars see clearly that reading and writing code—not merely using software created by others—can assure creativity and innovation gestate. Bill Gates, founder and Chairman of Microsoft says “Learning to write programs stretches your mind, and helps you think better, creates a way of thinking about things that I think is helpful in all domains.” will.i.am, musician and entrepreneur with The Black Eyed Peas put it, “Here we are, 2013, we ALL depend on technology to communicate, to bank, and none of us know how to read and write code. It's important for these kids, right now, starting at 8 years old, to read and write code.” Chris Bosh, NBA All-star who plays with Miami Heat has this take: “Coding is very important when you think about the future, where everything is going. With more phones and tablets and computers being made, and more people having access to every thing and information being shared, I think its very important to be able to learn the language of coding and programming.” (Code.org, 2013).

Code literacy is something that's fun and beneficial to pursue, which you can leverage within many learning environments to help create the kinds of authentic *situations*—situated opportunities for discovery and knowledge construction—project- and inquiry-based learning models are touted for. As I've shown here, using code snippets to create Web applications is an area rife with opportunities for informal learning, knowledge sharing and “reciprocal teaching” (Collins, Joseph, Bielaczyc, 2004). Making any script print “Hello World!” for the first time can be exciting, and anything one does to get beyond that requires exercising logic. We don't teach music in schools in order that every student become a professional musician. The learning sciences may never be defined in the way pure and applied sciences are because “simply observing learning and cognition as they naturally occur in the world is not adequate given that learning scientists frequently ...bring agendas to their work, seeking to produce specific results such as engaging students in the making of science, creating online communities for professional development, or creating history classrooms that confront

57 Code.org is a non-profit foundation dedicated to growing computer programming education. <http://www.code.org/>, accessed 2013-01-27.

students preexisting beliefs about race, gender, or class” (Barab & Squire, 2004). Activities that spark an interest and help young people self-identify talents have great value (Brown & Campione, 1996; Barab & Squire, 2004).

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Conclusions:

The World Wide Web has become a canon of applied hypertext and multimedia that requires, if not entirely new literacies, that we apply existing literacies in new ways. Educators can see this in the emergence of *Personal Learning Networks (PLNs)* within social networks, and in the open source community. Tools that allow illustration of ideas and their internal relationships, and support meaningful collaboration are particularly interesting as they exist, there are examples of their application to the design of digitally enhanced learning situations, their delivery, as a formative assessment tool for participants, and as a summative assessment tool for evaluators of participants and the program itself. The availability of these tools, and the applications to which they are put, are subject to the interplay of a wide range of social, economical and political forces. Literacy in the languages and dialects of web applications supports transformative change and empowers agency that can help counterbalance purely monetary pressures, but these must be bolstered by education and policy, and defended with vigilance. The problems such interplay of interests and incentives creates are *wicked* problems—if approached as such they may be tamed, but never “solved” in the sense we usually mean the word.

As a poem might woo a lover, a protest song might inspire a movement, or 5 simple symbols describing energy as the product of mass and the square of a universal constant⁵⁸ might alter the entire course of human history, Web applications are at once complex multi- and meta-modal artifacts, and simple human stories, with all the potential for individual, social, and cultural disruption and/or cohesion—or trivial, mundane repetition—we find in any of the Arts and Sciences. We apply the Web to the solution of problems and the creation of meaning, to communicate ideas and values, the building blocks of, and so Web apps will become a literary canon; the study of certain literacies will enhance both their scientific relevance and their design. Their sociological significance will present from within, due to the inherently transformational quality of pedagogy, and will continue to manifest in surprising ways, often suddenly. It is a bull that must be taken by the horns. Situated pedagogies “...allow interventions in the multiple facets of exclusion according to the specific forms that discrimination adopts for each group and in each educational context...” (Rodriguez-Romero, 2008, p. 115).

Cognitive apprenticeship believes technology can improve upon the traditional apprenticeship model (Ghefaili, 2003). Using the CA framework's own vocabulary, informal learning is one heuristic strategy humans typically employ. In any situation, however little or much we apply our efforts we naturally both learn and teach. If we all agree that “learning how to learn,” “critical thinking skills” and “collaboration” are desirable 21st century competencies, then informal learning belongs in children's classrooms, and in pre-service and professional development programs. Understanding how Internet systems work at the system level and

58 In the equation $E=mc^2$ the italic capital “E” means “energy.” Mathematicians, as a community of practice, agree that the symbol “=” means equivalency, “m” for mass, and “c,” it's been agreed, means “the speed of light.” A superscript number means “multiply the previous number by itself this many times.” These are examples of inside knowledge; if you knew this you may have already entered this community to a certain degree, or you may simply interact at a level requiring this level of mutual understanding.

how applications are coded are desirable 21st century literacies. Experts are readily available, but informed amateurs will accomplish more when they can speak each others languages.

The Internet is rife with learning objects, case studies, experts, and tools. All those responsible for the design of *thick learning situations* should bring them together (Conole et al., 2008, p. 3, fns. 1&2). But, just as Conklin (2006, 2010) and the IBIS school (see for example, CogNexus Group, <http://cognexus.org>) have demonstrated. Robyn Smyth articulates again: “The potential of these technologies to significantly enhance learning, community and society will be unlikely to be realised without effective policy supporting new holistic approaches to considering and adopting affordances.” (Smyth, 2009, p. 124).

A newer paradigm for elearning is emerging that is not teacher-in-a-box or talking-PowerPoint, and not do-it-yourself. It's learner to learner, learning situation to all. Concept-mapping and dialogue-mapping paradigms are generally a better fit for visualizing and organizing complex, asynchronous—fragmented—situations (Conklin, 2006, 2010; Conole et al., 2008; Ghefaili, 2003). There is research showing mind-mapping—with and without software—as effective strategy in designing, planning, executing and assessing programs and the activities they encompass (Conole, 2007; Conole et al., 2008; Seitamaa-Hakkarainen, 2011; Smyth, 2009). Open University UK and Tufts University have made notable contributions to the software side that hold great potential, but the techniques for applying them need to be developed and shared collaboratively within communities of practice in order to kindle effective adoption.

Communities of practice improve through the strength of the individuals who compose them, and their commitment to constructing community knowledge (Wenger, 2003, 2006a; Silvers, 2012b). Henry Giroux offers some big ideas: “Education as a democratic project always presupposes a vision of the future in its introduction to, preparation for, and legitimation of particular forms of social life. It is utopian in its goal of expanding and deepening the ideological and material conditions that make a democracy possible. As a moral and political practice, education produces the modes of literacy, critique, sense of social responsibility, and civic courage necessary to imbue young people with the knowledge and skills needed to enable them to be engaged critical citizens willing to fight for a sustainable and just society.” “...we need a language that is both critical and hopeful, ...of critique and possibility” (Giroux, 2012, para. 16). We need language, with accompanying media literacies, to describe information, transport and transform it, all the while keeping its relevance visible.

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