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Teaching for Engagement: Part 2: Technology in the Service of Active Learning

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Introduction

In the first piece in this series ("Teaching for Engagement: Part 1: Constructivist Principles, Case-Based Teaching, and Active Learning"), I sought to make the case that a wide range of teaching methods (e.g., case-based teaching, problem-based learning, anchored instruction) which share an intellectual grounding in constructivism can be understood as having the potential to change our understanding of what it means to be a learned person. All of these methods seek to engage students in collaborative analysis or real or hypothetical situations that require them to define problems, gather and analyse data, and formulate potential solutions. In the conclusion to that piece I suggested that "media and technology are shaping our understanding of what it means to be learned" (Hunter, 2015, para. 29). In this piece, I will extend that argument and illustrate how active learning is well served by technology-supported teaching.

Early interest in the use of technology in teaching was very much aligned with knowledge-transmission views of learning that portrayed a "learned" person to be one who had acquired a vast amount of information. Though books, pens, slates and a myriad of other tools might be regarded as technologies used in teaching and learning, the first case of using a technological tool to deliver instruction is generally considered to be Pressey's (1927) "machine for automatic teaching of drill material" (p. 549). Pressey (1926) believed that the time teachers spent on drill and practice could be better used for more important "inspirational and thought-stimulating activities" (p. 374) and that his teaching machine[1] would make that possible.

Media and Technology in Active Learning

Clearly, case-based teaching, starting a century ago, began with cases presented in text format (the Harvard business cases). Later, Brown, Collins, and Duguid (1989), in emphasising the importance of the learning situation, focused more attention on learning in real-life environments through cognitive apprenticeships. That is, in situated learning, what we might call "a case" is a set of events occurring in the real world. Both of these innovations involved learners in group-based problem solving. With the advent of Problem Based Learning (PBL), a broader range of presentation options began to take shape: "In PBL for medicine, a patient problem or a community health problem is presented in some format, such as a written case, case vignette, standardized (also called simulated) patient, computer simulation, or videotape" (Barrows, 1996, p. 5). In 2015, it is worth noting that "computer simulation" should be understood to include virtual reality environments and large-scale 3D simulated worlds like Second Life (http://secondlife.com/) as well as the emerging possibilities of educational holograms (e.g., Walker, 2013). We might well regard all of

these media-based cases as implementations of anchored instruction.

Tiernan (2015) reviewed the merits of using videos in teaching in various ways and conducted an investigation of students' attitudes toward the use of video in a large lecture class on communication at Dublin City University. While he found students to have been very enthusiastic about the uses of video in the course, he also reported:

> However, a small proportion of students either viewed the use of video as a time to relax, or found it difficult to concentrate afterwards. This suggests that while in and of itself video is a strong learning support, a variety of active learning methodologies must be blended with the use of video to maximise student interaction and engagement, and ensure the whole class are getting the most from the content. (Tiernan, 2015, p. 87)

The kinds of constructivist approaches to teaching and learning being discussed here fit very nicely with Tiernan's notion of "active learning methodologies."

Students as partners—using videos in active learning

- Have students critique popular films that address issues related to your teaching goals
- Have students create question sets that would focus others' attention on important course content
- Have students make home videos of role-plays of active learning group discussions

Hakkarainen, Saarelainen, and Ruokamo (2007) developed an interesting twist on the use of video cases when they divided a Network Management course into two parts: one face-to-face and one online. Students in the face-to-face section developed video cases on course topics and those videos were then used as the instructional cases in the online section. The numbers involved were small and the data were student perceptions, but the results, though mixed (students felt they learned a great deal, but the online students were concerned about difficulties with group processes), suggested that both groups benefited from engaging in constructivist activities designed to promote meaningful learning. Hakkarainen (2009) went on to show that students engaged in PBL and video production activities learn about both the technology of video production and the content of the videos themselves.

> *Authentic DV [Digital Video] productions can be used as a method to learn not just about DV production, but also about the subject matter of the DVs. In addition, they can be used in the learning of generic skills.* The results suggest that besides the technical skills needed in DV production, students can learn generic knowledge and skills in project management, collaboration, co-operation, and problem-solving. (Hakkarainen, 2009, p. 226, emphasis in original, parenthetical added)

Whether learners are engaged in video production or not, the manner of presentation of the case or problem is only one of the roles that technology may play in case-based teaching and learning. Returning to the

characteristics of constructivist learning environments laid out by Cunningham, Duffy, and Knuth (1993), it is possible to identify a variety of ways is which existing technologies might be employed in case-based teaching and learning—as described in Table 2 below.

Table 2. How characteristics of constructivist learning environments align with technology.

Characteristics of a constructivist learning environment (Cunningham, Duffy & Knuth, 1993)	**How this characteristic aligns with technology for use in case-based teaching**
provide experience in the knowledge construction process	Online search engines and library databases enable learners to access large bodies of relevant information quickly. Tools for data organization and analysis (e.g., databases, spreadsheets, statistical packages, qualitative analysis programs) provide ways to organise information and to explore the relationships that exist in the data. Word processors; photographic, sound and video technologies; and presentation software facilitate the process of organizing the information–sharing process.
provide experience in and appreciation for, multiple perspectives	Access to large bodies of information includes the possibility of learning from other cultures. Language translation software is making (limited) communication across linguistic barriers possible. Participation in geographically, religiously, and ethnically diverse discussion groups through various online communication tools (or social media) provide opportunities for real-time engagement with diverse perspectives.
embed learning in realistic and relevant contexts	The use of multimedia and virtual reality software allows teachers to create (or select) cases that have the feel of reality. The creation of online learning “adventures” (e.g., Second Life activities, web scavenger hunts, online simulations) make it possible to explore real-life learning that is occurring in online environments .
encourage ownership and voice in the learning process	Social media enable learners to create public environments for

	sharing their work and their voices. Blogs and wikis allow the possibility of doing this public presentation in a structured way.
embed learning in social experience	Audio and video conferences support real-time discussions with peers, tutors and members of broader communities. Discussion forums inside Learning Management Systems (e.g., BlackBoard, Moodle) not only allow discussion, but can be structured so that the discussion entries have characteristics of academic writing—reasoned argument, verifiable data, reference to existing literature, etc. Social media can be used to extend the engagement with other learners. MOOCs facilitate the involvement of very large numbers in a learning community.
encourage the use of multiple modes of representation	PowerPoint, Google Drive, Google Docs, Haiku Deck, Prezi, Padlet and dozens of other presentation environments provide learners opportunities to develop text, graphic, cartoon, audio, and other varied presentations of their work. Camtasia and YouTube work nicely together to make video presentations another option.
encourage self-awareness in the knowledge construction process	This is not an explicit or necessary element of using technology with case-based methods, but learners are often quite reflective when they are faced with the prospect of working with new technologies and, in my experience, these reflections often include perceptions of themselves as learners.

The challenge for instructors is how to actually implement such uses of technology in either face-to-face or online learning environments. Looking particularly at online learning and working from a constructivist perspective, Oliver and Herrington (1993) argued that there are three key parts to the design of technologically supported learning:

- The design and specification of ***tasks to engage and direct the learner*** in the process of knowledge acquisition and development of understanding;
- The design and specification of ***supports for the online learner*** to scaffold the learning and to provide meaningful forms of feedback; and

- The design and specification of ***the learning resources*** needed by the learner to successfully complete the set tasks and to facilitate the scaffolding and guidance. (p. 13, emphasis in original)

Students as partners—key supports for technology-supported learning.

- Ask students what technologies might help them learn in your course
- Have students create a resource wiki using course related content and links

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Cases or problems presented in whatever medium the instructor may choose are intended to serve as tasks that will engage learners. Discussions, questions, short lectures, printed advice may all serve to provide support in the form of scaffolding for learning. No matter what the particular form of scaffolding may be, Oliver and Herrington (2003) said "The essence of scaffolding is that the assistance and help is gradually reduced as the learning progresses to the point where the learner is finally able to act independently" (p. 14). The learning resources may include textbooks, readings, reading lists, web links, videos, presentations, instructor-developed readings or websites and much more.

The possibility of presenting cases or problems in various media formats is only one of the ways in which information and communication technologies might serve faculty interested in promoting active learning. Myriad other possibilities or "affordances" (Saloman, 1993) for using technology exist and they have been taxonomised by Conole and Dyck (2004) as follows:

- accessibility
- speed of change
- diversity
- communication and collaboration
- reflection
- multimodal and non-linear
- risk, fragility, and uncertainty
- immediacy
- monopolization
- surveillance

Even without elaboration, it is clear that not all of these affordances are positive—in particular, "surveillance" carries with it the idea of infringement of individual rights and a kind of "Big Brother" oversight of all that we do with technology. For our purposes, however, I will focus only on the "communication and collaboration" affordance as it applies to the kinds of active learning strategies discussed in this series.

Perhaps the most obvious of the possible communications affordances of technology is the possibility of online discussions. A considerable body of research has been developed on the use of discussion forums, especially within learning management systems or LMS's (e.g., BlackBoard or Moodle) in the context of distance education. Indeed, as early as 2001,

Rourke, Anderson, Garrison, and Archer reviewed 19 studies that used discussion forum data as research material and made a variety of suggestions regarding the methodological issues that arise in such research. More recently, Wang, Chen, and Anderson (2014) have sought to reconcile the growing literature on online learning with the emerging view of connectivist learning (e.g., Siemens & Tittenberger, 2009) by developing a new framework that defines four types of educational interaction:

- **Operation** interaction (in which learners use a wide variety of social media and online communications systems, largely of their own choosing)
- **Wayfaring** interaction (which involves "social network and informational network building" [p. 10] in the service of learning)
- **Sensemaking** interaction (which involves the building of meaning through the creation of connections among connectivist nodes or information sources)
- **Innovation** interaction (which engages learners in processes that result in new information sources that they then share with the network)

It seems clear to me that students who engage in these types of interactions in the process of addressing problems or cases presented by the instructor (or by peers) would be participating in an invigorating form of active learning.

Students as partners—communication and collaboration

- Encourage students to form study teams and to select a technological tool to facilitate dialogue
- Invite students to move course content from one communication to another (e.g., existing blog to new wiki, or discussion forum to Google document)

In a specific recent example of an online learning situation, looking at student's online class discussion posts, Leow and Neo (2015) found a variety of positive results of peer interaction, including students' engagement in cross checking and peer evaluation, students' appreciation of diversity in the group and students' promotion of online search activity to gain information related to their learning.

Blogs are a newer tool for interactive discussion and, unless they are incorporated into an LMS, are likely to be less instructor-controlled. Recognising that the limited research to date has not clearly demonstrated that the use of blogs in teaching results in more effective constructivist learning, Noel (2015) nonetheless outlined a variety of ways in which blogs facilitate communications in ways that could support learning as well as ways in which they might impede learning. From this analysis, he made a variety of recommendations based on the research he reviewed, including suggestions that the instructor should:

- develop a strong online blogging community with clear participation requirements
- explicitly state the blog's learning advantages
- actively facilitate discussions and provide assistance,

and

- teach students how to use automatic notifications of blog contributions

(Noel, 2015, p. 620, paraphrased)

Wikis are also a newer communication tool. I have indicated elsewhere (Hunter, 2012) that, in my own practice, I have found that graduate students were challenged by the task of building a course wiki since it constituted a kind of collective “disorienting dilemma” (e.g., Mezirow, 1997) —that is, it demanded that they re-think their prior understandings as a step toward constructing new ideas about the course content. Parker and Chao (2007) laid out an optimistic argument for wikis as collaborative learning tools and Rathnasiri Hewege and Chamila Roshani Perera (2013) reported that their own research supported a growing body of literature that found “wikis promoted collaborative learning, organic discussions and independent thinking” (p. 51). In reporting their own findings, Rathnasiri Hewege and Chamila Roshani Perera organised the results in terms of

- collaborative learning
- independent thinking and shaping it
- “organic” discussions
- laggards and leaders in wikis
- repetitions causing stagnations, and
- not everyone on board (p. 59).

The student comments provided in their study provide valuable guidance for instructors planning to use a wiki or wikis in their teaching.

Other possibilities certainly exist—an examination of the educational uses of Twitter, MySpace, Facebook, Pinterest, Google Docs and countless other sites designed to support collaboration and communication is beyond the scope or this paper, but interested instructors could do their own research on the ways in which these tools have been used. The work already reported here would suggest that they should expect to find research showing mixed but enthusiastic results and a lot of cautions about the importance of careful planning and scaffolding.

Recently Howard-Jones et al. (2015) may have given us a brief look at how constructivist learning, gaming, and neuroscience may combine to create engaging educational “apps” that have been informed by an iterative design process involving collaboration between neuroscientists and educators and a multi-stage “try and modify” approach to game development. The incorporation of lifelike games and problems in such a process would constitute an advanced development of the kinds of instructional innovation I have been advocating here.

In fact, “serious gaming” is the last of the technologies I want to mention here. Creative educators have long made use of dice games, card games, board games, quiz games, role-playing games, and myriad other games both to motivate their students and to actively engage them in game-based learning activities. With high resolution graphics, online interaction and powerful software engines, digital gaming promises to bring active learning to life on monitors and hand-held devices. Recently,

Waddington (2015), starting with an evocative B. F. Skinner quote about the desirability of learning through games, moved on to note that many contemporary advocates of educational games come from the opposite—social constructivist—end of the spectrum of learning theories. He credits Schaffer (2006) with making a case that "certain kinds of video games immerse children in simulated worlds that pose the kinds of experiential, structured problems of which Dewey would have approved" (p. 1). He claims that Dewey's vision of learning (academic disciplines) through the occupations suffered from two practical problems: 1) the immense effort required to create, on a large scale, the kind of learning environment Dewey's model required, and 2) the ease with which the model might slip into training for the occupations rather than academic learning. Waddington goes on to argue that "simulation video games" have affordances that mean they

> …can realize some of the original key tenets of Deweyan education through occupations, particularly scientific inquiry and technological transparency. I will further contend that video games have the power to solve some of the practical challenges that posed significant obstacles to Dewey's program. (Waddington, 2015, p. 9)

He goes on to examine how a game called Fate of the World engages learners in simulations and explorations that stimulate learning and concludes: "To summarize, Fate of the World, and other games like it, provide a space in which two of the most important educational outcomes of education through occupations—technological transparency and scientific inquiry—are made possible" (p. 12).

Waddington then responds to critics of the use of simulation games and makes a case for cautious optimism for the future of such games in education, concluding:

> Nevertheless, the fact remains that simulation games can recreate complex and pivotal social systems in such a way that children and adults can experiment with and learn about them at a profound level. Anyone who is sympathetic to Deweyan educational principles should be excited about these possibilities. Developing a degree of technological transparency with respect to key social challenges is an aspect of Dewey's educational program that is critical for today's citizens, and it has historically been very difficult to accomplish. The technology may have arrived too late for Dewey and the other pioneers of progressive education, but it is here now for us, and we should use it mindfully to create powerful educational experiences. (Waddington, 2015, p. 20)

So, with Waddington's (2015) rationale and optimistic conclusion, a reasonable question would be, what is the evidence for the success of using games? That question was addressed fairly recently by Connolly, Boyle, MacArthur, Hainey, and Boyle (2012). Building on previous literature reviews, Connolly et al. searched a variety of databases for articles dealing with some sort of outcome of working with any one of a variety of game categories (e.g., serious games, MUDs or multi-user dungeons, video games, etc.). Selecting only articles that included adolescents or adults as participants and that reported empirical data, were published between 2004

and 2009, and had an abstract, they came up with 129 studies for their analysis (from an original pool of nearly 7400). The did extensive classifying and rating of the studies (research methods used, study "quality") and classified the games used in the research on dimensions like the main purpose of the game, its genre, the discipline in which it fell, and the kinds of learning and behavioural outcomes reported. As might be expected, the results were a complex weave of positive and negative outcomes depending on the exact situations being studied, but the overall conclusion was: "The most notable point about the current review was the diversity of research on positive impacts and outcomes associated with playing digital games" (Connolly et al., 2012, p. 672). While they found evidence that learning games can promote knowledge acquisition and entertainment games can support the development of perceptual skills, they did not find support for games contributing to higher order thinking skills. In short, the literature seems consist with Waddington's (2015) call for cautious optimism.

An interesting blend of game and anchored instruction can be seen in Jenson, Taylor, and de Castell (2007), who embedded case stories in a website that teacher candidates used to learn about educational law and ethics. The report focuses on the development and use of the site, not empirical outcomes, but the authors note that the case stories, built around short videos with LEGO figures as characters, often served as stimuli for in-depth classroom discussion in ways that accompanying text did not. More recently, the same team (Jenson, Taylor, & de Castell, 2011) developed a game called Epidemic, in which players adopt the persona and characteristics of infectious organisms and learn health behaviours by exploring the ways they can make their "characters" more successful. Because their focus was on the way the game was used, they did not gather traditional "outcome" data, but using observational methods they reported a high degree of student attention, the development of a playful learning environment, and (elementary school) student presentations that were rich in health science terminology.

Wrap-up

For many instructors, all of the above may well be seen to beg the question: How do I go about designing lessons using case-based teaching or problem-based learning? They might understand that some cases appropriate for their needs may already exist, but be at a loss as to how to find them. They may want to create their own cases, but not know how to start; they may understand the importance of a tutorial or supporting role for the teacher, but lack experience (or even good models) of what that might entail; they might know that group work is a key component of the process, but be uncomfortable setting up and using groups. They may have comfort with many of these things and still be uncertain about how to appropriately assess learning when working with cases. In the next installment in this series, I will attempt to provide some guidance on each of these issues and, in the process, try to illustrate how technology may assist in bringing situated learning to life.

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End note

[1]An informative picture of Pressey's teaching machine can be found at Don Clark's website: http://www.nwlink.com/~donclark/hrd/history/machine.html

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