Pedagogical Affordances of Technology

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Introduction

Can technology influence learning and teaching? To be able to address this question meaningfully let us consider the extent to which different aircraft and their conditions influence the comfort level of their passengers. Those who have had the opportunity to travel as a first-class or business-class passenger and in a range of aircraft will know that the ambience of an aircraft’s cabin most certainly influences one’s comfort level and satisfaction with the journey. In much the same way, technology has the potential to influence learning, and different technologies offer different possibilities for rendering the learning experience in ways that can influence learning significantly differently. Arguably, it is not the attributes of technologies alone that can possibly influence learning, but how these unique attributes and the possibilities and opportunities they afford are used to render different types of learning content and learning experiences. Effective, efficient and engaging learning is a product of the synergy achieved from a combination of factors, and which include the possibilities offered by technologies, the optimal use of these attributes and the readiness of the learner.

Effective, efficient and engaging learning

Theories on how human beings learn abound, and so does controversy around how we learn best. The truth is that learning depends on numerous factors and these have to do with the learner, teacher, the subject matter content and the learning context. The more meaningful question to ask in relation to learning is not how we learn, but how we can learn a lot more effectively and efficiently (see Spector & Merrill, 2008).

Contemporary thinking around learning suggests that learning is most effective and efficient when it is situated within a meaningful learning context (see Brown, Collins, & Duguid, 1989). This learning context can be real or contrived. The most meaningful and effective ones are those that closely reflect real life, and those that do reflect real life are considered most authentic. This is called situated learning (see Lave & Wenger, 1991).

The notion of situated learning is grounded in the belief that learning is most effective and efficient when learners are engaged in problem-solving, reflecting upon their actions and learning by doing within authentic learning contexts. The
problems, scenarios and cases used in these learning contexts serve to situate and anchor all learning activities and also help in the understanding and retention of facts, principles and procedures (see Barrows & Tamblyn, 1980; Naidu & Oliver, 1996, 1999; Schank, 1990; Schank, Fano, Jona, & Bell, 1994). Within these learning contexts, learners are put into authentic and meaningful situations where they are required to think for themselves, take actions and draw conclusions, defend their actions and decisions, and reflect upon them (see Cognition and Technology Group at Vanderbilt, 1993a; Wilson, 1996). When this is the case, it helps learners recognise and appreciate the relevance and purposes of their learning (see Naidu & Oliver, 1999).

When learning activities such as problem-solving and critical reflection are carefully designed and orchestrated, and where the assessment of learning outcomes is closely aligned with the learning context and the learning activities, they serve as powerful mechanisms for cognitive apprenticeships (see Cognition and Technology Group at Vanderbilt, 1990). Cognitive apprenticeship comprises the development of cognitive (mental) skills with the guidance of an expert, much like hands-on experience under the close tutelage of an experienced practitioner.

In such educational settings learners are active partners in the learning and teaching process with their mentors and teachers, rather than passive recipients of information. In this process, knowledge and understanding is gained through the active engagement of learners with the learning content, context, teachers, the learning group and relevant resources. This is the constructivist view of learning and it sees learning as a process of developing understanding through problem-solving, critical reflection and negotiation of meaning with one’s own prior learning experiences, and those of others including expert practitioners (Glaserfeld, 1983; Schank, 1990, 1997; Cognition and Technology Group at Vanderbilt, 1990, 1993b).

Proponents of this line of thinking, especially social constructivists, see learning as also dependent on the learning group (see Vygotsky, 1978). This view argues that learning and the development of understanding is also a social process which comes about as a result of learners acting upon authentic problem situations collaboratively through dialogue, discussion and debate (see also Koschmann, 1996).

**E-learning, m-learning and distance learning**

In order to learn more effectively and efficiently, learners need a variety of learning resources. The selection and use of these resources depend upon the learning context. In most distance education settings, for instance, there is a much greater reliance on the printed text and increasingly now on information and communications technologies (ICTs). This is necessary and appropriate as distance education seeks to serve the educational and training needs of those who are, for various reasons, unable to access conventional face-to-face educational provision (see Larreamendy-Joerns & Leinhardt, 2006).

Distance education needs to
adopt methods that are flexible in terms of their accessibility and which have the capability to give learners choices about their place and pace of study (see Holmberg, 1986; Lewis, 1986; Paine, 1989; Rumble, 1989). However, the availability of choices and flexibility in relation to one’s place and pace of study is not unique to distance education provision. Contemporary campus-based education is also increasingly adopting flexible learning approaches as suitable technologies become more widely and cheaply available, and as the nature of contemporary student population changes along with changing perspectives on educational provision.

These trends have led to the rise of labels such as e-learning and m-learning. Like distance learning these terms refer to the predominant attributes of that learning mode. Just as distance learning is characterised by the physical separation of the learner from the teacher and the learning organisation for much of the learning process, e-learning refers to the use of electronic technologies and m-learning refers to the use of mobile technologies for much of the learning and teaching transaction.

**What is new about the learning prefixes?**

But does the use of electronic technologies (in e-learning), mobile technologies (in the case of m-learning), or distance learning technologies (in the case of distance education) change and/or influence the essential nature of effective, efficient and engaging learning and teaching? Answers to this question are not entirely clear one way or the other.

For some time Richard Clark has proclaimed that delivery media have no impact on learning (see Clark, 1983, 1994), while Robert Kozma (see Kozma, 1991) has argued that the influence of the medium and the instructional method on learning cannot be that easily disentangled. Clark has argued that effective and efficient learning is the result of carefully designed instructional method. As such the influence of the delivery technology on learning is no more than the influence a grocery truck might have on the nutrition and health of the consumers of the groceries it delivered.

While Clark’s argument seems like a reasonable proposition, it is arguable that the analogy between a delivery truck and an instructional medium such as a computer is perhaps not quite appropriate. While a delivery truck may have no impact on what it carries and therefore have no influence on the nutrition of the consumers of its product, an instructional technology such as a computer will and does influence how it renders the learning content to the learner, and in that regard it does and can influence the learning process. That said, it is arguable that a delivery truck can have no influence on the nutrition of the consumers of its products. Surely the nature of the truck has some impact on the condition of the groceries it might be carrying. For example, if the vehicle is not secure enough or not well refrigerated, the products can lose value and quality. If that happens then it is possible that the nutrition of the consumers of these products will be impacted, and that seems to be at the heart of Kozma’s counterargument.

Kozma (1991) has continued to argue that in the case of learning, the influence of the delivery medium and the way the learning experience is rendered to the learner is not easily distinguishable. Therefore, it is not possible to suggest with any level of certainty that the delivery technology cannot impact learning. To do so would be to suggest that it is possible to
separate the unique effects on learning of the delivery technology and how the learning experience is rendered to the learner. This is not possible to determine, and while this is the case, the reasonable position to assume is that the delivery technology is likely to have an impact on learning, just as a temperature-controlled transport vehicle may impact one's nutrition, eventually and indirectly.

If we were to push Kozma's line of thought a little bit further along, we would be getting close to suggesting that not only is it impossible to provide indisputable evidence on the unique contributions to learning of the delivery medium from those of the instructional strategy employed, but that there might be instances when the medium is so powerful that it is the message (see McLuhan, 1964). In proposing this McLuhan seemed to have been suggesting that there are situations where the medium is manifested so powerfully that it becomes more influential than the message itself. Instances of this occurring are prevalent in the case of popular television and, more recently, the Internet.

The television and the Internet are very powerful media. Not only do they have the power and the potential to significantly influence our perceptions and our behaviours, they have the capability to influence the quality of the content that they carry. Take for instance our views on politics, global warming or the economy. For most of us, our knowledge in relation to these subjects is based on what we hear in the news bulletins on the public channels, and we form our views and opinions and act upon them based on this often rather biased and incomplete picture of the state of affairs. The influence of the Internet is even more pervasive and precarious. Unlike television, what goes on the Internet is quite often uncensored. The Internet has the potential to place a great deal of resources within easy reach of us and as such they can be very empowering and disturbing as well.

**The affordances of technology**

What are the critical affordances of the learning prefixes, such as the "e" in e-learning, the "m" in m-learning and the "d" in distance learning? What do electronic, mobile and distance learning technologies afford which makes the nature of learning different, and perhaps more powerful than it would be without them? Does the delivery medium add any particular value to learning? These are perennial questions and which continue to attract much controversy. A pathway for meaningfully exploring these questions is to examine the affordances of various delivery technologies and explore the possibilities they might offer in the way in which information is captured and rendered, and how learners are able to interact with that information and the attributes of a medium (see also Naidu, 2008).

The concept of affordance is widely attributed to James Gibson who coined the term to refer to the possibilities, objects and tools the environment afford or offer (see Gibson, 1977). Take for instance, a pathway in a dense forest or a bench by the roadside or under a tree. The pathway in the forest affords/offers one the opportunity to walk along it, just as the roadside bench affords/offers the possibility of sitting or lying down on it. It follows also that the condition of the pathway in the forest will affect the quality of one's journey on it, just as the condition of the roadside bench will influence one's comfort level on the bench.
It is therefore possible to argue from these analogies that a physical artifact or object, depending upon its attributes, can and does influence how it gets used and the impacts it might have on its user.

As such it would be reasonable to suggest that various electronic, mobile and distance learning technologies, depending on their attributes, have the potential to influence how they get used and the impacts they might have on their users. Attributes of interest here are the possibilities for information storage, retrieval, communication, collaboration, engagement and interaction (see also Naidu, 2008).

Information storage and retrieval
ICTs, unlike the conventional printed material, have the potential to capture, store and deliver information to learners and teachers in a variety of formats. These include the integration of text with audio, video and animation. Information and data delivered via ICTs in a variety of formats, such as text with sound, animation, and video offer opportunities for a range of user preferences and approaches to study. Various types of media enhancements also have the potential to influence the appeal and consumption of different types of content. For instance, physical processes such as those in the natural sciences benefit from enhanced presentation with the moving image and with sound.

Not only do ICTs offer greater capabilities and a wider range of possibilities for the presentation of content they have greater storage capacity as well. Much larger amounts of information and various types of content can be stored using contemporary ICTs, such as is possible with Web 1.0 technology than was possible using conventional media (see Greenhow, Robelia, & Hughes, 2009). This information can be easily accessed and more readily updated, which is useful in maintaining its currency.

Communication and collaboration
Another unique feature of contemporary ICTs is their ability to support both synchronous and asynchronous
communication. This is especially critical for distance learners who are separated in time and place from their teachers, tutors and educational organisations. But opportunities for communication and collaboration are not uniquely important for distance learners alone. Full-time students in campus-based educational settings also appreciate the possibilities that these attributes of ICTs afford.

Teachers also find these and the read-and-write attributes of Web 2.0 technologies increasingly valuable in supporting their teaching strategies such as collaborative group work activities among their students (see Greenhow, Robelia, & Hughes, 2009). There is also now a substantial body of experience and literature which points to the role of online synchronous and asynchronous communication tools for building and promoting learning communities and communities of practice (see Wenger, 1998, 2007; Wenger, McDermott, & Snyder, 2002).

Engagement and interaction

These attributes of ICTs can be organised and harnessed in a variety of ways and combinations to support learning and teaching formats. They include self-paced learning online and offline, and group-based learning synchronously and asynchronously (see Naidu, 2008). These various modes of engagement and interaction oftentimes will also overlap and co-exist (see Figure 1.1). Many of these learning and teaching opportunities are simply not possible in conventional campus-based learning arrangements, with large numbers and in distributed or distance education settings.

Self-paced learning offline is possible with the help of CDs and DVDs, PDAs, and laptop computers which enable learners to readily access and use large amounts of information and rich data at their own time, place and pace, a lot more than what is possible via a printed resource.

Self-paced learning online is possible with the help of a range of computer-mediated communication technologies and networked resources such as online databases and of course the Internet and Web 1.0 technology. These technologies allow users to engage and interact with subject matter content in a variety of ways and also at a pace that is convenient for individuals.

The dynamics of learning are altered considerably when learners are able to work in groups collaboratively. A wide range of technologies is becoming increasingly available to support group-based collaborative learning synchronously as well as asynchronously. Group-based learning in real time is possible with a range of audio, videoconferencing, and audio- graphic technologies, and i-labs which facilitate remote control of laboratories over the Internet. Asynchronous group-based learning is possible through a plethora of online learning environments, discussion forums and Web 2.0 technologies which enable learners to work together from a place and time, and at a pace that is convenient for them (see Greenhow, Robelia, & Hughes, 2009).

Strategies for optimising technology affordances

Effective, efficient and engaging technology-enhanced learning environments make optimal use of the affordances of ICTs in the learning and
teaching process. Learning designs and experiences do not have to adopt the use of ICTs to be effective, efficient and engaging. However, learning designs that carefully integrate ICTs can significantly improve their impacts on learners and their learning. Prominent among these learning designs are scenario-based learning (see Naidu, Menon, Gunawardena, Lekamge, & Karunanayaka, 2007); problem-based learning (see Barrows, 1994; Naidu & Oliver, 1996); adventure learning (see Doering, 2006; Miller, 2008); and computer supported collaborative learning (see Koschmann, 1996; McConnell, 2000; Stahl, 2002).

What is careful integration of ICTs in learning and teaching? These are learning and teaching situations where the choice and use of a technology is closely aligned with the intent of the learning and teaching transaction. The place to start this process is with clearly identifying the learning outcome, and articulating the learning and teaching transaction. It is only when this is absolutely clear that the act of building the learning environment begins and this includes the identification of the appropriate tools and technologies and how they will be implemented and managed. This process is similar to the construction of a purpose-designed building. Nothing is begun without the identification of a need. No excavation is started; no brick is set; nor any concrete poured till the exact design of the structure is clearly developed by an architect first.

The affordances of ICTs offer many exciting possibilities for learning and teaching but they pose many challenges as well. A classic faulty example is found in the use of online discussion forums to foster collaboration and communication among the learners as well as the learners and the teachers. Educators, often

<table>
<thead>
<tr>
<th>What are the key learning and teaching questions to ask?</th>
<th>What are the most powerful and suitable learning designs?</th>
<th>What are some of the appropriate technologies?</th>
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</thead>
<tbody>
<tr>
<td>How to promote student engagement with learning?</td>
<td>With situated learning designs such as scenario-based learning and problem-based learning</td>
<td>CD/DVD, Blogs, Wikis, Mashups, Learning management systems (Sakai, Moodle, Blackboard, etc.).</td>
</tr>
<tr>
<td>How to support communication among learners?</td>
<td>By necessitating communication as a critical part of the learning and teaching process</td>
<td>Email, chat, discussion fora, and Web 2.0 tools (e.g. blogs, Wikis, podcasts).</td>
</tr>
<tr>
<td>How to promote cooperation and collaboration among learners?</td>
<td>By building collaborative learning tasks in the learning designs</td>
<td>Wikis, communal book marking, photo and video sharing, and Web 2.0 social networking tools etc.</td>
</tr>
<tr>
<td>How to design and support assessment of learning?</td>
<td>By building structure and guidance in the assessment task</td>
<td>Learning management systems (Sakai, Moodle, Blackboard, etc.), Web 2.0 technologies.</td>
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<tr>
<td>How to provide feedback to learners?</td>
<td>By building opportunities for feedback throughout the learning and teaching process</td>
<td>Learning management systems (Sakai, Moodle, Blackboard, etc.), Web 2.0 technologies.</td>
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<td>How to support opportunities for remediation?</td>
<td>By building opportunities for remedial work in the learning design</td>
<td>Learning management systems (Sakai, Moodle, Blackboard, etc.), Web 2.0 technologies.</td>
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erroneously, believe that by making the communication channel accessible to the learners, discussion and debate among them would be raging and hot. More often than not, they are surprised to find that there is silence while they continue to call for learners to engage among themselves.

Despite all their exhortations, there is still plenty of silence. The truth is that learners are not going to talk for any reasonable length of time about anything. Their time is precious and most of them will only do what is necessary and required of them. There has to be a purpose for the discussion to ensue in any setting, let alone online, and unless that is carefully designed and orchestrated no one will be inclined to stick around there for too long (see Salmon, 2000, 2003).

But silence in text-based online discussion fora is not necessarily an indication that someone has nothing to say on a matter. In fact occasional silence in online discussion fora could be an indication that a participant may be thinking and may indeed have a lot to say on the matter soon (see Zembylas & Vrasidas, 2007). Many learners also find articulating their thoughts online a rather traumatic experience. Speakers of the native language can skim-read online posts to be able to distinguish the grain from the chaff and also scribble on for hours without much effort. But, non-native speakers of the language could agonise for hours over what is essentially noise online while straining to compose their own responses (see Chen, Bennett, & Maton, 2008).

Therefore, the key challenges we face in relation to e-learning, m-learning and distance learning is not the technology itself, but our failure to focus our energies on the critical learning and teaching questions, lack of attention to careful design of suitable learning experiences, inappropriate selection of tools and technology, and our lack of attention to their use and implementation.

A framework for optimising these technology affordances is proposed in Table 1.1. The attraction of this framework is its approach to addressing complex learning and teaching issues and how they ought to be approached. It begins foremost by asking, what are the key learning and teaching questions we need to be asking? What are the most powerful learning designs for these questions? What are the technologies currently available to us that we can use to support these learning designs (see Dede, 2009), and finally how do we know that we are achieving our goals and answering the learning questions we set out to answer in the first place?

**Measures of effectiveness**

How do we know that the ways in which we have designed the student learning experiences and the technologies that we have selected and used, are enabling us to achieve the goals we set ourselves and the learning and teaching questions that we set about to answer? Our best attempts at optimising effective, efficient and engaging use of technology affordances will be those that will have adopted a culture of continuous quality improvement. This means demonstrating a disposition towards valuing all forms of feedback, collecting meaningful feedback systemically and systematically, impressing upon stakeholders that they value feedback, and using feedback in the improvement of their practices. Without this level of commitment to continuous quality improvement, chances are that technology affordances will remain underutilised and learning outcomes unrealised.
Concluding remarks

This chapter set out to refocus our lenses on the possibilities and opportunities that various attributes of ICTs afford us in relation to teaching and learning. It begins with the premise that the more meaningful question to ask in relation to sound educational practice is not how we learn and with what, but how we can learn more effectively and efficiently. In order to do this, it has been important to articulate what is effective, efficient and engaging learning. Only then, is it meaningful to ask how e-learning, m-learning and distance learning and what specifically about them can be used to leverage desirable educational processes. This chapter identifies these desirable technology affordances and offers a framework for optimising these technology affordances in the achievement of effective, efficient and engaging learning.

Acknowledgements

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Naidu, S. (2003a). If we build it, they will come! Exploring the role of ICTs in curriculum design and development: The myths, miracles and affordances. Keynote address at the 10th anniversary conference of the National Association for Distance Education and Open Learning in South Africa (NADEOSA) in Pretoria, South Africa.


References


