

Approaches and Trends in Education Technology

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“Too often, faculty members teach according to habits and hunchesin large part, the problem is that graduate students pursuing their doctorates get little or no training in how students learn. When these graduate students become faculty members, they might think about the content they want students to learn, but not the cognitive capabilities they want them to develop.....students should be made to grapple with the material and receive authentic and explicit practice in thinking like an expert. Faculty would need to provide timely and specific feedback, and move beyond lectures in which students can sit passively receiving information. We assume that telling people things without asking them to actively process them results in learning.”

Carl E. Wieman, a Nobel Prize-winning physicist and associate director of the White House Office of Science and Technology Policy.

Introduction

One mistake in considering technology is to view the technology itself as the magic bullet in changing practice and achieving a better result. The history of technology has shown that new technologies have to be accompanied by a change in the systems in which they are used in order to achieve real change in performance. For example, the British in World War One introduced the tank, but it did not transform warfare until thirty years later when the Germans accompanied it with new thinking on tactics. At the outbreak of the second world war the Germans had fewer and inferior tanks to their opponents, but what made the difference was they had developed a new system of warfare based around the tank - Blitzkrieg. It could be argued that despite over thirty years of development of computer technology in education we are still lacking the equivalent of Blitzkrieg.

Some have argued that computing technology has so far failed to have radical impact on education because we still cling to outmoded tactics for teaching and learning (lectures, textbook, single isolated instructors). Learning Management Systems, one of the most widely used and expensive educational technologies, in some respect just replaced photocopiers, i.e. instead of an instructor copying and distributing notes, slides and other learning material, they are loaded into a place where students can download and print them. One of the most frequently occurring requests for funding (often at widely varying cost) is to purchase technology to capture and transmit video of traditional classroom lectures. Although technology is now used throughout education, it is often used just to make existing learning approaches more efficient, rather than used as part of new strategies to make it more effective.

Developing more effective use of technology is not only important for improving educational practice, it is also important for preparing students for the workplace. There are many developments in the use of technology in modern organizations. The ability to lead and participate in those developments provides a competitive advantage to graduates. This is particularly true in the healthcare industry, where investment in technology is becoming greater (Senior et al, 2011¹), despite the relative conservatism in the past. For example, over 80% of hospitals are now experimenting with iPads and other mobile devices for improving their operations.

This paper will discuss new approaches and trends in education technology, but will do so also in relation to changing approaches to education enabled by the technologies. It will look to a future in which the effectiveness of graduates is improved by technology. It will envision a movement beyond just making current educational approaches more efficient.

¹ G Senior, RG Fichman, R Kohli (2011). The Role of Information Systems in Healthcare: Current Research and Future Trends, Information Systems - isr.journal.informs.org



The horseless carriage – design of early automobiles was constrained by the experience of previous technologies. Design of educational technologies is still being constrained by the pre-internet age thinking on education

Transferable skills and digital portfolios

“Although schools may continue to fundamentally look and act as they have for more than one hundred years, the way individuals learn has already been forever changed. Instead of learning from others who have the credentials to ‘teach’ in this new networked world, we learn with others whom we seek (and who seek us) on our own and with whom we often share nothing more than a passion for knowing.”

Will Richardson in *21st Century Skills: Rethinking How Students Learn*

Traditionally, a major part of education is to get information and knowledge into the head of a student. Large amounts of information and knowledge are crammed into memory just in case it may be needed. Thus, the traditional lecture is usually about presenting information to passive listeners and the traditional test is checking whether it has been retained (at least at the time of the test). This may no longer be achievable, or desirable, in the modern age.

Knowledge in most disciplines expands and changes at an exponential rate making it difficult to teach more than a small core of knowledge in an educational program. If the curriculum is packed with every piece of knowledge that might be useful to memorize, a situation akin to trying to drink water from a gushing fire hydrant results. Lectures are packed with more and more slides resulting in what is sometimes referred to as “death by PowerPoint”.

At the same time, the combination of the Internet and mobile computing has made much of the available knowledge accessible in an instant – provided the user has the appropriate skills to know where to look and how to evaluate the available sources. Cognitive skills to solve problems using digital information sources are becoming more important than the ability to carry large amounts of information in the head. This includes the skill to identify the appropriate knowledge and information just in time to support optimal problem solving. It also includes the skill to think creatively in solving problems with the information, and the skill to collaborate and communicate with stakeholders in the problem area.

There is talk now of defining and basing education around “21st century skills”, which will help distinguish the world-class knowledge workers that employers will seek out. Institutions that become expert in developing such skills are likely to obtain competitive advantage over institutions that just teach “the knowledge” in the traditional way.

Among the kind of skills listed in discussions of 21st century skills are the ability to:

- Communicate
- Adapt to change
- Work in (diverse) teams
- Solve problems
- Analyze and conceptualize
- Reflect upon and improve performance
- Self manage
- Create
- Innovate
- Critique
- Engage in life-long learning
- Appreciate and work with people in other disciplines
- Be information literate
- Be technology literate

Most of these skills have always been important and valued. The difference is that the combination of fast and exponentially developing knowledge combined with easy and mobile access to knowledge has made them a more important differentiator in graduates. Previously, the knowledge acquired and retained in memory was the most important measure of the graduate. Although this is still to some extent important, in many areas (e.g. technology programs) the knowledge acquired in the first year of a course may be out of date by the time the student graduates several years later.

Education institutions have become equally adept at the traditional knowledge presentation and test model. Thus, students tend to graduate with the same core knowledge. However, institutions are not all adept, or even focused, on graduating students with a high level of the skills noted above. The skills are not usually explicitly built into syllabi, or assessments of courses.

One example of an attempt to change this is the University of Clemson. A set of core skills have been identified for all undergraduate students to obtain and must be integrated into courses taught. Technology is used in order to demonstrate the student's achievement in core skills development. Specifically, every student must have an electronic portfolio that demonstrates these competencies to potential employers, together with any subject specific material they develop. Using Google sites, students develop their portfolio and will graduate not just with a GPA, but also with an openly viewable collection of their educational achievements on a web site.



Walgreens announced in November, 2011, that it was giving pharmacists working at its 20 pilot stores in Chicago iPads. This would allow the pharmacists to instantly access customers' medical records.

Collaboration and Social Networking

“Communicating with old people”

Answer of young adult to a survey question – what do you use email for?

For better or worse many people’s digital life is now dominated by social networking sites such as Facebook. Many educational institutions have tried to battle this trend by banning such sites as a distraction. Others have argued that such an approach is a losing battle and instead we should harness the power of social networking in education. A good example here, is given that YouTube is banned in many K12 schools despite it having large amounts of useful educational content, an educational equivalent “Teach Tube” has been developed. Other educators realizing the most effective way to communicate with their students is through social networking have setup Facebook accounts, or encouraged students to join LinkedIn - thus separating personal and professional social networking. An innovative approach from Google to social networking is allowing for a separation of personal and family networking from professional and learning oriented networking through the use of “circles” of contacts.

Some more recently developed Learning Management Systems, rather than including internal communications features like emailing and announcements, allow students to connect their social networking accounts. This means educational related messages are pushed to them instantly, they do not have to go to a web site, log in and learn another interface.

Social networking not only enables better connection with students, it also facilitates communication and sharing among educators. Educators are increasingly using professional social networking sites (such as LinkedIn), to connect with each other. There are also a number of social sites to share, rate and comment on learning content and communicate ideas.

In the traditional world of education, students rely on one instructor, one textbook and some of the students that are in their class at their geographical location. Through the Internet students now have access to a vast array of teachers, learning content, and people willing and able to help them. What they often lack is a good guide to effectively using these resources.

Also, in the traditional world the course instructor has been a 1:1 relationship with a course. Larger courses may include assistant instructors (TA), but in a subsidiary role to the main instructor. The problem with this approach is that education is a multi-skilled activity and not everyone is good at everything. Thus, an instructor may be on top of all the content of the course (although there may be areas of weakness); they may be good at course design, assessment, lab class management, but due to having a mono-tone voice they may not be a very inspiring lecturer. Another instructor may be an entertaining and inspiring lecturer but be poor in designing appropriately challenging assessments for the level at which they are teaching.

An alternative model is team teaching, where several instructors collaborate in both the design and teaching of the course, contributing what they are best at and mentoring each other in the improvement of areas of weakness. This model is particularly beneficial for new faculty.

Technology facilitates this approach; it enables team teaching across different locations and different institutions (even on a global scale). Thus, instead of three courses in three locations with three different instructors, you may have one course with a team of three instructors who work together to improve the overall quality of the educational experience in the combined course. Video communication technologies and shared desktops enable this more collaborative approach in both the instructional design and teaching.

There are various models for team teaching. There is a potential for it to be just a collection of individuals taking the traditional approach in sequence. A true team approach would enable all team member's participation in all parts of the course, not just the part they present, and the viewing and critiquing of the student experience of the whole course (continuous peer evaluation). A team approach should also involve participation of support services. A librarian can assist in finding preexisting content (slides, animations, diagrams, video, interactive lessons) already available on the internet. An instructional design expert can assist in the development of new teaching methods, the evaluation of current methods, and the development of new content (should there be gaps in what the librarian found).

Multimedia development and open content

“We are drowning in information, while starving for wisdom. The world henceforth will be run by synthesizers, people able to put together the right information at the right time, think critically about it, and make important choices wisely.”

E.O. Wilson

It was once the case that the only learning material that the students had access to (other than textbooks) was that provided by the instructor. The advent of open content on the Internet makes that no longer the case. Many teachers no longer create all their own material but instead identify materials from existing sources and concentrate their own development time into organizing this and having more interactive class exercises and assignments. In addition to free and open content, there are many emerging free software tools to enhance education. Google provides many free facilities and tools for education. In addition to free email, calendaring and video hosting services, tools such as mapping (Google earth) and sketching (Sketchup) are available to assist educational activities.

There are now many sites like the Khan Academy (partially funded by the Gates Foundation), that have collections of short videos that effectively teach key concepts across a large range of subjects. If you have a problem with technology, you will often find that someone who has also had the same problem has worked out the solution, filmed it on video and then posted it on YouTube. Sometimes you will have a child illustrating the solution better than any of the help manuals that used to come along with a technology. In addition, many large universities such as MIT have made their learning content open and free on the Internet. Institutions such as PBS, NASA and the Smithsonian also make high quality content available for free. Some professional organizations have free or low cost digital resources. There are several sites that collect open

educational content in one place e.g. Open Educational Resources, Merlot, Slideshare, Connexions, and Hippocampus.

The open-source movement specifically tries to include learners and educators in the content-creating and evaluation process. Traditionally, the emphasis in educational media creation has been on the teacher creating media for the students to view. It is often said that the best way to learn is to teach, and thus getting students to produce better content may be a better way to engage them in learning. It also prepares students in the skills of creating and communicating with media, which are skills being increasingly valued in the work place.

Classes at Harvard have included editing of Wikipedia articles as a learning approach. At many other institutions students learn to create podcasts, wikis, blogs and videos, rather than just view them. It helps them learn in a more interactive way and results in a product they can use in a portfolio to demonstrate what they have learned in addition to their evolving technology and communication skills.

There are now many tools available that allow students, in collaboration with instructors, to create sophisticated multimedia presentations and interactive media, for example, Microsoft Photo Story 3 for online audio slide shows, or Apple's free authoring software for creating interactive textbooks on the iPad. The use of digital portfolios is a way for students to both demonstrate these skills and highlight what they have learned. They are an impressive advancement over a traditional resume.

Reverse teaching

An approach that has recently become popular is known by various names, e.g. flip teaching, or backwards classroom. Essentially it flips the traditional model where students obtain information in class and then do practical assignments and projects as homework assignments. Students are expected to obtain a basic core of information and knowledge online outside of class and spend their time in class collaboratively working on practical assignments that apply and reinforce this knowledge.

The classroom is all about collaboration. In this model the relationships change within the course. The teacher's role shifts from being the owners and presenters of content to the facilitators and guides to learning. Courses will be made up of a large number of different approaches to teaching using a variety of media to facilitate learning. Instructional design becomes less about designing and presenting learning content, and more about designing a learning experience. The experience is focused on interaction and skill building, which makes use of the best available content from external sources.

Of course, the architecture of the traditional classroom, which has not changed over hundreds of years often works against a collaborative approach. There are ways of transitioning to newer approaches, such as using moveable furnishing, round tables rather than rows and using all wall space for presenting (e.g. whiteboard painted walls). Where students need to use computers to analyze and create, they can be asked to use one computer between two, rather than one each.



Classroom Design – Function follows form

Mobile technologies

Many students now carry around powerful computers in their hands; education has yet to find a way to leverage this fact. Many have in the past made laptop ownership compulsory for students, without any specific plans for how they should be used in the classroom. It is slowly being recognized that Mobile texting, together with Facebook, (and not email or phone calls) are now the major methods of communication for young people. Many universities, in response to campus shootings, have implemented mobile texting alert systems for instantly notifying students of danger. There is still the need to integrate other forms of communication in universities, into the mobile Smartphone world.



Tablet computers like Apple's iPad are becoming more popular than laptops because they offer instant on, long battery life, and easier to use software (apps). They allow libraries of book content to be accessed without visiting a library, interactive digital textbooks, and mobile recording and data collection. Digital lab books (e.g. lab guru) can integrate photographs, note

taking, timers and video recording. Tablets can also connect recording and measuring devices (e.g. temperature gauges) for direct data collection, and they can wirelessly connect to large HDTVs for presentations and very low cost interactive whiteboards.

User-centered design

"It's hard to know what it is like for someone else not to know something that you know.....It's the chief driver of bad writing and, I would argue, bad teaching."

Dr Stephen Pinker, Professor of Psychology, Harvard University

Traditionally, learning content is evaluated through peer review. For example, publishers will send textbooks written by professors to other professors to in order to determine if the book is a good learning resource. There now exists many techniques whereby we can collect data to assess the effectiveness of any learning content. Beyond end-of-course satisfaction surveys, little data is collected or analyzed. The process of evaluation and change tends to be discrete and informal, rather than continuous. It is often done at the end of a course when it is too late to effect change for current students. It tends to treat everyone the same, rather than look at students as individuals. It also tends to put the focus of problems entirely on teaching rather than learning.

Data collection on student's grades and satisfaction level can be collected and made available to a number of services that have the ability to help (instructional design, tutoring and mentoring). In addition to this quantitative data, it is important to have more qualitative data about how students feel (e.g. through focus groups) and actively involve them in the continuous design of the course (e.g. is the textbook good from their perspective?). Continuous data collection allows action to be taken as a course runs, not just at the end. Additionally, the focus should be on an evidence-based diagnosis of student learning problems. Problems may be due to ineffective teaching but it may also be due to a lack of developed learning skills (e.g. note taking) on the part of the student. Often students have difficulty in transitioning from high school to college, undergraduate to graduate level, and conventional to distance modes of education. It should not be supposed that because most students have no problems, those who do, lack intelligence or motivation. It should not be supposed that because students find it difficult currently to learn from an instructor, the instructor is at fault. In both cases the system could be at fault.

In an efficient organizational system, people should be looking for and taking ownership of problems. They should relish the challenge of solving them. Leadership should reward those who improve, rather than seek to punish those deemed responsible for deficiencies. Every stakeholder group has to be involved in this process, you cannot have one or two experts determining what the solution will be and imposing it on others without consultation. In his book "The Human Factor: Revolutionizing the Way People Live with Technology" Kim Vicente recounts how air safety has improved dramatically since blame was taken out of the reporting of near accidents. Before this the culture was such that people were reluctant to admit mistakes in order to avoid blame. He laments that in the medical profession, the blame culture is still prevalent and as a result the high levels of accidental deaths in hospitals may be partly due to

covering mistakes, rather than identifying them and analyzing their causes. In addition to the medical profession, there is a need to make a similar change in education.

Conclusion

We have covered a number of trends and issues in relation to the future of education and the role technology has to play in this future. A key point is that technology alone cannot effect a change; it has to come through people and the systems through which they operate. The intention of this paper is to stimulate thinking and discussion around real change. Change has to be welcomed and owned by everyone; it cannot be imposed. Its success is dependent on these discussions and a shared understanding of the path forward.

There is a clear choice emerging for educational institutions. Continue on as normal with a few technologies, supporting rather than changing the way things are done, or look to radically transform what we do by combining the right methods, attitudes and technologies into an effective system. It is the institutions making this change that may soon claim to be educating the world-class professionals of the twenty first century.