8.4 Video

Figure 8.4.1 An OpenLearn video from the Open University on communications technologies in developing countries. Click on the image to play the video

8.4.1 More power, more complexity

Although there have been massive changes in video technology over the last 25 years, resulting in dramatic reductions in the costs of both creating and distributing video, the unique educational characteristics are largely unaffected. (More recent computer-generated media such as simulations, will be analysed under 'Computing', in Section 8.5).

Video is a much richer medium than either text or audio, as in addition to its ability to offer text and sound, it can also offer dynamic or moving pictures. Thus while it can offer all the affordances of audio, and some of text, it also has unique pedagogical characteristics of its own. Once again, there has been considerable research on the use of video in education, and again I will be drawing on research from the Open University (Bates, 1984; 2005; Koumi, 2006) as well as from Mayer (2009).

Click on the links to see examples for many of the characteristics listed below.

8.4.2 Presentational features

Video can be used to:

- demonstrate experiments or phenomena, particularly:
    - where equipment or phenomena to be observed are large, microscopic, expensive, inaccessible, dangerous, or difficult to observe without special equipment (see an example from the University of Nottingham);
    - where resources are scarce, or unsuitable for student experimentation (e.g. live animals, human body parts) (see an example of the anatomy of the brain, from the University of British Columbia);
    - where the experimental design is complex (for example, testing whether wild sharks are more attracted to blood than fish oil)
    - where there is an element of risk or danger in conducting the experiment (see an example demonstrating the conservation of momentum)
    - where the experimental behaviour may be influenced by uncontrollable but observable variables;
- illustrate principles involving dynamic change or movement (see an example explaining exponential growth from a course at UBC);
- illustrate abstract principles through the use of specially constructed physical models, for instance an animation of a normal curve of distribution;
- illustrate principles involving three-dimensional space, for example, see this video from Nova Scotia Community College
- demonstrate changes over time through the use of animation, slow-motion, or speeded-up video (see an example of how haemophilus influenzae cells take up DNA, from UBC);
- demonstrate correct procedures in health, safety, repairs and maintenance (for an example, see Brady's EMR Skills Video)
- substitute for a field visit, by:
    - providing students with an accurate, comprehensive visual picture of a site, in order to place the topic under study in context; for instance see the Bodo aboriginal archeological site in Alberta
    - demonstrating the relationship between different elements of a system under study (e.g. production processes, ecological balanc brady's EMRe); for example, see the paper-making process
    - by identifying and distinguishing between different classes or categories of phenomena at the site (e.g. in forest ecology);
    - to observe differences in scale and process between laboratory and mass-production techniques;
    - through the use of models, animations or simulations, to teach certain advanced scientific or technological concepts (such as theories of relativity or quantum

physics) without students having to master highly advanced mathematical techniques; see for instance 'Einstein's Theory of Relativity Made Easy.'

- bring students primary resource or case-study material, i.e. recording of naturally occurring events which, through editing and selection, demonstrate or illustrate principles covered elsewhere in a course;
- demonstrate ways in which abstract principles or concepts developed elsewhere in the course have been applied to real-world problems, for example, innovative stormwater management in the University of British Columbia's Master of Land and Water Management;
- synthesise a wide range of variables into a single recorded event, e.g. to suggest how real world problems can be resolved;
- demonstrate decision-making processes or decisions 'in action' (e.g. triage in an emergency situation) by:
    - recording the decision-making process as it occurs in real contexts;
    - recording 'staged' simulations, dramatisation or role-playing, as in the scenarios in Ryerson University's Therapeutic Communication and Mental Health Assessment Program
- demonstrate correct procedures in using tools or equipment (including safety procedures);
- demonstrate methods or techniques of performance (e.g. mechanical skills such as stripping and re-assembling a carburetor, sketching, drawing or painting techniques, or dance);
- record and archive events that are crucial to topics in a course, but which may disappear or be destroyed in the near future, such as, for instance, street graffiti or condemned buildings (see an example about neon lights in Vancouver);
- demonstrate practical activities to be carried out by students, on their own (for example, see 32 cool experiments to do at home).

Figure 8.4.2 Don't do this yourself at home! Video on the conservation of momentum

8.4.3 Skills development

This usually requires the video to be integrated with student activities. The ability to stop, rewind and replay video becomes crucial for skills development, as student activity usually takes place separately from the actual viewing of the video. This may mean thinking through carefully activities for students related to the use of video.

If video is not used directly for lecturing, research clearly indicates that students generally need to be guided as to what to look for in video, at least initially in their use of video for learning. There are various techniques for relating concrete events with abstract principles, such as through audio narration over the video, using a still frame to highlight the observation, or repeating a small section of the program. Bates and Gallagher (1977) found that using video for developing higher order analysis or evaluation was a teachable skill that needs to be built into the development of a course or program, to get the best results.

Typical uses of video for skills development include:

- enabling students to recognize naturally occurring phenomena or classifications (e.g. classroom teaching strategies, symptoms of mental illness, classroom behaviour) in context;
- enabling students to analyse a situation, using principles either introduced in the video recording or covered elsewhere in the course, such as a textbook or lecture; for example, possible raw material on managing domestic violence,
- interpreting artistic performance (e.g. drama, spoken poetry, movies, paintings, sculpture, or other works of art);

- analysis of music composition, through the use of musical performance, narration and graphics;
- testing the applicability or relevance of abstract concepts or generalisations in real world contexts (see for example the European Space Agency's video on climate change)
- looking for alternative explanations for real world phenomena.

There are many ways in which video can be used for skills development. Nevertheless, however video is used for skill development, as well as the demonstration of the skill, attention must be paid to ensuring opportunities for student practice and feedback, probably using other media, although it is now increasingly easy for students to make their own videos to demonstrate their skill.

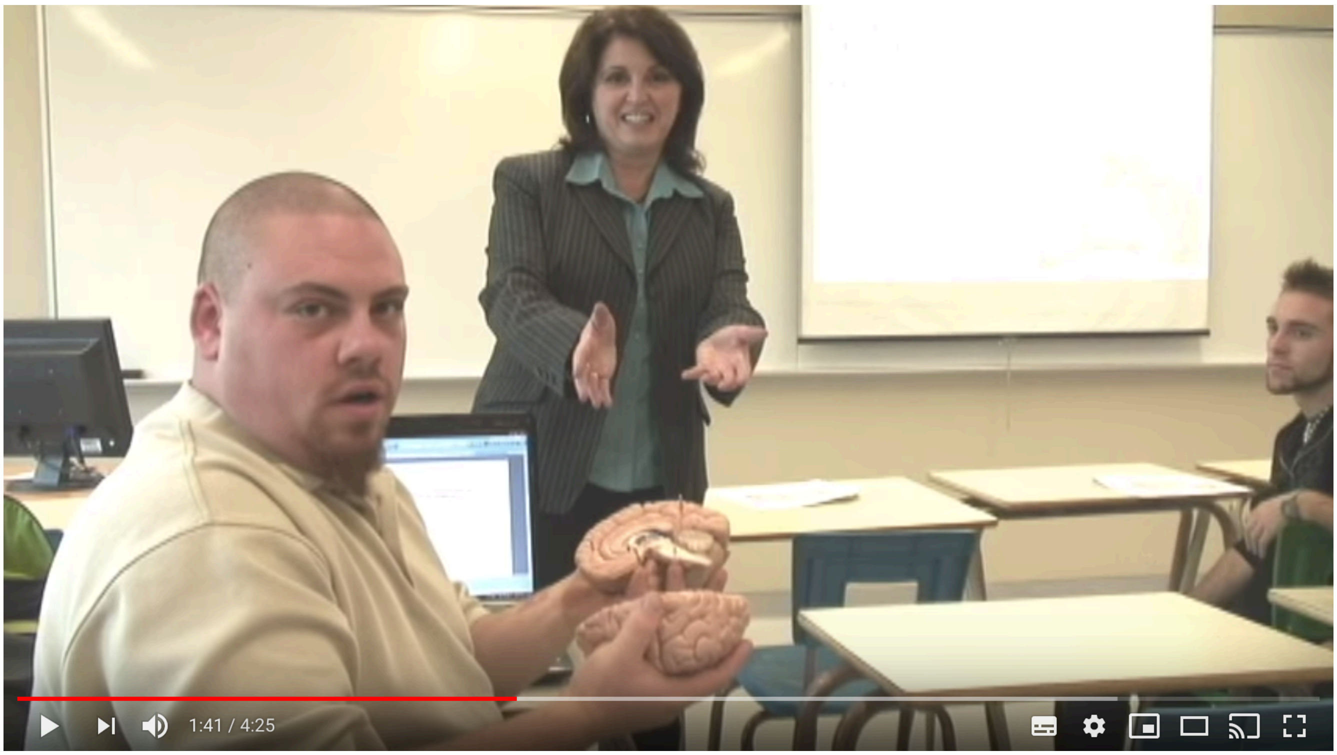

Figure 8.4.3 Demonstrating teaching strategies: kinesthetic learning

8.4.4 Strengths and weaknesses of video as a teaching medium

One factor that makes video powerful for learning is its ability to show the relationship between concrete examples and abstract principles, with usually the sound track relating the abstract principles to concrete events shown in the video (see, for example: Probability for quantum chemistry, UBC). Video is particularly useful for recording events or situations where it would be too difficult, dangerous, expensive or impractical to bring students to such events.

Thus its main strengths are as follows:

- linking concrete events and phenomena to abstract principles and vice versa;
- the ability of students to stop and start, so they can integrate activities with video;
- providing an alternative approach to the presentation of content that can help students having difficulties in learning abstract concepts;
- adding substantial interest to a course by linking it to real world issues;
- a growing amount of freely available, high quality academic videos;
- good for developing some of the higher level intellectual skills and some of the more practical skills needed in a digital age;
- the use of low cost cameras and free editing software enables some forms of video to be cheaply produced.

It should also be remembered that in addition to the features listed above, video can incorporate many of the features of audio as well.

The main weaknesses of video are:

- many faculty have no knowledge or experience in using video other than for recording lecturing;
- there is currently a limited amount of high quality educational video free for downloading, because the cost of developing high quality educational video that exploits the unique characteristics of the medium is still relatively high. Links also often go dead after a while, affecting the reliability of outsourced video. The availability of free material for educational use is improving all the time, but currently finding appropriate and free videos that meet the specific needs of a teacher or instructor can be time-consuming or such material may just not be available or reliable;
- creating original material that exploits the unique characteristics of video is time-consuming, and still relatively expensive, because it usually needs professional video production;
- to get the most out of educational video, students need specially designed activities that often will have to sit outside the video itself;
- students often reject videos that require them to do analysis or interpretation; they often prefer direct instruction that focuses primarily on comprehension. Such students need to be trained to use video differently, which requires time to be devoted to developing such skills.

For these reasons, video is not being used enough in education. When used it is often an afterthought or an ‘extra’, rather than an integral part of the design, or is used merely to replicate a classroom lecture, rather than exploiting the unique characteristics of video.

8.4.5 Assessment

If video is being used to develop the skills outlined in Section 8.4.3, then it is essential that these skills are assessed and count for grading. Indeed, one possible means of assessment might be to ask students to analyse or interpret a selected video, or even to develop their own media project, using video they themselves have collected or produced, using their own devices.

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The University of British Columbia also provides two annotated bibliographies of digital multimedia research. one collated at UBC and one by the University of Central Florida.

Activity 8.4 Identifying the unique pedagogical characteristics of video

1. Take one of the courses you are teaching. What key presentational aspects of video could be important for this course?

2. Look at the skills listed in Section 1.2 of this book. Which of these skills would best be developed through the use of video rather than other media? How would you do this using video-based teaching?

3. Under what conditions would it be more appropriate for students to be assessed by asking them to analyse or make their own video recording? How could this be done under assessment conditions?

4. Type in the name of your topic + video into Google.

- How many videos come up?
- What's their quality like?
- Could you use any of them in your teaching?
- If so, how would you integrate them into your course?
- Could you make a better video on the topic?
- What would enable you to do this?

Here are some criteria I would apply to what you find:

- it is relevant to what you want to teach;
- it demonstrates clearly a particular topic or subject and links it to what the student is intended to learn;
- it is short and to the point;
- the example is well produced (clear camera work, good presenter, clear audio);
- it provides something that you could not do easily yourself;
- it is freely available for non-commercial use.

For feedback on this activity, and some further comments on the value of video, click on the podcast below:

An audio element has been excluded from this version of the text. You can listen to it online here: https://pressbooks.bccampus.ca/teachinginadigitalagev2/?p=206

8.5 Computing

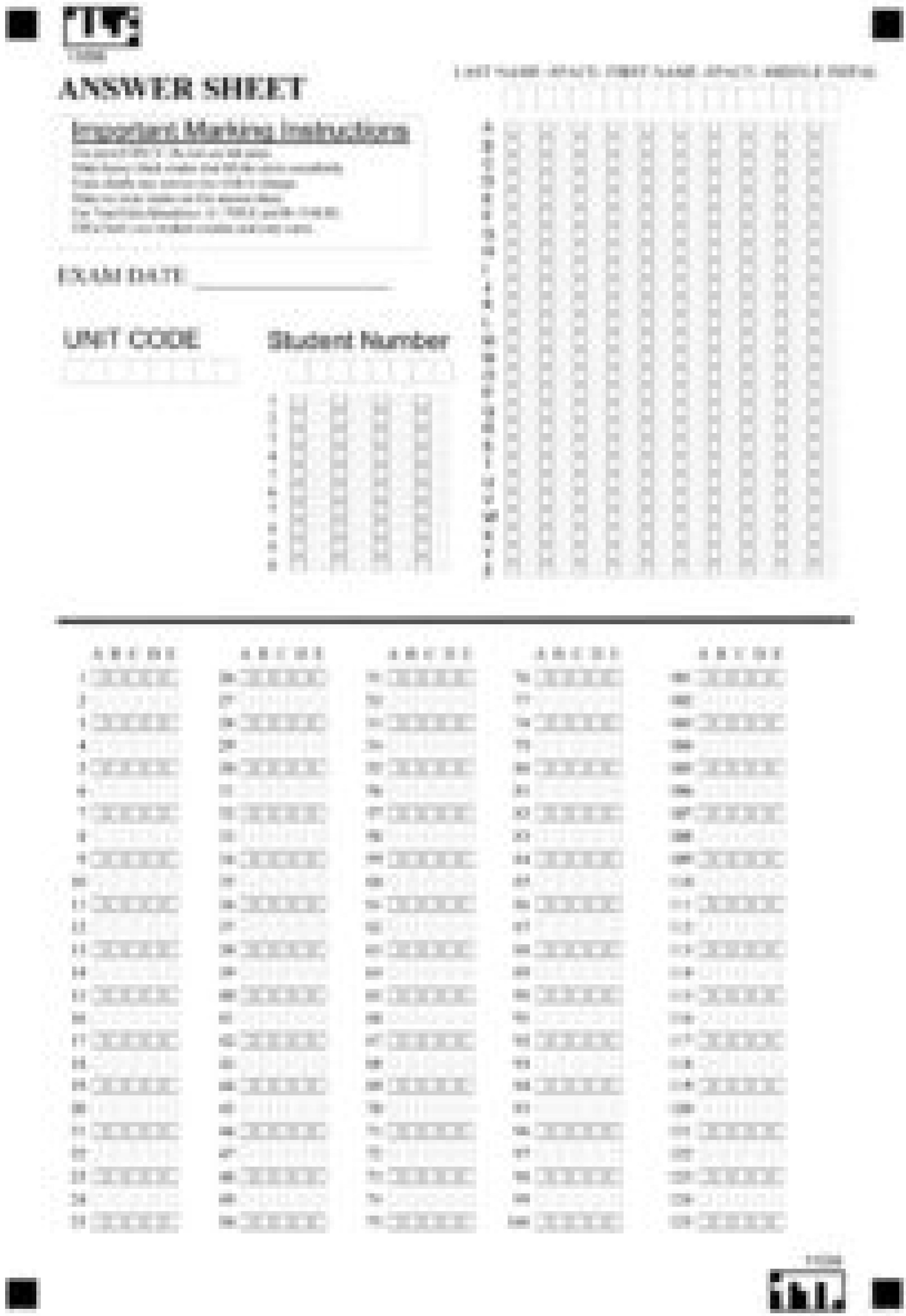
ANSWER SHEET
Important Marking Instructions
EXAM DATE
UNIT CODE
Student Number

Figure 8.5.1 A computer-marked assignment form (University of Western Australia)

8.5.1 A volatile and comprehensive medium

It is debatable whether computing should be considered a medium, but I am using the term broadly, and not in the technical sense of writing code. I prefer 'computing' to 'ICTs' (information and communications technologies). Computing is a medium while ICT refers more to the technologies used. The Internet in particular is an all-embracing medium that accommodates text, audio, video and computing, as well as providing other elements such as distributed communication and access to educational opportunities. Computing is also still an area that is fast developing, with new products and services emerging all the time. Indeed, I will treat recent developments in social media and some emerging technologies separately from computing, although technically they are sub-categories of computing. Once again, though, social media and some emerging technologies contain affordances that are not so prevalent in more conventional computing-based learning environments.

In such a volatile medium, it would be foolish to be dogmatic about unique media characteristics, but once again, the purpose of this chapter is not to provide a definitive analysis, but a way of thinking about technology that will facilitate an instructor's choice and use of technology. The focus is: what are the pedagogical affordances of computing that are different from those of other media (other than the important fact that it can embrace all the other media characteristics)?

Although there has been a great deal of research into computers in education, there has been less focus on the specifics of its pedagogical media characteristics, although a great deal of interesting research and development has taken place and continues in human-machine interaction and to a lesser extent in artificial intelligence. Thus I am relying more on analysis and experience than research on the unique affordances or characteristics of computing as an educational medium in this section.

8.5.2 Presentational features

Figure 8.5.2 Screen size can be a real presentational limitation with smaller, mobile devices

Presentation is not really where the educational strength of computing lies. It can represent text and audio reasonably well, and video less well, because of the limited size of the screen (and video often has to share screen space with text), and the bandwidth/pixels/download time required. Screen size can be a real presentational limitation with smaller, mobile devices, although tablets such as the iPad are a major advance in screen quality.

However, unlike the other media, computing enables the end user to interact directly with the medium, to the extent that the end user (in education, the student) can add to, change or interact with the content, at least to a certain extent. Also, more controversially, computing can automatically collect end-user responses for analytics. In this sense, computing comes closer to a complete, if virtual, learning environment.

Thus in presentational terms computing can be used to:

- create and present original teaching content in a rich and varied way (using a combination of text, audio, video and webinars);
- enable access to other sources of secondary 'rich' content through the Internet;
- enable students to communicate both synchronously and asynchronously with the instructor and other students;
- structure and manage content through the use of web sites, learning management systems, video servers, and other similar technologies;
- create virtual worlds or virtual environments/contexts through technology such as animations, simulations, augmented or virtual reality, and serious games;
- set multiple-choice tests, automatically mark such tests, and provide immediate feedback to

learners;

- enable learners digitally to submit written (essay-type), or multimedia (project-based) assignments through the use of e-portfolios.

8.5.3 Skills development

Skills development in a computing environment will once again depend very much on the epistemological approach to teaching. Computing can be used to focus on comprehension and understanding, through a behaviourist approach to computer-based learning (present/test/feedback). However, the communications element of computing also enables more constructivist approaches, through online student discussion and student-created multimedia work.

Thus computing can be used (uniquely) to:

- develop and test student comprehension of content through computer-based learning/testing;
- develop computer coding and other computer-based skills;
- develop decision-making skills through the use of digitally-based simulations and/or virtual worlds;
- develop skills of reasoning, evidence-based argument, and collaboration through instructor-moderated online discussion forums;
- enable students to create their own artefacts/online multimedia work through the use of e-portfolios, thus improving their digital communication skills as well as assessing better what they have learned;
- develop skills of experimental design, through the use of simulations, virtual laboratory equipment and remote labs;
- develop skills of knowledge management and problem-solving, by requiring students to find, analyse, evaluate and apply content, accessed through the Internet, to real world problems;
- develop spoken and written language skills through both presentation of language and through communication with other students and/or native language speakers via the Internet
- collect data on end-user/student interactions with computer and associated equipment such as mobile phones and tablets for:
    - learning analytics, which can be used to identify weaknesses in the design of the teaching, and student success and failure regarding learning outcomes, including skills development, as well as identifying at-risk students,
    - adaptive learning, offering learners alternative routes through learning materials, providing an element of personalisation,
    - assessment (including monitoring),
    - automated or human feedback.

These affordances are in *addition* to the affordances that other media can support within a broader computing environment.

8.5.4 Strengths and weaknesses of computing as a teaching medium

Many teachers and instructors avoid the use of computing because they fear it may be used to replace them, or because they believe it results in a very mechanical approach to teaching and learning. This is not helped by misinformed computer scientists, politicians and industry leaders who argue that computers can replace or reduce the need for humans in teaching. Both viewpoints show a misunderstanding of both the sophistication and complexity of teaching and learning, and the flexibility and advantages that computing can bring to teaching.

So here are some of the advantages of computing as a teaching medium:

- it is a very powerful teaching medium in terms of its unique pedagogical characteristics, in that it can combine the pedagogical characteristics of text, audio, video and computing in an integrated manner;
- its unique pedagogical characteristics are useful for teaching many of the skills learners need in a digital age;
- computing can enable learners to have more power and choice in accessing and creating their own learning and learning contexts;
- computing can enable learners to interact directly with learning materials and receive immediate feedback, thus, when well designed, increasing the speed and depth of their learning;
- computing can enable anyone with Internet access and a computing device to study or learn at any time or place;
- computing can enable regular and frequent communication between student, instructors and other students;
- computing is flexible enough to be used to support a wide range of teaching philosophies and approaches;
- computing can help with some of the 'grunt' work in assessment and tracking of student performance, freeing up an instructor to focus on the more complex forms of assessment and interaction with students.

On the other hand, the disadvantages of computing are:

- many teachers and instructors often have no training in or awareness of the strengths and weaknesses of computing as a teaching medium;
- computing is too often oversold as a panacea for education; it is a powerful teaching medium, but it needs to be managed and controlled by educators;
- the traditional user interface for computing, such as pull-down menus, cursor screen navigation, touch control, and an algorithmic-based filing or storage system, while all very functional, are not intuitive and can be quite restricting from an educational point of view. Voice recognition and search interfaces such as Siri and Alexa are an advance, and have potential for education, but at present they have not been used extensively as educational tools (at least by instructors);
- there is a tendency for computer scientists and engineers to adopt behaviourist approaches to

the use of computing for education, which not only alienates constructivist-oriented teachers and learners, but also underestimates or underuses the true power of computing for teaching and learning;

- despite computing's power as a teaching medium, there are many aspects of teaching and learning that require direct interaction between a student and teacher – and between students – even or especially in a fully online environment (see Chapter 4, Section 4) . The importance of face-to-face, human-to-human contact is probably greater the younger or the less mature the learner, but there will still be many learning contexts where face-to-face contact is necessary or highly desirable even for older or mature learners (this is discussed more in Chapter 10, Section 4). The importance of frequent face-to-face teacher-student interaction is also probably less than many instructors believe, but more than many advocates of computer learning understand. It is not either/or, but finding the right balance in the right context.
- computing needs the input and management of teachers and educators, and to some extent learners, to determine the conditions under which computing can best operate as a teaching medium; and teachers need to be in control of the decisions on when and how to use computing for teaching and learning;
- to use computing well, teachers need to work closely with other specialists, such as instructional designers and computer scientists.

The issue around the value of computing as a medium for teaching is less about its pedagogical value and more about control. Because of the complexity of teaching and learning, it is essential that the use of computing for teaching and learning is controlled and managed by educators. As long as teachers and instructors have control, and have the necessary knowledge and training about the pedagogical advantages and limitations of computing, then computing is an essential medium for teaching in a digital age.

8.5.5 Assessment

There is a tendency to focus assessment in computing on multiple choice questions and 'correct' answers. Although this form of assessment has its value in assessing comprehension and for testing a limited range of mechanical procedures, computing also supports a wider range of assessment techniques, from learner-created blogs and wikis to e-portfolios. These more flexible forms of computer-based assessment are more in alignment with measuring the knowledge and skills that many learners will need in a digital age.

Activity 8.5 Identifying the unique pedagogical characteristics of computing

1. Take one of the courses you are teaching. What key presentational aspects of computing could be important for this course?

2. Look at the skills listed in Section 1.2 of this book. Which of these skills would best be developed through the use of computing rather than other media? How would you do this using computer-based teaching?

3. Under what conditions would it be more appropriate in any of your courses for students to be assessed by asking them to create their own multimedia project portfolios rather than through a written exam?

What assessment conditions would be necessary to ensure the authenticity of a student's work? Would this form of assessment be extra work for you?

4. What are the main barriers to your using computing more in your teaching? Philosophical? Practical? Lack of training or confidence in technology use? Or lack of institutional support? What could be done to remove some of these barriers?

For feedback on some of these questions, click on the podcast below:

An audio element has been excluded from this version of the text. You can listen to it online here: *https://pressbooks.bccampus.ca/teachinginadigitalagev2/?p=210*

8.6 Social media

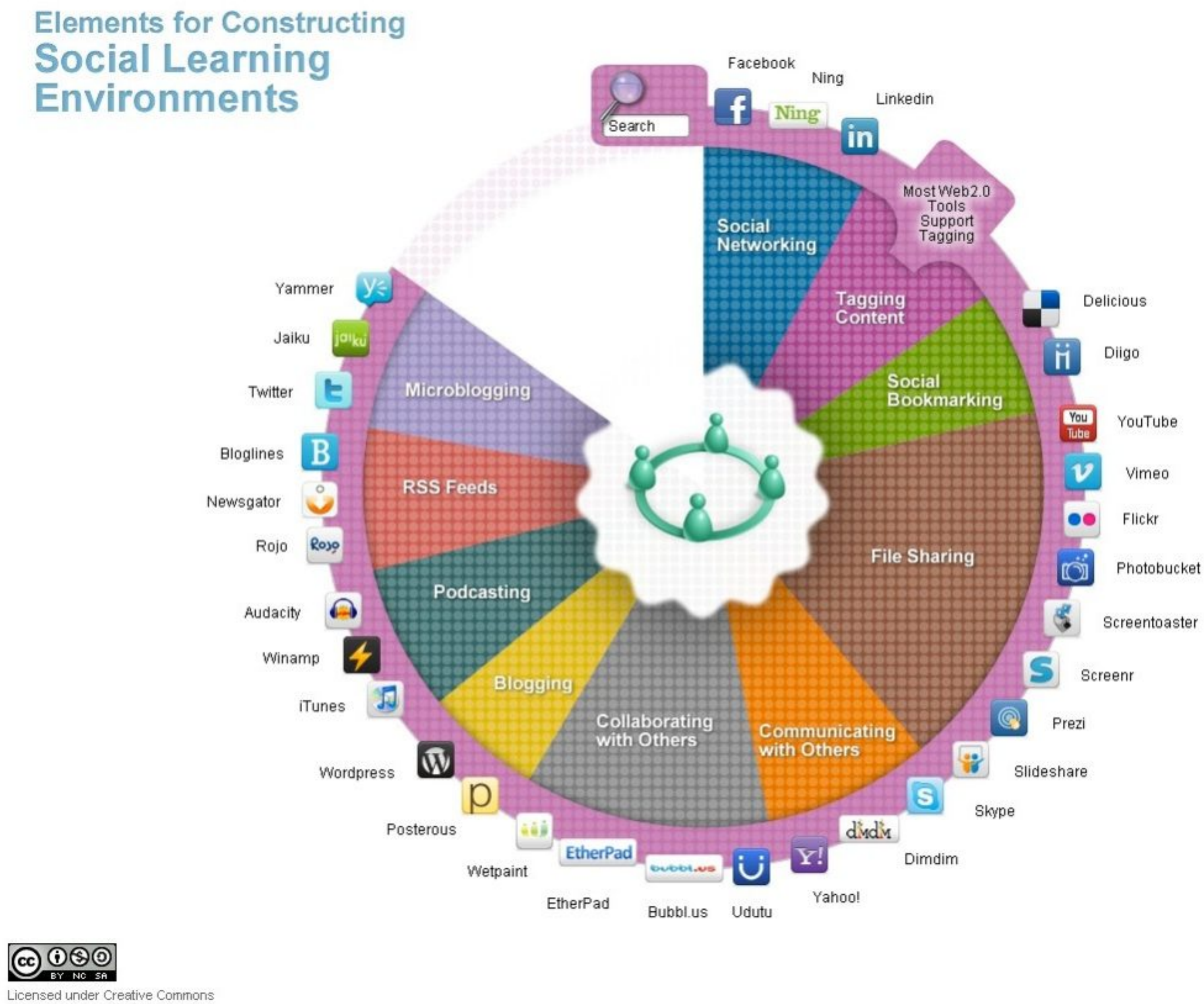

Figure 8.6.1 The range of social media in 2010
Image: © Abhijit Kadle, Upside Learning, 2010

Although social media are mainly Internet-based and hence a sub-category of computing, there are enough significant differences between educational social media use and computer-based learning or online collaborative learning to justify treating social media as a separate medium, although of course they are dependent and often fully integrated with other forms of computing. The main difference is in the extent of control over learning that social media offer to learners.

8.6.1 What are social media?

Around 2005, a new range of web tools began to find their way into general use, and increasingly into educational use. These can be loosely described as social media, as they reflect a different culture of web use from the former 'centre-to-periphery' push of institutional web sites.

Here are some of the tools and their uses (there are many more possible examples: click on each example for an educational application):

Type of tool	Example	Application
Blogs	Stephen's Web Online Learning and Distance Education Resources	Allows an individual to make regular postings to the web, e.g. a personal diary or an analysis of current events
Wikis	Wikipedia UBC's Math Exam Resources	An "open" collective publication, allowing people to contribute or create a body of information
Social networking	FaceBook LinkedIn	A social utility that connects people with friends and others who work, study and interact with them
Multi-media archives	Podcasts You-Tube Flikr e-portfolios MIT Open Course-Ware	Allows end users to access, store, download and share audio recordings, photographs, and videos
Multi-player games	RainbowSix Siege Dragonfly Propulsive Problematics	Enables players to compete or collaborate against each other or a third party/parties represented by the computer, usually in real time
Mobile learning	Mobile phones and apps, e.g. Soil TopARgraphy	Enables users to access multiple information formats (voice, text, video, etc.) at any time, any place

Figure 8.6.2 Examples of social media (adapted from Bates, 2011, p.25)

The main feature of social media is that they empower the end user to access, create, disseminate and share information easily in a user-friendly, open environment. Usually the only direct cost is the time of the end-user. There are often few controls over content, other than those normally imposed by a state or government (such as libel or pornography). One feature of such tools is to empower the end-user – the learner or customer – to self-access and manage data (such as online banking) and to form personal networks (for example through FaceBook). For these reasons, some have called social media the 'democratization' of the web, although at the same time one could argue that social media are now heavily commercialised through advertising.

In general, social media tools are based on very simple software, in that they have relatively few lines of code. As a result, new tools and applications ('apps') are constantly emerging, and their use is either free or very low cost. For a good broad overview of the use of social media in education, see Lee and McCoughlin (2011).

8.6.2 General affordances of social media

The concept of 'affordances' is frequently used in discussions of social media. McLoughlin & Lee (2011) identify the following 'affordances' associated with social media (although they use the term web 2.0) in general:

- connectivity and social rapport;
- collaborative information discovery and sharing;
- content creation;
- knowledge and information aggregation and content modification.

However, we need to specify more directly the unique pedagogical characteristics of social media.

8.6.3 Presentational characteristics

Social media enable:

- networked multimedia communication between self-organising groups of learners;
- access to rich, multimedia content available over the Internet at any time or place, as long as there is a suitable Internet connection;
- learner-generated multimedia materials;
- opportunities to expand learning beyond 'closed' courses and institutional boundaries.

8.6.4 Skills development

Social media,when well designed within an educational framework, can help with the development of the following skills (click on each to see examples):

- digital literacy: this web site was designed by the Library at the University of British Columbia to enable students to manage their digital identity;
- independent and self-directed learning: this is a Wiki built by UBC math graduate students to provide assistance to undergraduate students in their exams;

- collaboration/collaborative learning/teamwork; this was a class project to build Wikipedia entries on Latin American literature by a third year undergraduate class at UBC;
- internationalisation/development of global citizens;
- networking and other inter-personal skills;
- knowledge management; students at UBC use social media to research emerging technologies and build a possible educational business around the technology
- decision-making in specific contexts (for example, emergency management, law enforcement).

8.6.5 Strengths and weaknesses of social media

Some of the advantages of social media are as follows:

- they can be extremely useful for developing some of the key skills needed in a digital age, such as digital communication akills;
- they can enable teachers to set online group work, based on cases or projects, and students can collect data in the field using social media such as mobile phones or iPads;
- learners can post media-rich assignments either individually or as a group;
- these assignments when assessed can be loaded by the learner into their own personal learning environment or e-portfolios for later use when seeking employment or transfer to graduate school;
- learners can take more control over their own learning, as we have seen in connectivist MOOCs in Chapter 5 Section 3.2
- through the use of blogs and wikis, courses and learning can be thrown open to the world, adding richness and wider perspectives to learning.

However, many students are not, at least initially, independent learners (see Candy, 1991). Many students come to a learning task without the necessary skills or confidence to study independently from scratch (Moore and Thompson, 1990). They need structured support, structured and selected content, and recognized accreditation. The advent of new tools that give students more control over their learning will not necessarily change their need for a structured educational experience. However, learners can be taught the skills needed to become independent learners (Moore, 1973; Marshall and Rowland, 1993). Social media can make the learning of how to learn much more effective but still only in most cases within an initially structured environment.

The use of social media raises the inevitable issue of quality. How can learners differentiate between reliable, accurate, authoritative information, and inaccurate, biased or unsubstantiated information, if they are encouraged to roam free? What are the implications for expertise and specialist knowledge, when everyone has a view on everything? As Andrew Keen (2007) has commented, ‘we are replacing the tyranny of experts with the tyranny of idiots.’ Not all information is equal, nor are all opinions.

These are key challenges for the digital age, but as well as being part of the problem, social media can also be part of the solution. Teachers can consciously use social media for the development of knowledge management and the responsible use of social media, but the development of such knowledge and skills through the use of social media will need a teacher-supported environment. Many students look for structure and guidance in their learning, and it is the responsibility of teachers to provide it. We therefore need a middle ground between the total authority and control of the teacher, and the complete anarchy of the children roaming free on a desert island in the novel "Lord of the Flies" (Golding, 1954). Social media allow for such a middle ground, but only if as teachers we have a clear pedagogy or educational philosophy to guide our choices and use of the technology.

For more on social media, see Chapter 9, Section 8.

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Activity 8.6 Identifying the unique pedagogical characteristics of social media

1. Take one of your courses, and analyse how social media could be used in your course. In particular:
   - what new learning outcomes could the use of social media help develop?
   - would it be better just to add social media to the course or to re-design it around social media?
2. I have offered only a cursory list of the unique pedagogical characteristics of social media. Can you think of others that have not already been covered in this section?
3. How does this chapter influence your views on students bringing their own devices to class?
4. Are you (still) skeptical about the value of social media in education? What do you see as its downsides?

For feedback on some of these questions and some more general points about social media in education, click on the podcast below.

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8.7.a Emerging technologies: serious games and gamification

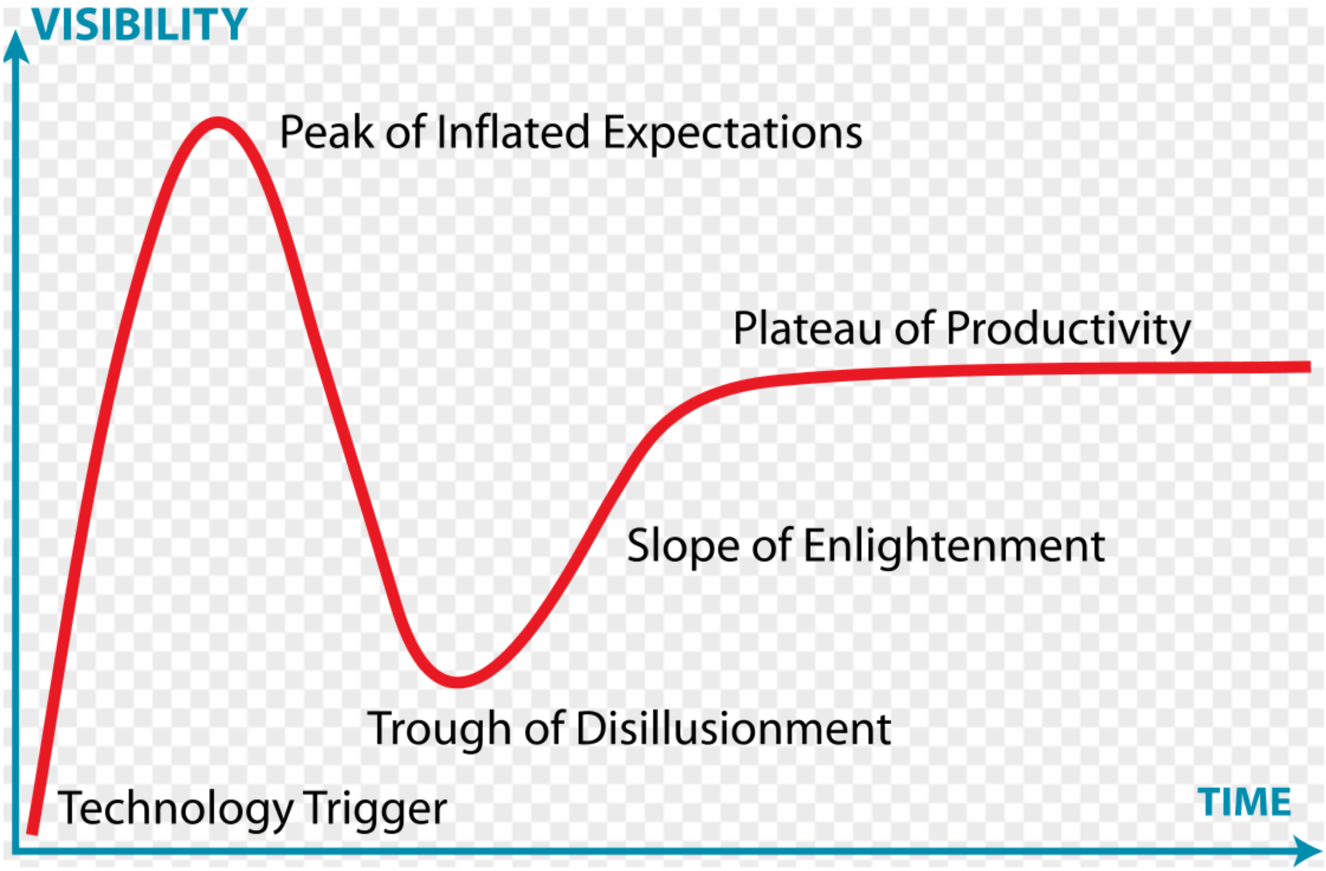

Figure 8.7a.1 The Gartner Hype Cycle for Emerging Technologies. Image: Wikimedia Commons, 2019

8.7a.1 The challenge of emerging technologies

It is not uncommon for a school principal, a college VP Education, or a university president to go to a conference and come back thrilled about the potential of the latest technology for teaching and learning. They are victims of what the consulting firm Gartner calls the hype cycle.

A new technology triggers excitement, the media picks up on it, the technology reaches a peak of inflated expectations, it starts to get more widely applied, disillusionment sinks in when faced with the realities of implementation, then the technology starts to find its niche as better understanding of its strengths and weaknesses emerge, eventually reaching a plateau of productivity, where it works well within its limits. MOOCs are an excellent example of this, with most knowledgeable observers in 2019 placing them towards the top of the slope of enlightenment or just emerging on to the plateau of productivity (see, for instance, Web Courseworks, 2018).

New technologies that have educational applications are constantly emerging. For instance in the first edition of this book (written in 2015) there was no extensive discussion of artificial intelligence, virtual reality or serious games, yet four years later they are now at the forefront of many discussions about the future of digital learning, which is why this section has been added. There are several other technologies that could be included, but many of these will be subsumed under artificial intelligence.

I will not be able to go into depth about any of these three technologies (each deserves its own book), but they are significant enough to bring them to your attention. Once again, I will focus on their potential affordances, although it must be recognised that with all emerging technology, it may take time to identify all their advantages and disadvantages.

8.7a.2 Serious games

Gartner's hype cycle is best considered as a way of thinking about emerging technologies, rather than as a factual representation of their development. For instance, serious games are more of a slow burner. There have never been vastly inflated expectations about their likely impact on education; indeed for a long time they have been written off as too expensive or not appropriate for serious education. However, that view has been changing in recent years.

8.7a.2.1 What are serious games?

There are several different definitions of serious games. I have included two definitions that cover both educational and corporate settings.

The Financial Times Lexicon offers the following definition:

> ***Serious games*** *are games designed for a purpose beyond pure entertainment. They use the motivation levers of game design – such as competition, curiosity, collaboration, individual challenge – and game media, including board games through physical representation or video games, through avatars and 3D immersion, to enhance the motivation of participants to engage in complex or boring tasks. Serious games are therefore used in a variety of professional situations such as education, training, assessment, recruitment, knowledge management, innovation and scientific research.*

Zhonggen (2019) provides this definition in his comprehensive review of the research on serious games:

> ***Serious games*** *are referred to as entertaining tools with a purpose of education, where players cultivate their knowledge and practice their skills through overcoming numerous hindrances during gaming.*

It is important to distinguish between serious games, game-based learning and gamification because of the differences in their purpose, approach and impact on learning.

- **Game-based learning** refers to *"the pedagogical approach of utilizing games in education"*

(Anastasiadis, Lampropoulos and Siakas, 2018)

- **Gamification** is defined as the *"use of game design elements in non-game contexts"* (Deterding et al., 2011)

Note that serious games are not necessarily digital. However, whether digital or not, they are governed by similar principles of of design, such as mechanics, dynamics and aesthetics (Hunicke et al., 2004).

8.7a.2.2 Why use serious games?

The main reasons offered for using games in education are to:

- improve students' motivation to learn,
- engage learners more deeply in the learning process,
- improve learning outcomes,
- improve attendance and participation.

However, an extensive review of the literature conducted by Dichev and Dicheva in 2017 found that research remains inconclusive on these assumptions. They also found that:

- the practice of gamifying learning has outpaced researchers' understanding of its mechanisms and methods;
- insufficient high quality evidence exists to support the long-term benefits of serious games in an educational context;
- a limited understanding that how to gamify an activity depends on the specifics of the educational context.

Dichev and Dicheva do conclude though that their study does not mean that gamification *cannot* be used successfully in a learning context; rather better designs and more research are needed.

Other research tends to be more positive. Hamari et al. (2016) and Clark et al. (2016) found sufficient evidence that, when well designed, and under the right conditions, serious games significantly enhanced student learning relative to nongame conditions.

Zhonggen (2019) found among the ' *huge number of findings in serious game assisted learning, most …are supportive, coupled with a few negative results*.' However, the main benefits tended to be in the affective domain (student 'happiness' and improved social learning and communication) rather than in immediately improved cognitive learning outcomes, except in science (improved retention and holistic understanding), architecture and medicine/health. In the latter, games helped children with autism to learn. Zhonggen reports:

'*Generally, … medical science has recently witnessed clearly more studies on serious game assisted learning compared with other fields and most of studies in medical science supported use of serious games*.'

8.7a.2.3 Examples of serious games

The Digital Education Strategies team (DES) at Ryerson University has participated in the development of several virtual games simulations including:

Games-based learning: Ryerson University's Academic Integrity office, in collaboration with DES, developed a digital learning game called Academic Integrity in Space to motivate students to complete self-study training and to learn about the academic integrity, values and behaviours expected of students. The game development team's objectives were to create a well-designed digital game to meet the learning objectives of making choices, learning by doing, and experiencing situations first-hand, through role-playing.

Figure 8.7a.2 Academic Integrity game, Ryerson University. Click on image to play game

Video Game Simulation: A Home Visit game promotes the application of knowledge and skills related to establishing a therapeutic nurse-client relationship and completing a mental health assessment. Students assume the role of a community health nurse assigned to complete a home visit. Video is used to create an authentic experience, and students have to respond to particularly challenging situations, based on procedures taught elsewhere in the course. Depending on the student response, further video segments are used to provide feedback and to continue to scenarios to test the next appropriate procedure. Professors from Centennial College, Ryerson University and George Brown College are developing a series of open access video game simulations through a virtual healthcare experience portal.

Figure 8.7a.3 Home visit video game, Ryerson University. Click on image to see video.

Gamification: Kyle Geske, an instructor at Red River College, Winnipeg, has developed a games-based approach to teaching web design. In his elective course on Full Stack Development of web sites, students have to design a project according to principles provided by the instructor. At each stage of the design process within the project students gain marks, and compete throughout the course with other students, who can see the marks at each stage for all the other students. A student can 'level up' their mark by going back and improving on each of the steps of the design. This approach has resulted in an increase in the average end of course grade compared to the more traditional classroom methods. Note this course involves elements of gaming, such as competition, and 'levelling up', without using games themselves.

8.7a.2.4 Designing serious games

Zhonggen's review of the literature (2018) highlighted the importance of the following in effective games design:

- backstory and production,
- realism,
- artificial intelligence and adaptivity,
- interaction,
- feedback and debriefing,

- ease of use,
- surprises.

As a result of this prior research, and under the leadership of Naza Djafarova, the Digital Education Strategies team (DES) at the G. Raymond Chang School for Continuing Education at Ryerson University in Toronto developed a practical design guide (2018) for serious game-based learning, based on a games research process. This guide is an open educational resource and is designed to serve three purposes:

- provide a conceptual framework to guide game design within multidisciplinary teams in higher education;
- offer a methodological guide to running a participatory workshop focused on the pre-production phase of the game development process;
- share resources by making the guide and the design of the workshop available as open educational resources.

The games design methodology is an adaptation of the Design, Play, and Experience (DPE) Framework, developed by Winn (2009). The game development process consists of three phases:

- the **pre-production phase**, during which brainstorming among team members takes place, leading to the design of a paper prototype of the game;
- the **production phase**, when the game is developed; and
- the **post-production phase**, during which the game is tested and refined before being offered to learners.

The Digital Education Strategies team utilized the Design, Play and Experience model to identify four essential educational game elements:

- **Learning** refers to the content to be learned by players through the game with specific and measurable learning outcomes;
- **Storytelling** refers to the background story of the game and includes a description of the character(s), the setting, and the ultimate goal of the game;
- **Gameplay** refers to the way in which the player interacts with the game, or with other players (if a multiplayer game). It encapsulates the type of activity (e.g., puzzle, trivia, etc.) found in the game;
- **User Experience** refers to the player's emotions and attitudes while playing the game, as well as how the player interacts with the game.

Figure 8.7a.4 provides a more detailed representation of the various components of the Ryerson serious game design methodology.

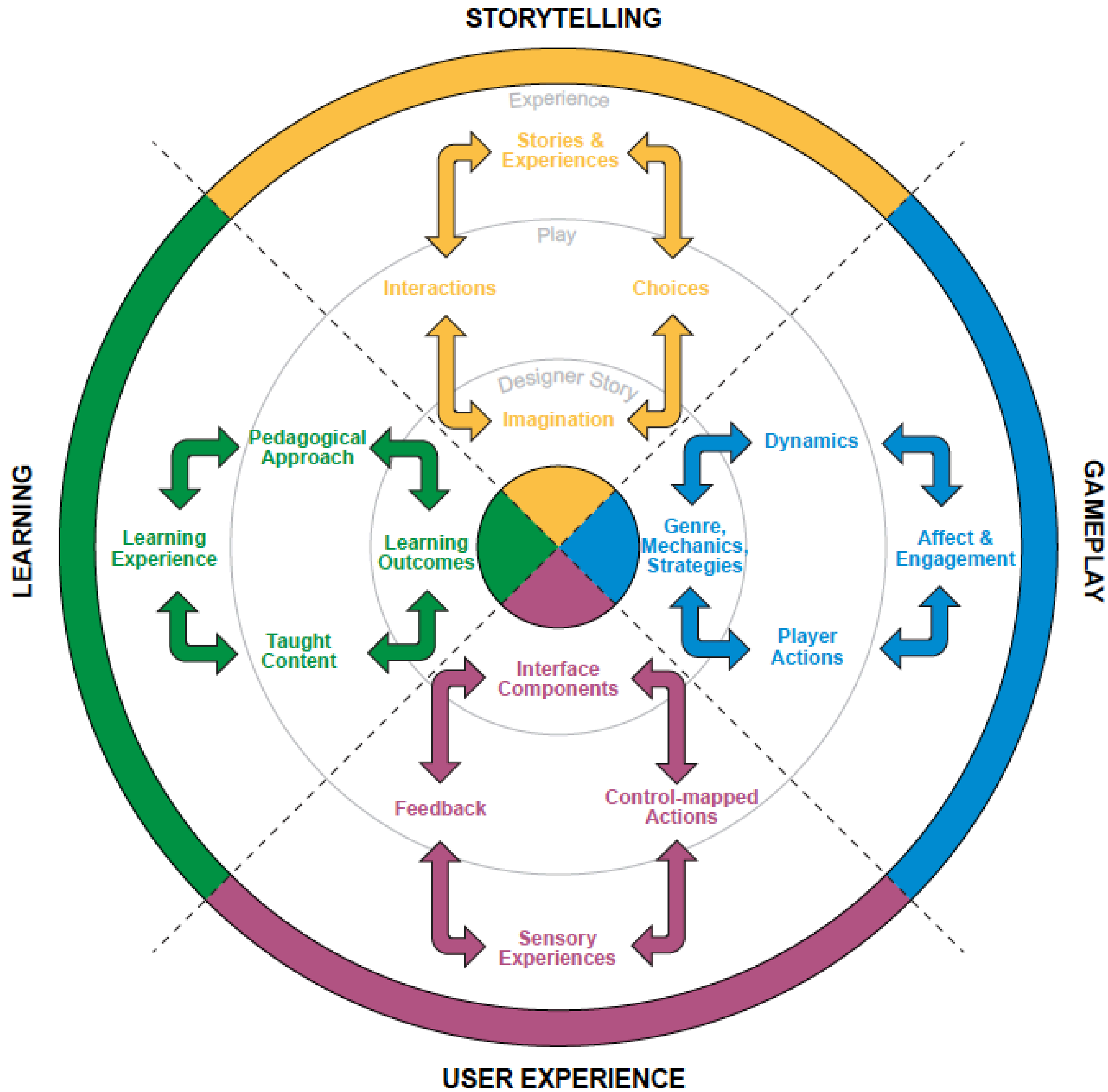

Figure 8.7a.4 Serious game design methodology, from Djafarova er al., 2018

The Digital Education Strategies' report suggests a workshop approach to serious games design, in which all the key stakeholders (content experts, instructional designers, media producers, and so forth) are involved. Brainstorming in the early stages of design is considered essential. Also built into the design is testing and user feedback before releasing the game.

There are probably other effective design approaches, but the above approach highlights the essential multi-disciplinary approach of serious games design.

8.7a.2.5 Unique educational characteristics of serious games

These still need to be clearly identified and validated, but two rather different claims are made for serious games:

- the first is that they can increase student motivation and engagement;

- the second is that games can be particularly useful for developing the following skills:
    - problem solving
    - communication skills
    - decision-making

within specific contexts that approximate to the real world.

8.7a.2.6 Strengths and weaknesses

In terms of the hype cycle, serious games are somewhere along the slope of enlightenment. There is not the research yet to move them into the plateau of productivity, but there is enough evidence from practice that they are gaining traction in education.

However, there are a number of reasons why serious games have not become more prevalent in education. The first is philosophical. There is resistance to the idea of games because some see serious games as an oxymoron. How can a game be serious? Many instructors fear that learning could easily be trivialised through games or that games can cover only a very limited part of what learning should be about – it can't all be fun; that is not the purpose of education. Similarly, many professional game designers are not interested in developing serious games because they fear that if the primary goal is learning and not enjoyment, a focus on education risks killing the main element of a game: being fun to play.

A more pragmatic reason is cost and quality. The assumed high cost of video games has so far acted as a deterrent in education. There is no obvious business plan to justify the investment. The best selling video games for entertainment for instance cost millions of dollars to produce, on a scale similar to mainstream movies. If games are produced cheaply, won't the quality – in terms of production standards, narrative/plot, visuals, and learner engagement – suffer, thus making them unattractive for learners?

However, probably the main reason serious games are not more prevalent in education is that most educators simply do not know enough about serious games: what exists, how they can be used, nor how to design them. Experience suggests that there are many possible and realistic applications for serious games in education. There is some evidence (see for instance, Arnab, 2014) that effective serious games can be developed at very little cost.

Nevertheless, there is always a high degree of risk in serious games design. There is no sure way of predicting in advance that a new game will be successful. Some low-cost simple games can work well; some expensively produced games can easily flop. This means careful testing and feedback during development. So serious games should be more seriously considered for teaching in a digital age – but their application needs to be done carefully and professionally.

Thus serious games are a relatively high risk, high return activity for teaching in a digital age. Success in serious games means building on best practices in games design, both within and outside education, sharing costs and experience, and collaboration between institutions and games development teams. However, as teaching in a digital age moves more and more towards high-level skills development, experiential learning, and problem-solving in real world contexts, serious games are bound to play an increasingly important role.

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Activity 8.7a Using and designing seriou games

1. What are your views on serious games and gamification? Do you think they are useful approaches to teaching in a digital age, or are they just a gimmick that avoids the real challenges of learning, especially at a higher education level?
2. Take a look at the Ryerson University's 'Art of Serious Games Design'. Is this a model that could be used at your institution? Who would lead this effort? With what learning goals or outcomes could this process help in your program? What would be the main barrier to doing this?
3. What other approaches could be taken to getting serious games used in your teaching?

Click on the podcast below for feedback on this activity.

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8.7.b. Emerging technologies: virtual and augmented reality

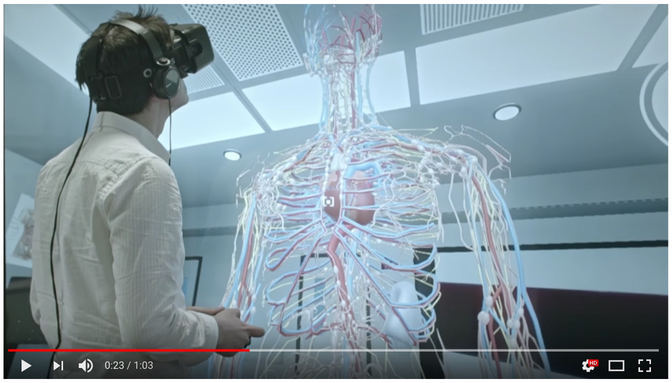


Figure 8.7.b.1 Video by Atelier 101. Click on image to see video

As with serious games, virtual and augmented reality are technologies that have been around for some time while making a relatively small impact on education in their earlier development. However more recent technological developments that have moved virtual worlds from two-dimensions (such as Second Life) into three-dimensional, deeply immersive environments have brought more attention to their potential in education (for a good overview of the history and potential of augmented and virtual reality in education, see Elmqadden, 2019).

8.7b.1 What are virtual/augmented/mixed reality?

A simple definition of these technologies is '*human immersion in a synthetic world*' (Seidel and Chatelier, 1997). The Franklin Institute provides the following more detailed definitions that attempt to distinguish between the different types of 'synthetic' worlds:

> ***Augmented reality (AR)*** *adds digital elements to a live view often by using the camera on a smartphone. Examples of augmented reality experiences include Snapchat lenses and the game Pokémon Go.*
>
> ***Virtual reality (VR)*** *implies a complete immersion experience that shuts out the physical world. Using VR devices such as HTC Vive, Oculus Rift or Google Cardboard, users can be transported into a number of real-world and imagined environments such as the middle of a squawking penguin colony or even the back of a dragon.*
>
> *In a* ***mixed reality (MR)*** *experience, which combines elements of both AR and VR, real-world and*

digital objects interact. Mixed reality technology is just now starting to take off, with [Microsoft's HoloLens] one of the most notable early mixed reality apparatuses.

I will use the term 'immersive technologies' for all these technologies. However, verbal descriptions will always be somewhat inadequate in describing what are essentially multi-sensory experiences, combining vision, hearing and movement. These technologies are something that need to be experienced rather than explained if they are to be better understood.

8.7b.2 Why use immersive technologies?

There are several reasons why these technologies are beginning to be used more in education:

- the recent development of relatively low cost and easily wearable end-user technology (headsets in particular);
- deep immersion into three-dimensional, highly realistic learning environments that are strongly compelling/motivating for the end user;
- the ability for end users to manipulate objects within the three dimensional environment;
- more powerful cloud computing technology that allows for the development of more complex and more realistic learning environments, combined with more advanced developments in mobile technologies and high-speed wireless networks;
- the potential for developing a range of skills and knowledge that would be difficult, impossible or dangerous in real-world environments.

8.7b.3 Examples of immersive environments in education

Looking at the challenges above, it may be wondered why anyone would bother with immersive technologies in education. However, the potential benefits have barely been explored. I provide examples here that demonstrate both the potential benefits and how some immersive environments can be developed relatively easily.

8.7b.3.1 Virtual reality

In the Department of Chemistry at the University of Bristol in England, Dr. David Glowacki and his team in their VR laboratory created an interactive molecular dynamics modelling tool in the form of Nano Simbox VR, which allowed anyone to visit and play within the invisible molecular world (O'Connor et al., 2018). The main aim of this particular project was to provide an intuitive feeling of the way molecules operate in multiple dimensions to enable researchers and students to have a better understanding of how nano worlds operate, leading to better hypotheses for testing within this particular domain.

As the authors state in the article:

> *From a modeling perspective, the nanoscale represents an interesting domain, because the objects of study (for example, molecules) are invisible to the naked eye, and their behavior is governed by physical forces and interactions significantly different from those forces and interactions that we encounter during our day-to-day phenomenological experience. In domains like this, which are imperceptible to the naked*

eye, effective models are vital to provide the insight required to make research progress….molecular systems typically have thousands of degrees of freedom. As a result, their motion is characterized by a complicated, highly correlated, and elegant many-body dynamical choreography, which is nonintuitive compared to the more familiar mechanics of objects that we encounter in the everyday physical world. Their combined complexity, unfamiliarity, and importance make molecules particularly interesting candidates for investigating the potential of new digital modeling paradigms.

Glowacki and his team in Science Advances (O'Connor et al., 2018) describe how the VR app enabled researchers to:

- easily "grab" individual C_{60} atoms and manipulate their real-time dynamics to pass the C_{60} back and forth between each other.
- take hold of a fully solvated benzylpenicillin ligand and interactively guide it to dock it within the active site of the TEM-1 β-lactamase enzyme (with both molecules fully flexible and dynamic) and generate the correct binding mode (33), a process that is important to understanding antimicrobial resistance
- guide a methane molecule (CH_4) through a carbon nanotube, changing the screw sense of an organic helicene molecule,
- tie a knot in a small polypeptide [17-alanine (17-ALA)

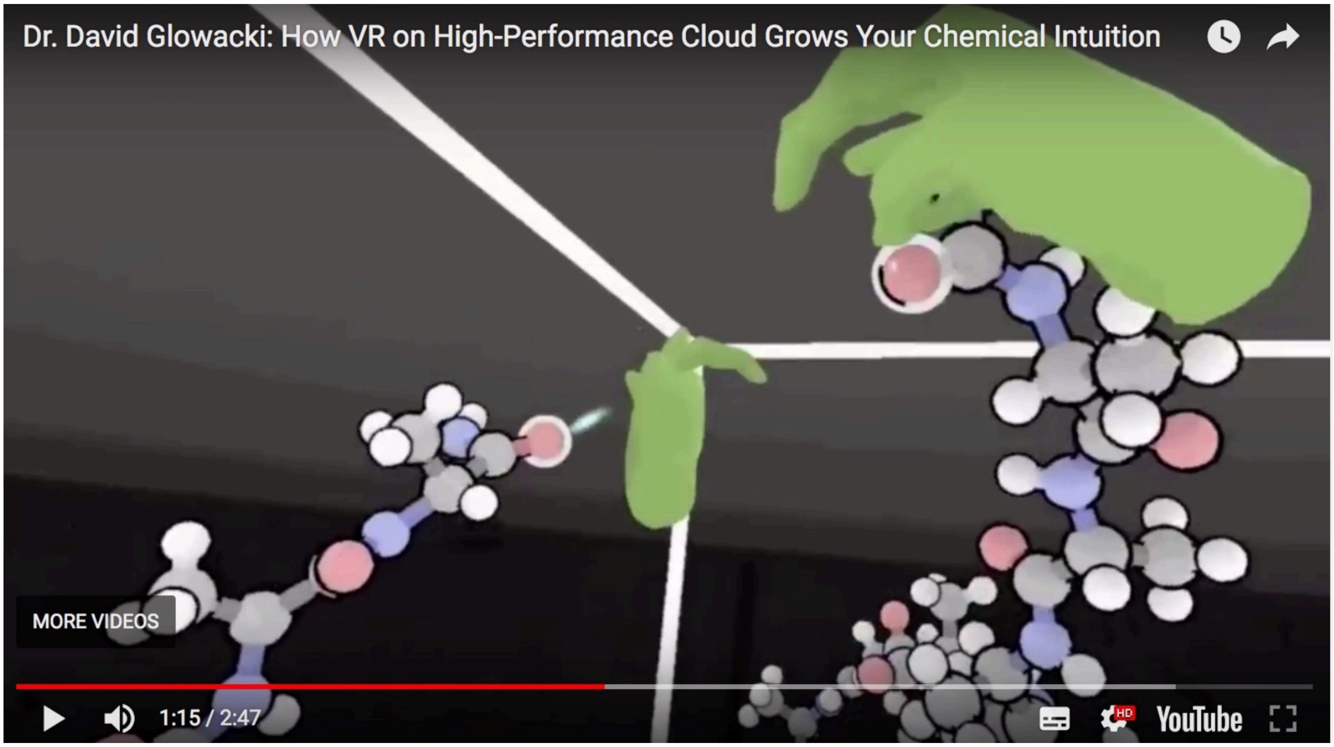


Figure 8.7b.2 The use of virtual reality to foster chemical intuition Dr. David Glowacki, University of Bristol. Click on the image to see the video.

Building dynamic models that operate not only in real time but also in three dimensions can require not only specialized virtual reality equipment, but more importantly massive amounts of computing power to handle the visual representation and modelling of highly complex, interactive dynamic molecular processes. However, through the use of cloud computing and faster networks, building such models has now become a reality, enabling not only such models to be represented but allowing some degree of real-time manipulation by researchers in different locations but within the same time-frame. The main advantage of the use of a cloud platform is to allow the scaling up of modelling from simple to much more complex dynamic nano interactions and the synchronous sharing of the virtual reality experience with multiple users.

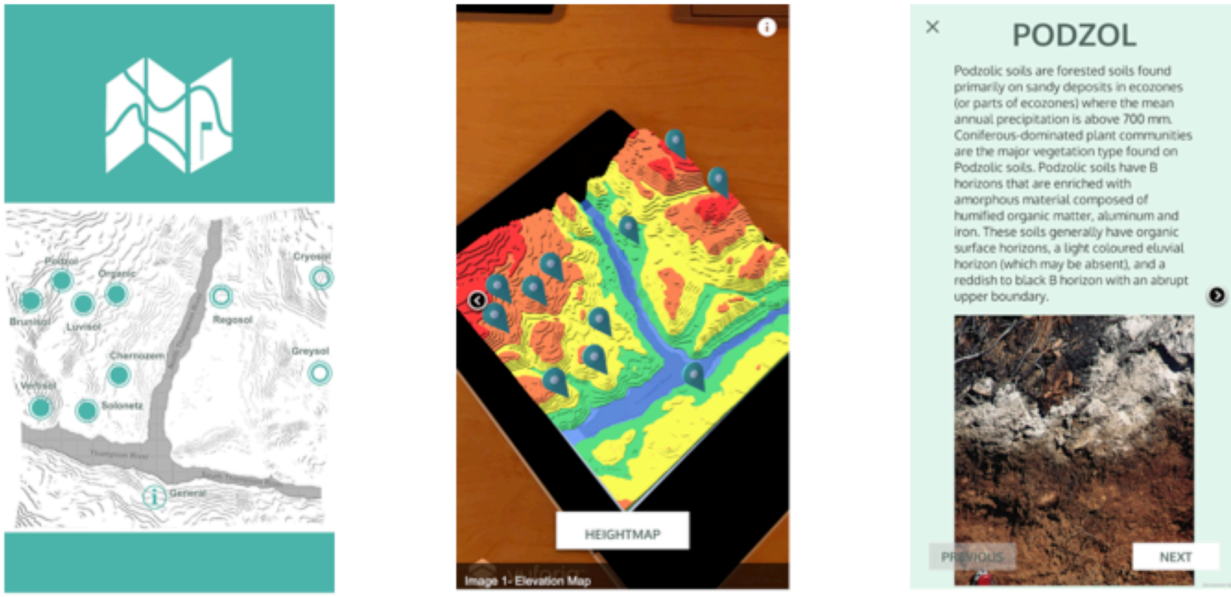
Not all applications of VR though need massive computing power. Other exploratory uses of virtual reality are

- for students to find their way round a complex campus
- in architecture/space planning, allowing clients to understand in three dimensions the final 'look' of a building design by virtually walking through it (Brandaõ et al., 2018), Google Blocks, a free software program for developing 3D models, is one tool that can support this kind of application.
- in music: at the University of British Columbia, Dr. Jonathon Girard is exploring the use of VR for learning how to conduct an orchestra (the virtual orchestra 'responds' to the hand gestures of the conductor)
- in medicine and health: researchers at UBC are exploring the use of VR for pain management

8.7b.3.2 Augmented reality

Augmented reality is a simpler immersive technology than virtual reality, often based on apps for mobile phones. For instance, students in the University of British Columbia's APBI 200 Introduction to Soil Science learn about the effects of topography on the formation of different soil types. The department has developed the Soil TopARgraphy app, which allows viewing and manipulating a terrain model in the Kamloops region of British Columbia. Students learn how topography impacts the distribution of soil orders through its effects on microclimate (i.e. temperature and water). Students are able to view the terrain model with a color-coded elevation map or a satellite image on their mobile phones. Furthermore, students can tap on flags to read about different soil orders, view images, and take a self-study quiz to reinforce their understanding.

For this project, UBC's Emerging Media Lab built two mobile apps, an AR viewer for students (Android and iOS) and an editor for the instructor (Android). The AR viewer is the app described above to view a predefined terrain. The instructor can customize contents with the supplementary editor app. They can update soil location on terrain, description, image, and quizzes



Target map Height map Information box

Figure 8.7.c.3 Screen images from Soil TopARgraphy

Other examples of AR applications from UBC:

- Dr. Patrick Walls is developing a mobile phone-based app that helps students visualise multivariable functions, in order to learn the underlying concepts at a deeper level much more quickly.
- in GEOG 498: Geographies in the Middle East, students learn about the history of the Syrian Civil War and its ongoing developments. The instructor, Dr. Siobhán McPhee, has developed a mobile app that follows the stories of five Syrian refugees who eventually reached Vancouver. Students are forced to make choices (or given a lack of choice), wait, and run/walk with the app to be able to progress the narrative of the experience. The purpose of this project is to evoke empathy and help students understand the emotional consequences of the Syrian Civil War. This app also applies some gamification principles as well.

8.7b.4 Designing immersive educational environments

This technology is so recent that there are few or no accepted best practices developed yet for educational use. Most educational applications to date have been deliberately exploratory in nature. However, there are several stages of development required that will apply to all educational applications of these technologies:

- identify start-up costs and possible sources of funding: this is not likely to be a cheap exercise, at least initially; for this reason, several universities, such as the University of British Columbia, and Drexel University, have set up their own emerging technologies research labs to experiment with educational applications;

- define learning outcomes/objectives: what is the learner expected to learn? In the early stages of development this may be both a brainstorming exercise (preferably including students/end-users) and an iterative process, because the full potential of the technology is not always clear in first applications. In particular, the instructor needs to have a clear vision of what might be possible using an immersive technology. Thus some familiarity with the technology is essential before starting design;
- determine where the use of this technology fits within the overall design of a course/program: in other words, what knowledge and skills will be developed within the immersive environment, and how does this integrate with what is being taught in the rest of the course/program?
- decide between using an existing immersive design/learning environment that can be applied or adapted relatively easily for 'local' use; or designing a new immersive environment from scratch. The latter is obviously more expensive and time-consuming and will require a high level of expertise; as a result the pay-off from design from scratch (improved learning outcomes/return on investment) needs to be worth the effort;
- choice of appropriate/affordable technology. Headsets or mobile apps are the least expensive part of the use of immersive technologies. The main cost will be in developing or adapting the 'augmented' or 'virtual' world. However, as with serious games, there can be an intermediary step, where an existing 'world' can be licensed and adapted for local use (see for instance, Lightwave). In some cases, open access immersive worlds are available for use or adaptation, although they are not common (see OpenSimulator, Art of Illusion, or MayaVerse, for examples.). Often students can be used to help with programming and design of the environment, as part of their studies, but they will need direction as well as the opportunity to offer creative ideas. Truly interactive virtual worlds where learners/users make decisions and the consequences are 'programmed' into the learning environment may require large amounts of computing capacity, such as cloud computing;
- to be effective, the VR environment has to be as authentic or realistic as possible. This means paying as much attention to creating the specific learning context. It will be necessary to decide what parts of the learning will best be done outside the VR/AR experience, and which inside. For instance, the procedures for monitoring the state of a nuclear reactor, for identifying critical incidents, for deciding whether or not or when to shut down the reactor, and for actually shutting down the reactor must also be built in to the learning process. Most of this may be taught outside the VR context, but VR can be used to test or develop the skills of applying this knowledge in a realistic, challenging context. In other words, the VR experience needs to be embedded within a broader learning context or environment;
- testing and adaptation: design, at least initially, needs to be an iterative process, where ideas are developed and tried, and feedback received and incorporated into the design;
- assessment: this can be a particular challenge, particularly if new learning outcomes result from the experience. How can assessment best capture what students have learned? Will assessment take place within the 'virtual' world, in the real world, or in some other way (and if so, how authentic will such an assessment be)?

- in what ways could the new immersive environment be scaled up to enable costs to be recovered?
- evaluation: what is the best way to evaluate the success or limitations of the design and application of the immersive world? How best to disseminate the knowledge and experience gained?

These may appear formidable challenges, but the potential benefits could be considerable.

8.7b.5 The unique characteristics of immersive technologies

The development of fully immersive technologies is so recent that it is premature to try to identify all the educational affordances that are unique to this medium. New applications are being explored all the time. Most of the evidence is qualitative, based on people's personal experience of using the technology. Empirical evidence that validates specific educational affordances of VR/AR in terms of improved learning outcomes is currently lacking. However, the *potential* of VR/AR in terms of assisting learning can be identified.

First of all, many of the affordances or educational characteristics of other media, and in particular video, will apply to VR and AR, but often more intensely, because of the immersive experience.

Virtual and augmented reality applications can provide students with a deep, intuitive understanding of phenomena that are otherwise difficult if not impossible to achieve in other ways. This enables students who often struggle with the abstract nature of an academic subject to understand in more concrete terms what the abstractions mean or represent. This intuitive understanding is critical not only for deeper understanding but also for breakthroughs in research and applications of science.

Educational applications where the cost of alternative or traditional ways of learning are too expensive or too dangerous, will be particularly suitable for virtual reality applications. Examples might be emergency management, such as shutting down an out-of-control nuclear reactor, or defusing a bomb, or managing a fire on an oil tanker, or exploring inside the physical structure of a human brain. In particular, VR would be appropriate for learning in contexts where real environments are not easily accessible, or where learners need to cope with strong emotions when making decisions or operating under pressure in real time.

AR, which is often easier to design and implement, enables learners to practice applications of knowledge in semi-realistic contexts.

However, at the time of writing we are just beginning to understand the potential of this medium. Over time, the educational affordances of this medium will become much clearer.

8.7b.6 Strengths and weaknesses

VR is not just a fad that will disappear. There are already a large number of commercial applications, mainly in entertainment and public relations, but also increasingly for specific areas of education and training. There is already a lot of excellent, off-the-shelf software for creating VR environments, and the cost of hardware is dropping rapidly (although good quality headsets and other equipment are still probably too expensive for required use by large numbers of students).

The fields of application of this technology are unlimited: training in the use of complex equipment, simulation of surgical procedures, architectural design testing, the reconstruction of sites in archeology, virtual museum visits, treatment of pain and phobias, and many other possibilities.

To enable the more emotional aspects of decision making to be handled, the immersive experience needs to be realistic. This will probably require high quality media production. Thus VR may often need to be combined with simulation design, quality media production and powerful computing to be educationally effective, again pushing up the cost. For these reasons, medicine is a particularly likely area for development, where traditional training costs are really high or where training is difficult to provide with real patients.

Once again, though, applications will tend to be very specific to the needs of a particular subject area. This means designers must include subject specialists with a deep understanding of the field who can combine the power of the technology with the needs of learners in a particular learning context. VR in particular requires instructors with imagination and creativity, working with other professionals such as media producers, learners themselves, as well as specialists in VR design.

What has inhibited widespread educational use of earlier two-dimensional VR developments such as Second Life has been the high cost and difficulty of creating the graphics and contexts for learning. Thus even if the hardware and software costs for VR are low enough for individual student use, the high production costs of creating realistic educational contexts and scenarios are likely to inhibit its general use.

Some caution is also needed in assuming that people will behave the same in real life as they do in VR environments. Gallup et al. (2019) found a major difference in the influence of social factors within real-world and virtual environments: social cues in actual reality appear to dominate and supersede those in VR. One of the authors, Alan Kingstone, concluded:

> *"Using VR to examine how people think and behave in real life may very well lead to conclusions that are fundamentally wrong. This has profound implications for people who hope to use VR to make accurate projections regarding future behaviours. For example, predicting how pedestrians will behave when walking amongst driverless cars, or the decisions that pilots will make in an emergency situation. Experiences in VR may be a poor proxy for real life."*
>
> Rolfsen, 2019

This means we need more experimentation. This is still a relatively new technology, and there may be very simple ways to use it in education that are not costly and meet needs that cannot be easily met in traditional teaching or with other existing technology. For this to happen, though, educators, software developers, and media producers need to come together to play, experiment, test and evaluate.

Nevertheless, VR and AR are exciting technologies with the potential to change radically conventional learning processes.

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Activity 8.7.b Using and designing VR and AR

- Go to YouTube and type in Virtual Reality in the search box (I found about 20 examples). Do any of these videos suggest a way in which VR could be used in the area in which you are teaching (assuming that the resources were available)?
- What are the advantages of VR over video? What can it do educationally that would be more difficult to do using video?
- Your head of department has just come back from a conference and has seen a demonstration of VR. He is very excited and wants the department to 'become the leader in the state in the use of VR for teaching.' What questions would you ask of him? (Assume you will still keep your job afterwards!)

Click on the podcast below for my feedback and my personal views on VR for teaching and learning.

An audio element has been excluded from this version of the text. You can listen to it online here: https://pressbooks.bccampus.ca/teachinginadigitalagev2/?p=1544

8.7c Emerging technologies: artificial intelligence

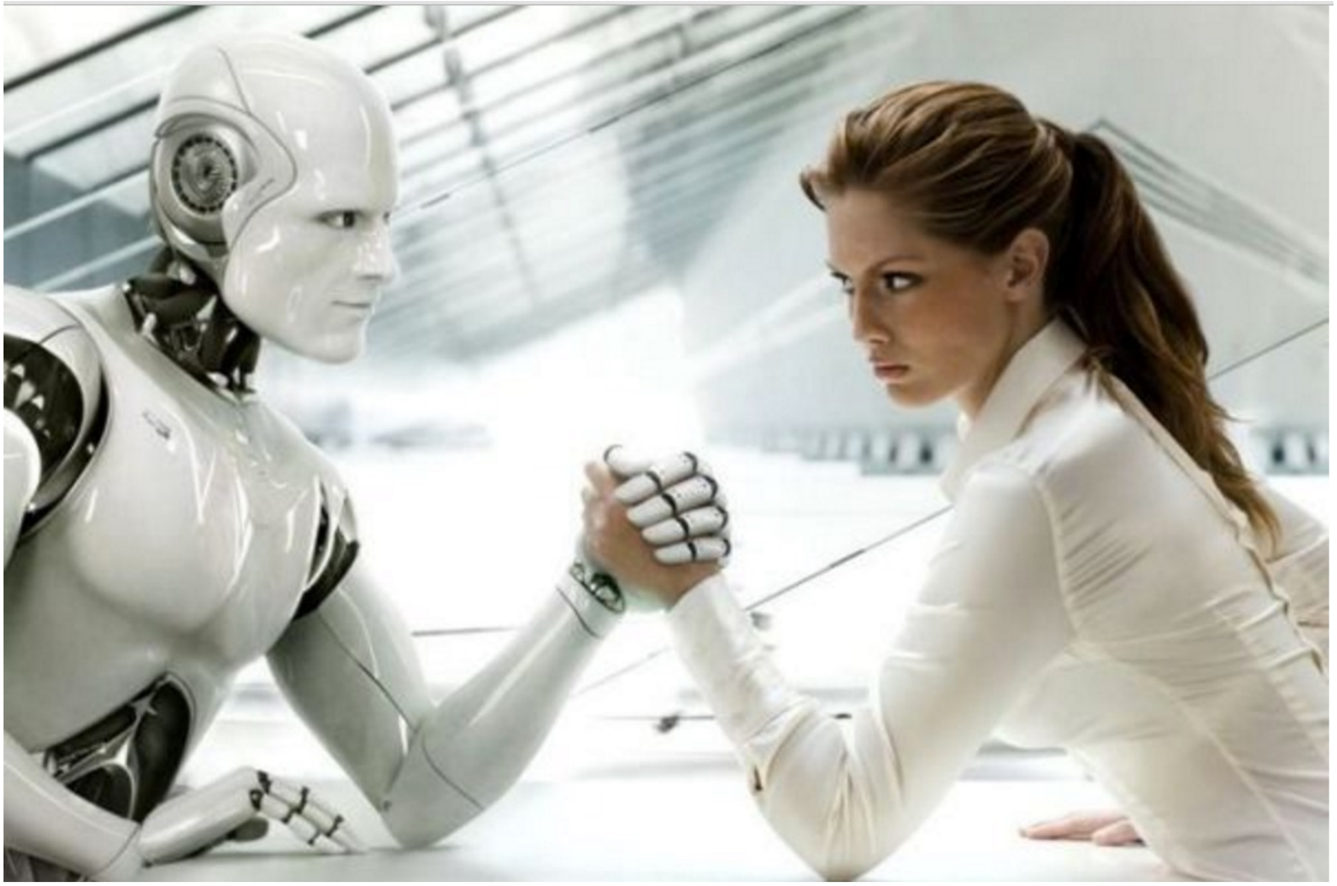

Figure 8.7c.1 Image: Applift

8.7c.1 Focusing on AI's affordances for teaching and learning

Artificial intelligence (AI) is a daunting topic as there are so many issues with respect to its use in education. AI is also currently going through yet another period of extreme hype as a panacea for education, currently being at the top of the peak of inflated expectations, but this hype is driven mainly by successful applications outside the field of education, such as in finance and marketing. Furthermore the term 'AI' is increasingly being used (incorrectly) as a general term for any computational activity.

Even in education, there are very different possible areas of application of AI. Zeide (2019) makes a very useful distinction between institutional, student support and instructional applications (Figure 8.7.c.2 below).

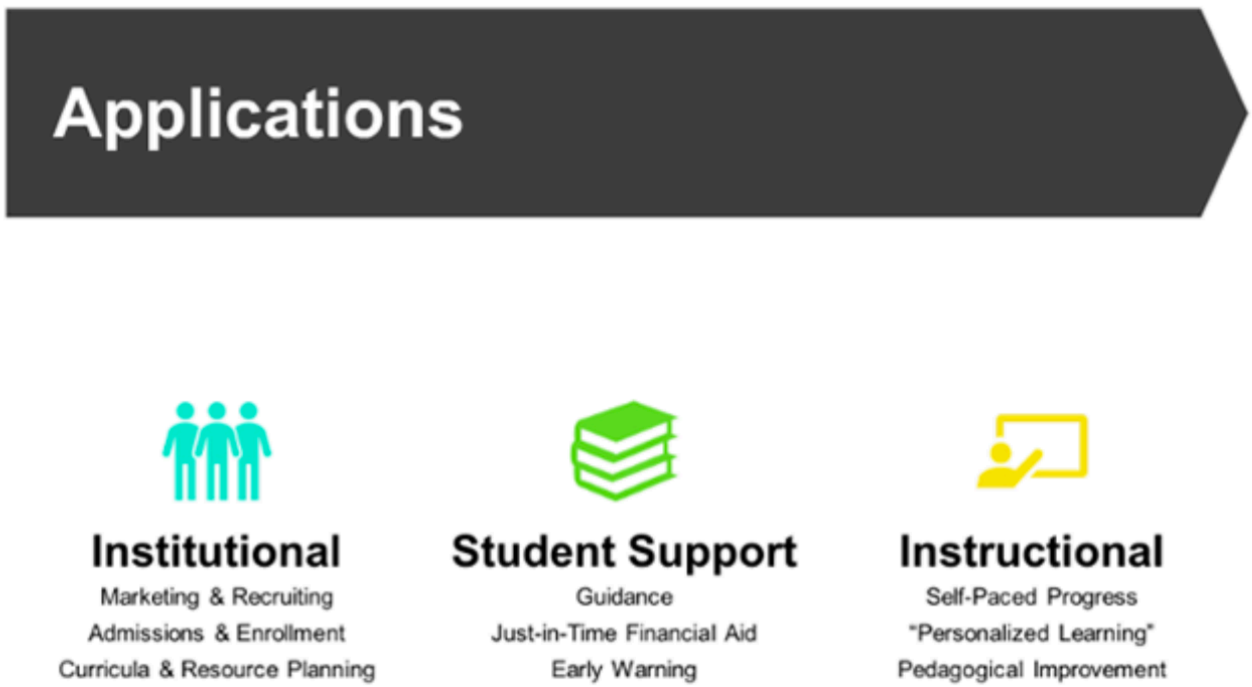

Figure 8.7c.2 AI applications in education Image: © Zeide, 2019

Although AI applications for institutional or student support purposes are very important, this chapter is focused on the pedagogical affordances of different media and technologies (what Zeide calls 'instructional' applications). In particular, the focus in this section will be on the role of AI as a form of media or technology for teaching and learning, its pedagogical affordances, and its strengths and weaknesses in this area.

Moreover, AI is really a sub-set of computing. Thus all the general affordances of computing in education set out in Section 5 of this chapter will apply to AI. This section aims to tease out the extra potential that AI can offer in teaching and learning. This will mean particularly focusing on its role as a medium rather than a general technology in teaching, which means looking at a wider context than just the computational aspects of AI, in particular its pedagogical role.

8.7c.2 What is artificial intelligence?

The original definition of artificial intelligence by McCarthy (1956, cited in Russell & Norvig, 2010) is:

> *every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves.*

Zawacki-Richter et al. (2019), in a review of the literature on AI in higher education, report that those authors that defined artificial intelligence tended to describe it as:

> *intelligent computer systems or intelligent agents with human features, such as the ability to memorise knowledge, to perceive and manipulate their environment in a similar way as humans, and to understand human natural language.*

Klutka et al. (2018) also define AI in terms of what it can do in higher education (Figure 8.7.c.3 below):

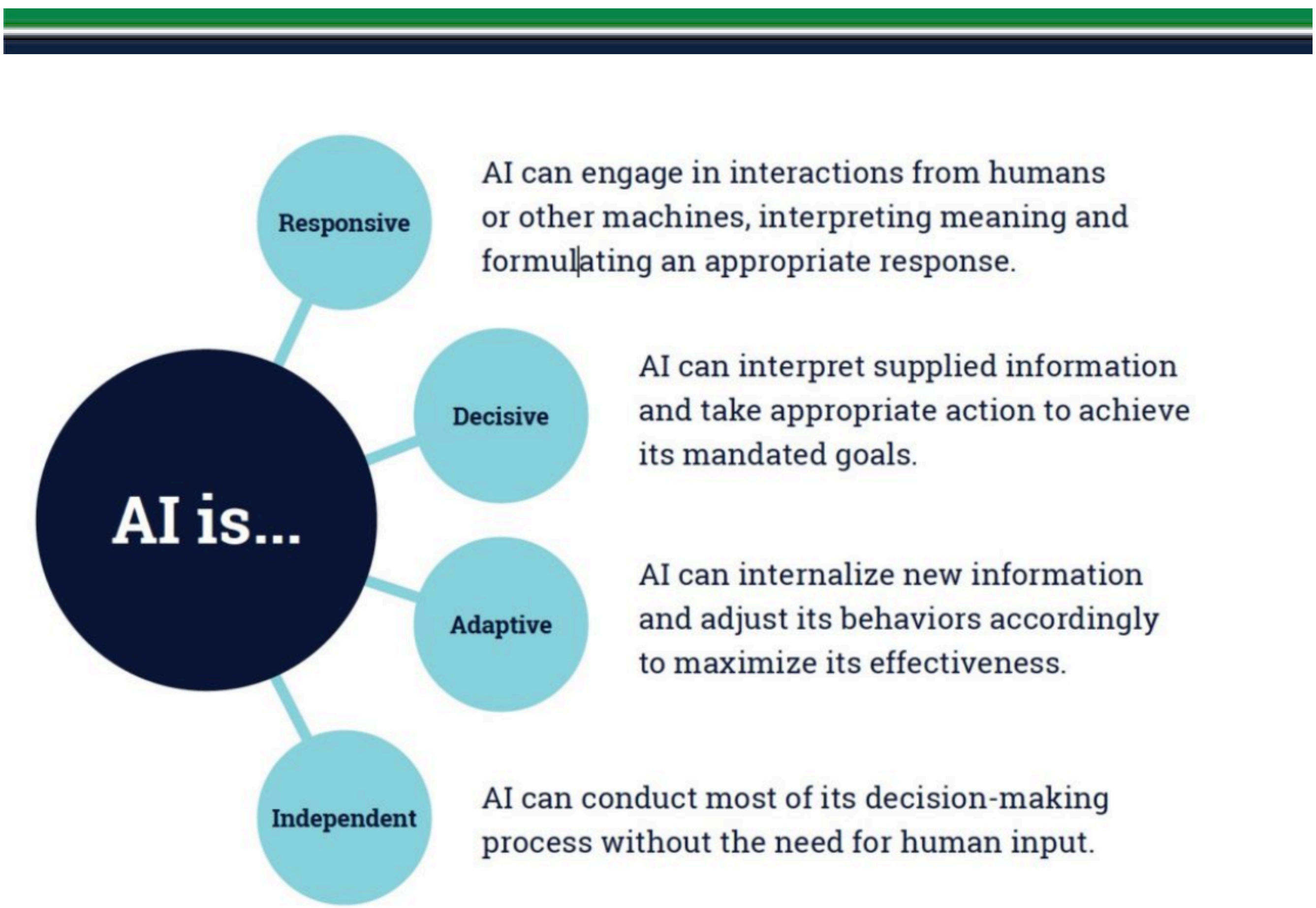

Figure 8.7.c. 3 What AI can do in education Image: Klutka et al. (2018)

There are three basic computing requirements that set 'modern' AI apart from other computing applications:

- access to massive amounts of data;
- computational power on a large scale to manage and analyze the data;
- powerful and relevant algorithms for the data analysis.

8.7c.3 Why use artificial intelligence for teaching and learning?

There are two somewhat different goals for the general use of artificial intelligence. The first is to increase the efficiency of a system or organization, primarily by reducing the high costs of labour, namely by replacing relatively expensive human workers with relatively less costly machines (automation). In education in particular, the main cost is that of teachers and instructors. Politicians, entrepreneurs and policy makers increasingly see a move to automation as a way of reducing the costs of education.

The second is to increase the effectiveness of teaching and learning, in economic terms to increase outputs: better learning outcomes and greater benefits for the same or more cost. With this goal, AI would be used alongside or supporting teachers and instructors.

Klutka et al. (2018) provide a general statement of the potential of AI in higher education 'instruction' through Figure 8.7c.4:

Figure 8.7c.4 Goals for AI in higher education instruction Image: Klutka et al. (2018)

These are understandable goals, but we shall see later in this section that such goals to date are mainly aspirational rather than real.

In terms of this book, a key focus is on developing the knowledge and skills required by learners in a digital age. The key test then for artificial intelligence is to what extent it can assist in the development of these higher level skills.

8.7c.4 Affordances and examples of AI use in teaching and learning

Zawacki-Richter et al. (2019) in a review of the literature on AI in education initially identified 2,656 research papers in English or Spanish, then narrowed the list down by eliminating duplicates, limiting publication to articles in peer-reviewed journals published between 2007 and 2018, and eliminating articles that turned out in the end not to be about the use of AI in education. This resulted in a final 145 articles which were then analysed. Zawacki-Richter et al. then classified these 145 papers into different uses of AI in education. This section draws heavily on this classification. (It should be noted that within the 145 articles, only 92 were focused on instruction/student support. The rest were on institutional uses such as identifying at risk students before admission).

The Zawacki-Richter study offers one insight into the main ways that AI has been used in education for teaching and learning over the ten years between 2007 and 2018, the closest we can come to 'affordances'. First, three main general 'instructional' categories (with considerable overlap) from the study are provided below, followed by some specific examples. (I have omitted Zawacki-Richter et al.'s category of profiling and prediction concerned with administrative issues such as admissions, course scheduling, and early warning systems for students at risk.)

8.7c.4.1 Intelligent tutoring systems (29 out of 92 articles reviewed by Zawacki-Richter et al.)

Intelligent tutoring systems:

- provide teaching content to students and, at the same time, support them by giving adaptive feedback and hints to solve questions related to the content, as well as detecting students' difficulties/errors when working with the content or the exercises;
- curate learning materials based on student needs, such as by providing specific recommendations regarding the type of reading material and exercises done, as well as personalised courses of action;
- facilitate collaboration between learners, for instance, by providing automated feedback, generating automatic questions for discussion, and the analysis of the process.

8.7c.4.2 Assessment and evaluation (36 out of 92)

AI supports assessment and evaluation through:

- automated grading;
- feedback, including a range of student-facing tools, such as intelligent agents that provide students with prompts or guidance when they are confused or stalled in their work;
- evaluation of student understanding, engagement and academic integrity.

8.7c.4.3 Adaptive systems and personalization (27 out of 92)

AI enables adaptive systems and the personalization of learning by:

- teaching course content then diagnosing strengths or gaps in student knowledge, and providing automated feedback;

- recommending personalized content;
- supporting teachers in learning design by recommending appropriate teaching strategies based on student performance;
- supporting representation of knowledge in concept maps.

Klutka et al. (2018) identified several uses of AI for teaching and learning in universities in the USA. ECoach, developed at the University of Michigan, provides formative feedback for a variety of mainly large classes in the STEM field. It tracks students progress through a course and directs them to appropriate actions and activities on a personalized basis. Other applications listed in the report include sentiment analysis (using students' facial expressions to measure their level of engagement in studying), an application to monitor student engagement in discussion forums, and organizing commonly shared mistakes in exams into groups for the instructor to respond once to the group rather than individually.

8.7c.4.4 Chatbots

A chatbot is programming that simulates the conversation or 'chatter' of a human being through text or voice interactions (Rouse, 2018). Chatbots in particular are a tool used to automate communications with students. Bayne (2014) describes one such application in a MOOC with 90,000 subscribers. Much of the student activity took place outside the Coursera platform within social media. The five academics teaching the MOOC were all active on Twitter, each with large networks, and Twitter activity around the MOOC hashtag (#edcmooc) was high across all instances of the course (for example, a total of around 180,000 tweets were exchanged on the first offering of the MOOC). A 'Teacherbot' was designed to roam the tweets using the course Twitter hashtag, using keywords to identify 'issues' then choosing pre-designed responses to these issues, which often entailed directing students to more specific research on a topic. For a review of research on chatbots in education, see Winkler and Söllner (2018).

8.7c.4.5 Automated essay grading

Natural language processing (NLP) artificial intelligence systems – often called automated essay scoring engines – are now either the primary or secondary grader on standardized tests in at least 21 states in the USA (Feathers, 2019). According to Feathers:

> *Essay-scoring engines don't actually analyze the quality of writing. They're trained on sets of hundreds of example essays to recognize patterns that correlate with higher or lower human-assigned grades. They then predict what score a human would assign an essay, based on those patterns.*

Feathers though claims that research from psychometricians and AI experts show that these tools are susceptible to a common flaw in AI: bias against certain demographic groups (see Ongweso, 2019).

Lazendic et al. (2018) offer a detailed account of the plan for machine grading in Australian high schools. They state:

> *It is …crucially important to acknowledge that the human scoring models, which are developed for each NAPLAN writing prompt, and their consistent application, ensure and maintain the validity of*

> *NAPLAN writing assessments. Consequently, the statistical reliability of human scoring outcomes is fundamentally related to and is the key evidence for the validity of NAPLAN writing marking.*

In other words, the marking must be based on consistent human criteria. However, it was announced later (Hendry, 2018) that Australian education ministers agreed not to introduce automated essay marking for NAPLAN writing tests, heeding calls from teachers' groups to reject the proposal.

Perelman (2013) developed a computer program called the BABEL generator that patched together strings of sophisticated words and sentences into meaningless gibberish essays. The nonsense essays consistently received high, sometimes perfect, scores when run through several different scoring engines. See also Mayfield, 2013, and Parachuri, 2013, for thoughtful analyses of the issues in the automated marking of writing.

At the time of writing, despite considerable pressure to use automated essay grading for standardized exams, the technology still has many questions lingering over it.

8.7c.5 Strengths and weaknesses

There are several ways to assess the value of the teaching and learning affordances of particular applications of AI in teaching and learning:

- is the application based on the three core features of 'modern' AI: massive data sets, massive computing power; powerful and relevant algorithms?
- does the application have clear benefits in terms of affordances over other media, and particularly general computing applications?
- does the application facilitate the development of the skills and knowledge needed in a digital age?
- is there unintended bias built into the algorithms? Does it appear to discriminate against certain categories of people?
- is the application ethical in terms of student and teacher/instructor privacy and their rights in an open and democratic society?
- are the results of the application 'explainable'? For example, can a teacher or instructor or those responsible for the application understand and explain to students how the results or decisions made by the AI application were reached?

These issues are addressed below.

8.7c.5.1 Is it really a 'modern' AI application in teaching and learning?

Looking at the Zawacki-Richter et al. study and many other research papers published in peer-reviewed journals, very few so-called AI applications in teaching and learning meet the criteria of massive data, massive computing power and powerful and relevant algorithms. Much of the intelligent tutoring within conventional education is what might be termed 'old' AI: there is not a lot of processing going on, and the data points are relatively small. Many so-called AI papers focused on intelligent tutoring and adaptive learning are really just general computing applications.

Indeed, so-called intelligent tutoring systems, automated multiple-choice test marking, and automated feedback on such tests have been around since the early 1980s. The closest to modern AI applications appear to be automated essay grading of standardised tests administered across an entire education system. However there are major problems with the latter. More development is clearly needed to make automated essay grading a valid exercise.

The main advantage that Klutka et al. (2018) identify for AI is that it opens up the possibility for higher education services to become scalable at an unprecedented rate, both inside and outside the classroom. However, it is difficult to see how 'modern' AI could be used within the current education system, where class sizes or even whole academic departments, and hence data points, are relatively small, in terms of the numbers needed for 'modern' AI. It cannot be said to date that modern AI has been tried, and failed, in teaching and learning; it's not really even been tried.

Applications outside the current formal system are more realistic, for MOOCs, for instance, or for corporate training on an international scale, or for distance teaching universities with very large numbers of students. The requirement for massive data does suggest that the whole education system could be massively disrupted if the necessary scale could be reached by offering modern AI-based education outside the existing education systems, for instance by large Internet corporations that could tap their massive markets of consumers.

However, there is still a long way to go before AI makes that feasible. This is not to say that there could not be such applications of modern AI in the future, but at the moment, in the words of the old English bobby, 'Move along, now, there's nothing to see here.'

However, for the sake of argument, let's assume that the definition of AI offered here is too strict and that most of the applications discussed in this section are examples of AI. How do these applications of AI meet the other criteria above?

8.7c.5.2 Do the applications facilitate the development of the skills and knowledge needed in a digital age?

This does not seem to be the case in most so-called AI applications for teaching and learning today. They are heavily focused on content presentation and testing for understanding and comprehension. In particular, Zawacki-Richter et al. make the point that most AI developments for teaching and learning – or at least the research papers – are by computer scientists, not educators. Since AI tends to be developed by computer scientists, they tend to use models of learning based on how computers or computer networks work (since of course it will be a computer that has to operate the AI). As a result, such AI applications tend to adopt a very behaviourist model of learning: present/test/feedback. Lynch (2017) argues that:

> *If AI is going to benefit education, it will require strengthening the connection between AI developers and experts in the learning sciences. Otherwise, AI will simply 'discover' new ways to teach poorly and perpetuate erroneous ideas about teaching and learning.*

Comprehension and understanding are indeed important foundational skills, but AI so far is not helping with the development of higher order skills in learners of critical thinking, problem-solving, creativity and knowledge-management. Indeed, Klutka et al. (2018) claim that that AI can handle many of the routine functions currently done by instructors and administrators, freeing them up to solve more complex problems and connect with students on deeper levels. This reinforces the view that the role of the instructor or teacher needs to move away from content presentation, content management and testing of content comprehension – all of which can be done by computing – towards skills development. The good news is that AI used in this way supports teachers and instructors, but does not replace them.

The bad news is that many teachers and instructors will need to change the way they teach or they will become redundant.

8.7c.5.3 Is there unintended bias in the algorithms?

It could be argued that all AI does is to encapsulate the existing biases in the system. The problem though is that this bias is often hard to detect in any specific algorithm, and that AI tends to scale up or magnify such biases. These are issues more for institutional uses of AI, but machine-based bias can discriminate against students also in a teaching and learning context as well, and especially in automated assessment.

8.7c.5.4 Is the application ethical?

There are many potential ethical issues arising from the use of AI in teaching and learning, mainly due to the lack of transparency in the AI software, and particularly the assumptions embedded in the algorithms. The literature review by Zawacki-Richter et al. (2019) concluded:

> *…a stunning result of this review is the dramatic lack of critical reflection of the pedagogical and ethical implications as well as risks of implementing AI applications in higher education*.

What data are being collected, who owns or controls it, how is it being interpreted, how will it be used? Policies will need to be put in place to protect students and teachers/instructors (see for instance the U.S. Department of Education's student data policies for schools), and students and teachers/instructors need to be involved in such policy development.

8.7c.5.5 Are the results explainable?

The biggest problem with AI generally, and in teaching and learning in particular, is the lack of transparency. How did it give me this grade? Why I am directed to this reading rather than that one? Why isn't my answer acceptable? Lynch (2017) argues that most data collected about student learning is indirect, inauthentic, lacking demonstrable reliability or validity, and reflecting unrealistic time horizons to demonstrate learning.

> '*current examples of AIEd often rely on …. poor proxies for learning, using data that is easily collectable rather than educationally meaningful*.'

8.7c.6 Conclusions

8.7c.6.1. Dream on, AI enthusiasts

In terms of what AI is actually doing now for teaching and learning, the dream is way beyond the reality. What works well in finance or marketing or astronomy does not necessarily translate to teaching and learning contexts. In doing the research for this section, it proved very difficult to find any compelling examples of AI for teaching and learning, compared with serious games or virtual reality. It is always hard to prove a negative, but the results to date of applying AI to teaching and learning are extremely limited and disappointing.

This is mainly due to the difficulty of applying 'modern' AI at scale in a very fragmented system that relies heavily on relatively small class sizes, programs, and institutions. Probably for modern AI to 'work', a totally different organizational structure for teaching and learning would be needed. But be careful what you wish for.

There is a strong affective or emotional influence in learning. Students often learn better when they feel that the instructor or teacher cares. In particular, students want to be treated as individuals, with their own interests, ways of learning, and some sense of control over their learning. Although at a mass level human behaviour is predictable and to some extent controllable, each student is an individual and will respond slightly differently from other students in the same context. Because of these emotional and personal aspects of learning, students need to relate in some way to their teacher or instructor. Learning is a complex activity where only a relatively minor part of the process can be effectively automated. Learning is an intensely human activity, that benefits enormously from personal relationships and social interaction. This relational aspect of learning can be handled equally well online as face-to-face, but it means using computing to support communication as well as delivering and testing content acquisition.

8.7c.6.2 Not fit for purpose

Above all, AI has not progressed to the point yet where it can support the higher levels of learning required in a digital age or the teaching methods needed to do this, although other forms of computing or technology, such as simulations, games and virtual reality, can.

In particular AI developers have been largely unaware that learning is developmental and constructed, and instead have imposed an old and less appropriate method of teaching based on behaviourism and an objectivist epistemology. However, to develop the skills and knowledge needed in a digital age, a more constructivist approach to learning is needed. There has been no evidence to date that AI can support such an approach to teaching, although it may be possible.

8.7c.6.3 AI's real agenda

AI advocates often argue that they are not trying to replace teachers but to make their life easier or more efficient. This should be taken with a pinch of salt. The key driver of AI applications is cost-reduction, which means reducing the number of teachers, as this is the main cost in education. In contrast, the key lesson from all AI developments is that we will need to pay increased attention to the affective and emotional aspects of life in a robotic-heavy society, so teachers will become even more important.

Another problem with artificial intelligence is that the same old hype keeps going round and round. The same arguments for using artificial intelligence in education go back to the 1980s. Millions of dollars went into AI research at the time, including into educational applications, with absolutely no payoff.

There have been some significant developments in AI since then, in particular pattern recognition, access to and analysis of big data sets, powerful algorithms, leading to formalized decision-making within limited boundaries. The trick though is to recognise exactly what kind of applications these new AI developments are good for, and what they cannot do well. In other words, the context in which AI is used matters, and needs to be taken account of. Teaching and learning is a particularly difficult environment then for AI applications.

8.7c.6.4 Defining AI's role in teaching and learning

Nevertheless, there is plenty of scope for useful applications of AI in education, but only if there is continuing dialogue between AI developers and educators as new developments in AI become available.

But that will require being very clear about the purpose of AI applications in education and being wide awake to the unintended consequences.

In education, AI is still a sleeping giant. 'Breakthrough' applications of AI for teaching and learning are probably not going to come from the mainstream universities and colleges, but from outside the formal post-secondary system, through organizations such as LinkedIn, lynda.com, Amazon or Coursera, that have access to large data sets that make the applications of AI scalable and worthwhile (to them). However, this would pose an existential threat to public schools, colleges and universities. The issue then becomes: what system is best to protect and sustain the individual in a digital age: multinational corporations using AI for teaching and learning; or a public education system with human teachers using AI as a support for learners?

The key question then is whether technology should aim to replace teachers and instructors through automation, or whether technology should be used to empower not only teachers but also learners. Above all, who should control AI in education: educators, students, computer scientists, or large corporations? These are indeed existential questions if AI does become immensely successful in reducing the costs of teaching and learning: but at what cost to us as humans? Fortunately AI is not yet in a position to provide such a threat; but it may well do so soon.

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Activity 8.7.c Artificial intelligence

- what do you think about AI for teaching and learning? Is it so esoteric that you can safely not worry about it? Or do you feel you need to be better informed about that it can and cannot do?
- do you agree with the three minimum requirements for modern AI: large data sets, powerful computing capacity, and powerful algorithms? Are there other possible applications of AI that do not need to meet these three criteria?
- can you think of areas of teaching and learning that could generate large data sets even in a class of 30?
- what other skills beside comprehension could AI facilitate? How would it do this?

Click on the podcast below to get some feedback on these questions, plus some of my personal thoughts on AI and teaching and learning:

An audio element has been excluded from this version of the text. You can listen to it online here: https://pressbooks.bccampus.ca/teachinginadigitalagev2/?p=1597

8.7.d Emerging technologies: conclusion and summary

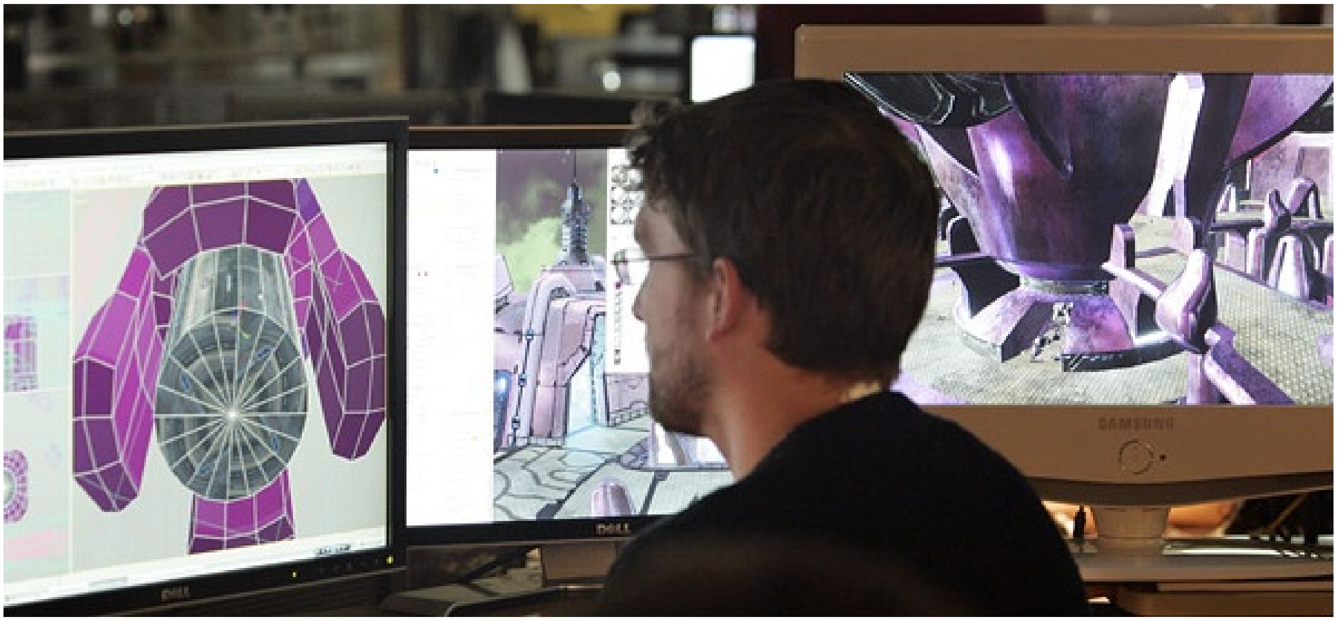

Figure 8.7.d.1 Games designer at work

8.7d.1 Comparing the three emerging technologies

Section 8.7 has looked at three very different emerging technologies: serious games; immersive technologies; and artificial intelligence. Each has the potential to influence profoundly teaching and learning in a digital age.

Both serious games and immersive technologies such as virtual and augmented reality will be extremely valuable in 'niche' areas of teaching and learning. They both have the potential to develop some of the higher order learning skills of problem solving, analysis, intuitive thinking, and creative thinking, and also can be used to develop affective skills, such as empathy.

However, neither is likely to be a 'core' technology that will be extensively used across all forms of teaching. Also both need significant investment of time and possibly money if they are to be of good quality for teaching purposes. In particular, they will need a multi-disciplinary team approach to design and development.

Therefore it will be essential to choose the right kind of project, such as topics that are difficult to teach using other methods, or projects aimed at learners who struggle with more conventional teaching methods. Above all, it will be necessary to identify and exploit the optimum educational affordances of these two technologies.

Artificial intelligence is somewhat different to the other two emerging technologies. Artificial intelligence to date manages well the presentation and testing of content acquisition, comprehension and understanding, but so far has not shown much promise in supporting the development or assessment of the higher level cognitive skills needed in a digital age. However, by focusing on supporting learners' comprehension and understanding, AI can free up human teachers and instructors to focus their time on the development of these higher order skills. Again, this emphasises the importance of teachers and instructors moving their focus away from content delivery – which AI can increasingly manage well – and focusing more on teaching methods that support higher order skills development.

Furthermore these three technologies are not really separate and unrelated but will become increasingly integrated. AI applications could improve the power and range of both serious games and virtual reality. Games can be designed within a virtual reality. The extent to which these technologies become feasible in education will depend heavily on applications outside education which can then be carried over and adapted for educational purposes.

Again though we come back to three critical issues:

- what are the educational goals of the application?
- to what extent does the application help with the development of higher order cognitive and/or affective skills?
- what are the costs and organizational implications of such applications within education?

8.7d.2 Lessons to be learned from the use of emerging technologies

New technology developments show no sign of slowing down. Over time, other new technologies will emerge beside the three technologies discussed in this section. Educators will continue to be challenged to incorporate these new technologies as they emerge. In responding to this challenge, the following needs to be considered:

1. New technologies are not necessarily better than existing technologies for teaching. They may however offer new opportunities for teaching differently, and may enable new or better learning outcomes, as well as improving on existing learning outcomes.
2. Old technologies rarely disappear completely as a result of popular new technologies. Older technologies become more focused and find a niche that they serve best.
3. Most educators will be best served by not jumping on the latest technology bandwagon, but should wait a couple of years for a particular technology to reach at least the Gartner 'slope of enlightenment' before experimenting with the new technology.
4. More important than the general characteristics of a new technology is its design and application in education; in other words, how does it perform as an educational medium? Being a big success in the financial sector for instance does not mean a technology will be automatically appropriate for education. Indeed, the technology may need to be heavily adapted or modified to be useful in the educational sector.
5. Given the rate of change and the number of new technologies entering the market, educators need a strong framework or set of criteria for selecting and evaluating technologies, not just emerging technologies but also existing technology. This will be discussing in the following final section of this chapter.

Activity 8.7.d Assessing and developing applications of emerging technologies

- Are there other emerging technologies that you would have chosen over these three?
- How do you think teachers/instructors should react to emerging technologies? Ignore them? Wait for others in education to try them first? Or should they jump in and try a new technology as soon as possible?
- Some institutions such as UBC and Drexel University have set up emerging media labs to encourage faculty to experiment with new technologies. What other methods could be used to encourage teachers and instructors to experiment with new technologies?

For feedback on this activity, and my personal observations on these three emerging technologies, click on the podcast below:

An audio element has been excluded from this version of the text. You can listen to it online here: https://pressbooks.bccampus.ca/teachinginadigitalagev2/?p=1638

8.8 A framework for analysing the pedagogical characteristics of educational media

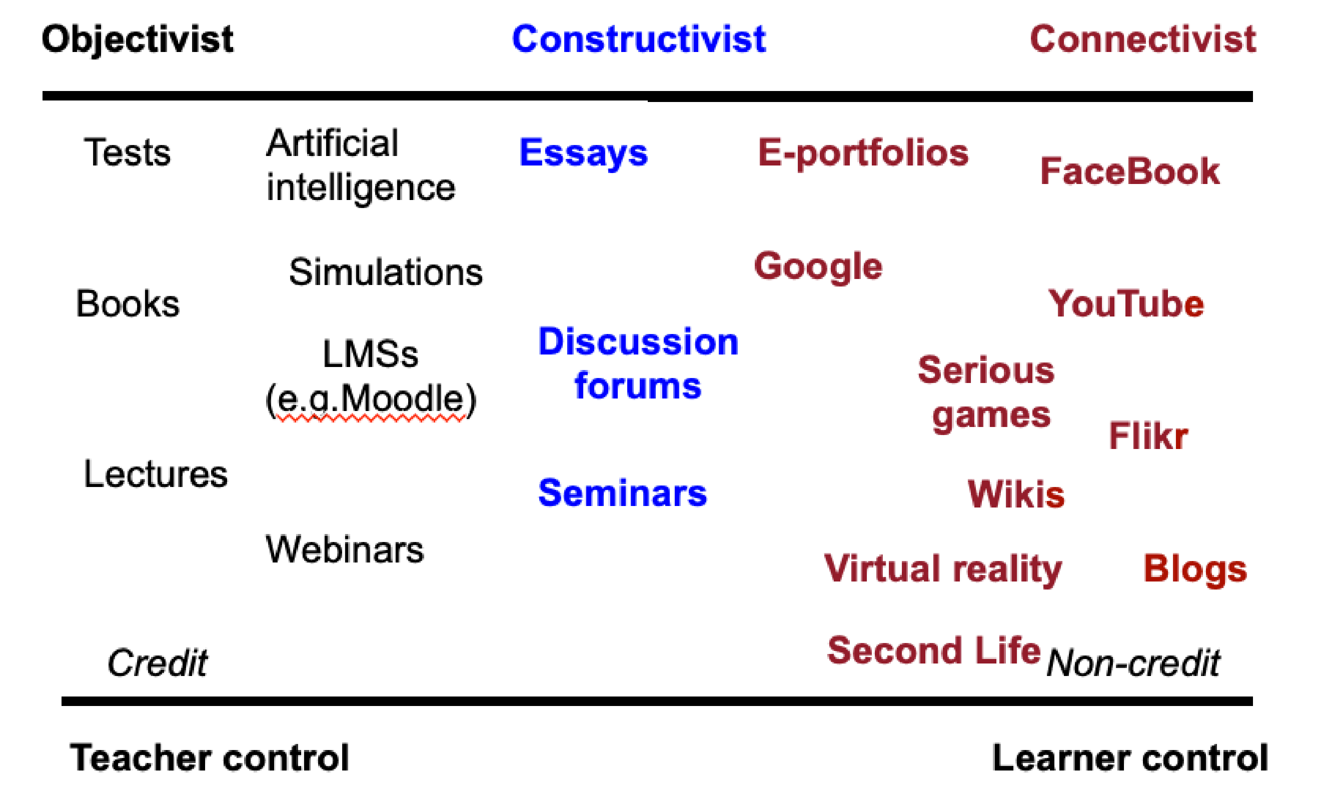

Figure 8.8.1 Analysis of different media by pedagogical criteria (adapted from Bates, 2011)

8.8.1 Brief summary of pedagogical differences in media

I will now summarise the unique pedagogical characteristics of the different media discussed in this chapter.

Figure 8.8.1 presents a diagrammatic analysis of various learning media. I have arranged them primarily by where they fit along an epistemological continuum of objectivist (black), constructivist (blue) and connectivist (red), but also I have used two other dimensions, teacher control/learner control, and credit/non-credit. Note that this figure also enables traditional teaching modes, such as lectures and seminars, to be included and compared. Figure 8.8.1 represents my personal interpretation of these media, and other teachers or instructors may well re-arrange the diagram differently, depending on their particular applications of these tools.

Not all tools or media are represented here (for example, audio and video or MOOCs). The position of any particular tool in the diagram will depend on its actual use. Learning management systems can be used in a constructivist way, and blogs can be very teacher-controlled, if the teacher is the only one permitted to use a blog on a course. Badia et al (2011) have shown that educational design and the situational use of technology very much influence whether specific affordances or unique characteristics of a medium are successfully exploited. Student preferences or pre-dispositions can inhibit or support the successful implementation of specific affordances of different media (for instance, computer science students' preferences for adaptive learning rather than the communication and discussion affordances of ICT – Arenas, 2015).

However, the aim here is not to provide a cast-iron categorization of the affordances of different educational media, but to provide a framework for teachers in deciding which tools and media are most likely to suit a particular teaching approach. Indeed, other teachers may prefer a different set of pedagogical values as a framework for analysis of the different media and technologies.

However, to give an example from Figure 8.8.1, a teacher may use an LMS to organize a set of resources, guidelines, procedures and deadlines for students, who then may use several of the social media, such as photos from mobile phones to collect data. The teacher provides a space and structure on the LMS for students' learning materials in the form of an e-portfolio, to which students can load their work. Students in small groups can use discussion forums or FaceBook to work on projects together.

The example above is in the framework of a course for credit, but the framework would also fit the non-institutional or informal approach to the use of social media for learning, with a focus on tools such as FaceBook, blogs and YouTube. These applications would be much more learner driven, with the learner deciding on the tools and their uses. The most powerful examples are connectivist or cMOOCs, as we saw in Chapter 5.

8.8.2 Key takeaways

Chapter 8: Key Takeaways

There is a very wide range of media available for teaching and learning. In particular:

- text, audio, video, computing, social media and emerging technologies all have unique characteristics that make them useful for teaching and learning;
- the choice or combination of media will need to be determined by:
  - the overall teaching philosophy behind the teaching;
  - the presentational and structural requirements of the subject matter or content;
  - the skills that need to be developed in learners;
  - and not least by the imagination of the teacher or instructor (and increasingly learners themselves) in identifying possible roles for different media;

- learners now have powerful tools through social media for creating their own learning materials or for demonstrating their knowledge;
- courses can be structured around individual students' interests, allowing them to seek appropriate content and resources to support the development of negotiated competencies or learning outcomes;.
- content is now increasingly open and freely available over the Internet; as a result learners can seek, use and apply information beyond the bounds of what a professor or teacher may dictate;
- students can create their own online personal learning environments;
- many students will still need a structured approach that guides their learning;
- teacher presence and guidance is likely to be necessary to ensure high quality learning via social media;
- teachers need to find the middle ground between complete learner freedom and over-direction to enable learners to develop the key skills needed in a digital age.

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Activity 8.8 Choosing media for a teaching module

1. Take a module or main topic of a course you are teaching. Identify the key learning outcomes, in terms of skills to be taught, then the content area to be covered.
2. Then look through the key characteristics of each of the media in this chapter, and think how each medium might be used to teach your module. Use your analysis from Activities 8.2 to 8.7 Make a list of the functions you have chosen and their relationship to content and skills in the module.
3. Using Figure 8.8.1, allocate a range of tools and media that you might consider using and place them on the continuum.
4. Are you still happy with your choice?

Don't worry – we haven't finished yet. The next chapter will provide a way to make decisions on a more realistic basis. The main purpose here is to get you thinking about possible uses of different media in your subject area.

There is no feedback offered for this activity. Chapter 9 should give some guidance as to the appropriateness of your answers.

Chapter 9: Choosing and using media in education: the SECTIONS model

Purpose of the chapter

The main purpose of this chapter is to provide a framework for making effective decisions about the choice and use of media for teaching and learning. The framework used is the SECTIONS model, which stands for:

- S tudents
- E ase of use
- C osts
- T eaching functions
- I nteraction
- O rganisational issues
- N etworking
- S ecurity and privacy

On completion of this chapter, you should be able to choose appropriate media and technology for any subject that you may be teaching, and be able to justify your decision.

What is covered in this chapter

- 9.1 Models for media selection
- 9.2 Students
- 9.3 Ease of Use
- 9.4 Cost
- 9.5 Teaching and media selection
- 9.6 Interaction
- 9.7 Organisational issues
- 9.8 Networking (and novelty)
- 9.9 Security and privacy
- 9.10 Deciding

Also in this chapter you will find the following activities:

- Activity 9.1 Making a preliminary decision
- Activity 9.2 Knowing your students
- Activity 9.3 Ease of use
- Activity 9.4 How will cost affect your decision about what media to use?
- Activity 9.5 Multimedia design principles
- Activity 9.6 Using media to promote student activity
- Activity 9.7 Organisational issues (no activity)
- Activity 9.8 Networking (and novelty)
- Activity 9.9 Security and privacy
- Activity 9.10 Choosing media and technologies

Chapter 9 Key Takeaways

1. Selecting media and technologies is a complex process, involving a very wide range of interacting variables.

2. There is currently no generally accepted theory or process for media selection. The SECTIONS model however provides a set of criteria or questions the result of which can help inform an instructor when making decisions about which media or technologies to use.

3. Because of the wide range of factors influencing media selection and use, an inductive or intuitive approach to decision-making, informed by a careful analysis of all the criteria in the SECTIONS framework, is one practical way to approach decision-making about media and technologies for teaching and learning.

4. However, media selection needs to be integrated within the broader framework of course design.

9.1 Models for media selection

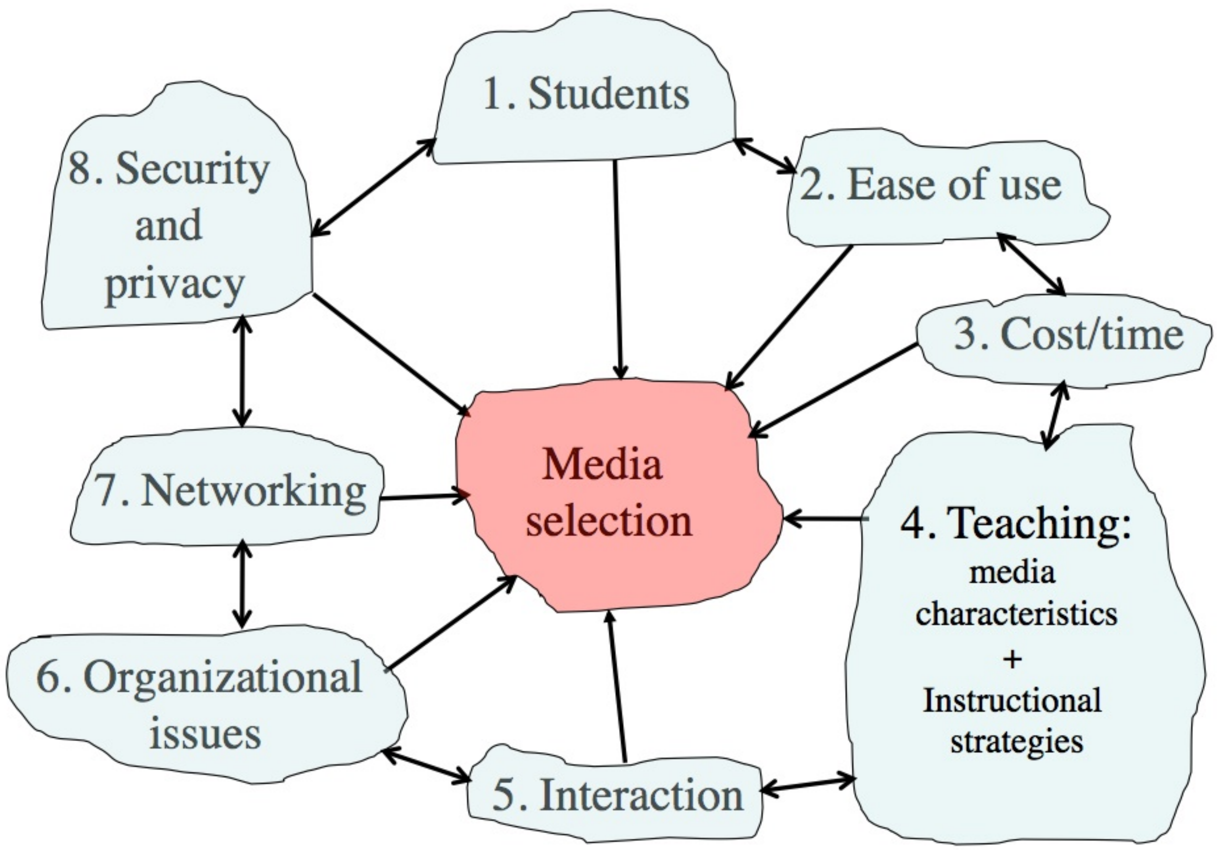

Figure 9.1.1 The SECTIONS model

9.1.1 What the literature tells us

Given the importance of the topic, there is relatively little literature on how to choose appropriate media or technologies for teaching. There was a flurry of not very helpful publications on this topic in the 1970s and 1980s, but relatively little since (Baytak, undated). Indeed, Koumi (1994) stated that:

> there does not exist a sufficiently practicable theory for selecting media appropriate to given topics, learning tasks and target populations . . . the most common practice is not to use a model at all. In which case, it is no

> wonder that allocation of media has been controlled more by practical economic and human/political factors than by pedagogic considerations (p. 56).

Mackenzie (2002) comments in a similar vein:

> When I am discussing the current state of technology with teachers around the country, it becomes clear that they feel bound by their access to technology, regardless of their situation. If a teacher has a television-computer setup, then that is what he or she will use in the classroom. On the other hand, if there is an LCD projector hooked up to a teacher demonstration station in a fully equipped lab, he or she will be more apt to use that set up. Teachers have always made the best of whatever they've got at hand, but it's what we have to work with. Teachers make due.

Mackenzie (2002) has suggested building technology selection around Howard Gardner's multiple intelligences theory (Gardner, 1983, 2006), following the following sequence of decisions:

learner → teaching objective → intelligences → media choice.

Mackenzie then allocates different media to support the development of each of Gardner's intelligences. Gardner's theory of multiple intelligences has been widely tested and adopted, and Mackenzie's allocations of media to intelligences make sense intuitively, but of course it is dependent on teachers and instructors applying Gardner's theory to their teaching.

A review of more recent publications on media selection suggests that despite the rapid developments in media and technology over the last 20 years, my ACTIONS model (Bates, 1995) is one of the major models still being applied, although with further amendments and additions (see for instance, Baytak, undated; Lambert and Williams, 1999; Koumi, 2006). Indeed, I myself modified the ACTIONS model, which was developed for distance education, to the SECTIONS model to cover the use of media in campus-based as well as distance education (Bates and Poole, 2003).

Patsula (2002) developed a model called CASCOIME which includes some of the criteria in the Bates models, but also adds additional and valuable criteria such as socio-political suitability, cultural friendliness, and openness/flexibility, to take into account international perspectives. Zaied (2007) conducted an empirical study to test what criteria for media selection were considered important by faculty, IT specialists and students, and identified seven criteria. Four of these matched or were similar to Bates' criteria. The other three were student satisfaction, student self-motivation and professional development, which are more like conditions for success and are not really easy to identify before making a decision.

Koumi (2006) and Mayer (2009) have come closest to to developing models of media selection. Mayer has developed twelve principles of multimedia design based on extensive research, resulting in what Mayer calls a cognitive theory of multimedia learning. (For an excellent application of Mayer's theory, see UBC Wikis.) Koumi (2015) more recently has developed a model for deciding on the best mix and use of video and print to guide the design of xMOOCs.

Mayer's approach is valuable at a more micro-level when it comes to designing specific multimedia educational materials, as is Koumi's work. Mayer's cognitive theory of multimedia design suggests the best combination of words and images, and rules to follow such as ensuring coherence and avoiding cognitive overload. When deciding to use a specific application of multimedia, it provides very strong guidelines. It is nevertheless more difficult to apply at a macro level. Because Mayer's focus is on cognitive processing, his theory does not deal directly with the unique pedagogical affordances or characteristics of different media. Neither Mayer nor Koumi address non-pedagogical issues in media selection, such as cost or access. Mayer and Koumi's work is not so much competing as complementary to what I am proposing. I am trying to identify which media (or combinations of media) to use in the first place. Mayer's theory then would guide the actual design of the application. I will discuss Mayer's twelve principles further in Section 5 of this chapter, which deals with teaching functions.

Puentedura's SAMR model (2014), discussed in Chapter 7, Section 4, is valuable for assessing the choice of a particular medium, but it focuses solely on pedagogical issues, particularly in terms of whether the choice augments or transforms learning. Although this is a powerful criterion for media selection, the SAMR model does not take into account other essential factors in media selection, such as cost or ease of use.

It is not surprising that there are not many models for media selection. The models developed in the 1970s and 1980s took a very reductionist, behaviourist approach to media selection, resulting in often several pages of decision-trees, which are completely impractical to apply, given the realities of teaching, and yet these models still included no recognition of the unique affordances of different media. More importantly, technology is subject to rapid change, there are competing views on appropriate pedagogical approaches to teaching, and the context of learning varies so much. Finding a practical, manageable model founded on research and experience that can be widely applied has proved to be challenging.

9.1.2 Why we need a model

At the same time, every teacher, instructor, and increasingly learner, needs to make decisions in this area, often on a daily basis. A model for technology selection and application is needed therefore that has the following characteristics:

- it will work in a wide variety of learning contexts;
- it allows decisions to be taken at both a strategic, institution-wide level, and at a tactical, instructional, level;
- it gives equal attention to educational and operational issues;
- it will identify critical differences between different media and technologies, thus enabling an appropriate mix to be chosen for any given context;
- it is easily understood, pragmatic and cost-effective;
- it will accommodate new developments in technology.

For these reasons, then, I will continue to use the Bates' SECTIONS model, with some modifications to take account of recent developments in technology, research and theory. The SECTIONS model is based on research, has stood the test of time, and has been found to be practical. SECTIONS stands for:

- **S** tudents
- **E** ase of use
- **C** ost
- **T** eaching functions, including pedagogical affordances of media
- **I** nteraction
- **O** rganizational issues
- **N** etworking

- **S** ecurity and privacy

I will discuss each of these criteria in the following sections, and will then suggest how to apply the model.

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Activity 9.1 Making a preliminary decision on media selection

1. Choose a course that you are teaching or may be teaching. Identify what media or technologies you might be interested in using. Keep a note of your decision and your reasons for your choice of media/technologies.

When you have finished reading this chapter you will be asked to do a final activity (Activity 9.10) and then you can compare your answers to both this activity and Activity 9.10 after reading the whole chapter.

There is no feedback provided for this activity.

9.2 Students

The Malaysian Ministry of Education announced in 2012 that it will enable students to bring handphones to schools under strict guidelines
Image: © NewStraightsTimes, 2012

The first criterion in the SECTIONS model is students. At least three issues related to students need to be considered when choosing media and technology:

- student demographics;
- access; and
- differences in how students learn.

9.2.1 Student demographics

One of the fundamental changes resulting from mass higher education is that university and college teachers must now teach an increasingly diverse range of students. This increasing diversity of students presents major challenges for all teachers, not just post-secondary teachers. However, it has been less common for instructors at a post-secondary level to vary their approach within a single course to accommodate to learner differences, but the increasing diversity of students now requires that all courses should be developed with a wide variety of approaches and ways to learn if all students in the course are to be taught well.

In particular, it is important to be clear about the needs of the target group. First and second year students straight from high school are likely to require more support and help studying at a university or college level. They are likely to be less independent as learners, and therefore it may be a mistake to expect them to be able to study entirely through the use of technology. However, technology may be useful as a support for classroom teaching, especially if it provides an alternative approach to learning from the face-to-face teaching, and is gradually introduced, to prepare them for more independent study later in a program.

On the other hand, for students who have already been through higher education as a campus student, but are now in the workforce, a program delivered entirely by technology at a distance is likely to be attractive. Such students will have already developed successful study skills, will have their own community and family life, and will welcome the flexibility of studying this way.

Third and fourth year undergraduate students may appreciate a mix of classroom-based and online study or even one or two fully online courses, especially if some of their face-to-face classes are closed to further enrolments, or if students are working part-time to help cover some of the costs of being at college.

Lastly, within any single class or group of learners, there will be a wide range of differences in prior knowledge, language skills, and preferred study styles.The intelligent use of media and technology can help accommodate these differences. In particular, if you are trying to reach students in remote areas, or homeless or poor people, or students with physical disabilities, then this too should influence your choice of technology. Indeed, for most courses, there is likely to be a mix of different student needs, which suggests that a multi-media approach will be necessary to accommodate all student needs.

So, once again, it is important to know your students, and to keep this in mind when making decisions about what media or technology to use. This will be discussed further in Chapter 10.

9.2.2 Access

Of all the criteria in determining choice of technology, this is perhaps the most discriminating. No matter how powerful in educational terms a particular medium or technology may be, if students cannot access it in a convenient and affordable manner they cannot learn from it. Thus video streaming may be considered a great way to get lectures to students off campus, but if they do not have Internet access at home, or if it takes four hours or a day's wages to download, then forget it. Difficulty of access is a particular restriction on using xMOOCs in developing countries. Even if potential learners have Internet or mobile phone access, which 3.8 billion globally still do not (ITU, 2018), it often costs a day's wages to download a single YouTube video – see Marron, Missen and Greenberg, 2014.

Any teacher or instructor intending to use computers, tablets or mobile phones for teaching purposes needs answers to a number of questions:

- what is the institutional policy with regard to students' access to a computer, tablets or mobile phones?
- can students use any device or is there a limited list of devices that the institution will support?
- is the medium or software chosen for teaching compatible with all makes of devices students might use?
- is the network adequate to support any extra students that this initiative will add?
- who else in the institution needs to know that you are requiring students to use particular devices?

If students are expected to provide their own devices (which increasingly makes sense):

- what kind of device do they need: one at home with Internet access or a portable that they can bring on to campus – or one that can be used both at home and on campus?
- what kind of applications will they need to run on their device(s) for study purposes?
- will they be able to use the same device(s) across all courses, or will they need different software/apps and devices for different courses?
- what skills will students need in operating the devices and the apps that will be run on them?
- if students do not have the skills, would it still be worth their learning them, and will there be time set aside in the course for them to learn these skills?

Students (as well as the instructor) need to know the answers to these questions before they enrol in a course or program. In order to answer these questions, you and your department must know what students will use their devices for. There is no point in requiring students to go to the expense of purchasing a laptop computer if the work they are required to do on it is optional or trivial. This means some advance planning on your part:

- what are the educational advantages that you see in student use of a particular device?
- what will students need to do on the device in your course?
- is it really essential for them to use a device in these ways, or could they easily manage without the device? In particular, how will assessment be linked to the use of the device?

It will really help if your institution has good policies in place for student technology access (see Section 9.7). If the institution does not have clear policies or infrastructure for supporting the technologies you want to use, then your job is going to be a lot harder.

The answer to the question of access and the choice of technology will also depend somewhat on the mandate of the institution and your personal educational goals. For instance, highly selective universities can require students to use particular devices, and can help the relatively few students who have financial difficulties in purchasing and using specified devices. If though the mandate of the institution is to reach learners denied access to conventional institutions, equity groups, the unemployed, the working poor, or workers needing up-grading or more advanced education and training, then it becomes critical to find out what technology they have access to or are willing to use. If an institution's policy is open access to anyone who wants to take its courses, the availability of equipment already in the *home* (usually purchased for entertainment purposes) becomes of paramount importance.

Another important factor to consider is access for student with disabilities. This may mean providing textual or audio options for deaf and visually impaired students respectively. Fortunately there are now well established practices and standards under the general heading of Universal Design standards. Universal Design is defined as follows:

> *Universal Design for Learning, or UDL, refers to the deliberate design of instruction to meet the needs of a diverse mix of learners. Universally designed courses attempt to meet all learners' needs by incorporating multiple means of imparting information and flexible methods of assessing learning. UDL also includes multiple means of engaging or tapping into learners' interests. Universally designed courses are not designed with any one particular group of students with a disability in mind, but rather are designed to address the learning needs of a wide-ranging group.*
>
> Brokop, F. (2008)

Most institutions with a centre for supporting teaching and learning will be able to provide assistance to faculty to ensure the course meets universal design standards. For instance, BCcampus has produced an accessibility toolkit (Coolidge et l., 2018) and Norquest College, Alberta, has published a detailed guide to ensuring online materials are accessible for persons with disabilities.

9.2.3 Student differences with respect to learning with technologies

It may seem obvious that different students will have different preferences for different kinds of technology or media. The design of teaching would cater for these differences. Thus if students are 'visual' learners, they would be provided with diagrams and illustrations. If they are auditory learners, they will prefer lectures and podcasts. It might appear then that identifying dominant learning styles should then provide strong criteria for media and technology selection. However, it is not as simple as that.

McLoughlin (1999), in a thoughtful review of the implications of the research literature on learning styles for the design of instructional material, concluded that instruction could be designed to accommodate differences in both cognitive-perceptual learning styles and Kolb's (1984) experiential learning cycle. In a study of new intakes conducted over several years at the University of Missouri-Columbia, using the Myers-Briggs inventory, Schroeder (1993) found that new students think concretely, and are uncomfortable with abstract ideas and ambiguity.

However, a major function of a university education is to develop skills of abstract thinking, and to help students deal with complexity and uncertainty. Perry (1970) found that learning in higher education is a developmental process. It is not surprising then that many students enter college or university without such 'academic' skills. Indeed, there are major problems in trying to apply learning styles and other methods of classifying learner differences to media and technology selection and use. Laurillard (2001) makes the point that looking at learning styles in the abstract is not helpful. Learning has to be looked at in context. Thinking skills in one subject area do not necessarily transfer well to another subject area. There are ways of thinking that are specific to different subject areas. Thus logical-rational thinkers in science do not necessarily make thoughtful husbands, or good literary critics.

Part of a university education is to understand and possibly challenge predominant modes of thinking in a subject area. While learner-centered teaching is important, students need to understand the inherent logic, standards, and values of a subject area. They also need to be challenged, and encouraged to think outside the box. In particular, at a university level we need strategies to gradually move students from concrete learning based on personal experience to abstract, reflective learning that can then be applied to new contexts and situations. Technology can be particularly helpful for that, as we saw in Chapter 8.

Thus when designing courses, it is important to offer a range of options for student learning within the same course. One way to do this is to make sure that a course is well structured, with relevant 'core' information easily available to all students, but also to make sure that there are opportunities for students to seek out new or different content. This content should be available in a variety of media such as text, diagrams, and video, with concrete examples explicitly related to underlying principles. The increasing availability of open educational resources (discussed in Chapter 11.2) makes the provision of this 'richness' of possible content much more viable.

Similarly, technology enables a range of learner activities to be made available, such as researching readings on the Web, online discussion forums, synchronous presentations, assessment through e-portfolios, and online group work. The range of activities increases the likelihood that a variety of learner preferences are being met, and also encourages learners to involve themselves in activities and approaches to learning where they may initially feel less comfortable. Thus it is important to ensure that students have a wide range of media (text, audio, video, computing) within a course or program.

Lastly, one should be careful in the assumptions made about student preferences for learning through digital technologies. On the one hand, technology 'boosters' such as Mark Prensky (2001) and Don Tapscott (2008) have argued that today's 'digital natives' are different from previous generations of students. They argue that today's students live within a networked digital universe and therefore expect their learning also to be all digitally networked. It is also true that professors in particular tend to underestimate students' access to advanced technologies (professors are often late adopters of new technology), so you should always try to find up-to-date information on what devices and technologies students are currently using, if you can.

On the other hand, it is also dangerous to assume that all students are highly 'digital literate' and are demanding that new technologies should be used in teaching. Jones and Shao (2011) conducted a thorough review of the literature on 'digital natives', with over 200 appropriate references, including surveys of relevant publications from countries in Europe, Asia, North America, Australia and South Africa. They concluded that:

- students vary widely in their use and knowledge of digital media;
- the gap between students and their teachers in terms of digital literacy is not fixed, nor is the gulf so large that it cannot be bridged;
- there is little evidence that students enter university with demands for new technologies that teachers and universities cannot meet;
- students will respond positively to changes in teaching and learning strategies that include the use of new technologies that are well conceived, well explained and properly embedded in courses and degree programmes. However there is no evidence of a pent-up demand amongst students for changes in pedagogy or of a demand for greater collaboration;
- the development of university infrastructure, technology policies and teaching objectives should be choices about the kinds of provision that the university wishes to make and not a response to general statements about what a new generation of students are demanding;
- the evidence indicates that young students do not form a generational cohort and they do not express consistent or generationally organised demands, thus challenging general assumptions about the differences between post-millennials, millennials, Generation X and

boomers in the way that they learn.

Graduating students that have been interviewed about learning technologies at the University of British Columbia made it clear that they will be happy to use technology for learning so long as it contributes to their success (in the words of one student, 'if it will get me better grades') but the students also made it clear that it was the instructor's responsibility to decide what technology was best for their studies.

It is also important to pay attention to what Jones and Shao are *not* saying. They are not saying that social media, personal learning environments, or collaborative learning are inappropriate, nor that the needs of students and the workforce are unchanging or unimportant, but the use of these tools or approaches should be driven by a holistic look at the needs of all students, the needs of the subject area, and the learning goals relevant to a digital age, and not by an erroneous view of what a particular generation of students are demanding.

In summary, one great advantage of the intelligent application of technology to teaching is that it provides opportunities for students to learn in a variety of ways, thus adapting the teaching more easily to student differences. Thus, the first step in media selection is to know your students, their similarities and differences, what technologies they already have access to, and what digital skills they already possess or lack that may be relevant for your courses. This is likely to require the use of a wide range of media within the teaching to accommodate these differences.

9.2.4 The information you need about your students

It is critical to know your students. In particular, you need the following information to provide an appropriate context for decisions about media and technology:

1. What is the mandate or policy of your institution, department or program with respect to student access in general (selective vs open; accommodation of disabilities, etc.)? How will students who do not have access to a chosen technology be supported?
2. What are the likely demographics of the students you will be teaching? How appropriate is the technology you are thinking of using for these students?
3. If your students are to be taught at least partly off campus, to which technologies are they likely to have convenient and regular access at home or work?
4. If students are to be taught at least partly on campus, what is – or should be – your or your department's policy with regard to students' access to devices in class?
5. What digital skills do you expect your students to have before they start the program?
6. If students are expected to provide their own access to technology, will you be able to provide unique teaching experiences that will justify the purchase or use of such technology?
7. What prior approaches to learning are the students likely to bring to your program? How suitable are such prior approaches to learning likely to be to the way you need to teach the course? How could technology be used to cater for student differences in learning?

There are many different ways to get the information needed to answer these questions. In many cases, you will still have to make decisions on insufficient evidence, but the more accurate information you have about your potential students, the better your likely choice of media and technology. Almost certainly, though, you will have a variety and diversity of students, so the design of your teaching will need to accommodate this.

Activity 9.2: Knowing your students

- How many of the questions in Section 9.2.4 can you answer off the top of your head?
- What additional information do you need, and where can you find it?

There is no feedback provided on these questions.

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9.3 Ease of Use

Figure 9.3.1 Technology reliability is important!
Image: © pixgood.com

9.3.1 Keep it simple

In most cases, the use of technology in teaching is a means, not an end. Therefore it is important that students and teachers do not have to spend a great deal of time on learning how to use educational technologies, or on making the technologies work. The exceptions of course are where technology is the area of study, such as computer science or engineering, or where learning the use of software tools is critical for some aspects of the curriculum, for instance computer-aided design in architecture, spreadsheets in business studies, and geographical information systems in geology. In most cases, though, the aim of the study is not to learn how to use a particular piece of educational technology, but the study of history, mathematics, or biology.

One advantage of face-to-face teaching is that it needs relatively little advance preparation time compared with for instance developing a fully online course. Media and technologies vary in their capacity for speed of implementation and flexibility in up-dating. For instance, blogs are much quicker and easier to develop and distribute than virtual reality. Teachers and instructors then are much more likely to use technology that is quick and easy to use, and students likewise will expect such features in technology they are to use for studying. However, what's 'easy' for instructors and students to use will depend on their digital literacy.

9.3.2 Computer and information literacy

If a great deal of time has to be spent by the students and teachers in learning how to use for instance software for the development or delivery of course material, this distracts from the learning and teaching. Of course, there is a basic set of literacy skills that will be required, such as the ability to read and write, to use a keyboard, to use word processing software, to navigate the Internet and use Internet software, and increasingly to use mobile devices. These generic skills though could be considered pre-requisites. If students have not adequately developed these skills in school, then an institution might provide preparatory courses for students on these topics.

It will make life a lot easier for both teachers and students if an institution has strategies for supporting students' use of digital media. For instance, at the University of British Columbia, the Digital Tattoo project prepares students for learning online in a number of ways:

- introducing students to a range of technologies that could be used for their learning, such as learning management systems, open educational resources, MOOCs and e-portfolios;
- explaining what's involved in studying online or at a distance;
- setting out the opportunities and risks of social media;
- advice on how to protect their privacy;
- how to make the most of connecting, networking and online searching;
- how to prevent cyber-bullying;
- maintaining a professional online presence.

If your institution does not have something similar, then you could direct your students to the Digital Tattoo site, which is fully open.

It is not only students though who may need prior preparation. Technology can be too seductive. You can start using it without fully understanding its structure or how it works. Even a short period of training – an hour of less – on how to use common technologies such as a learning management system or lecture capture could save you a lot of time and more importantly, enable you to see the potential value of all features and not just those that you stumble across.

9.3.3 Orientation

A useful standard or criterion for the selection of course media or software is that ‘novice’ students (students who have never used the software before) should be studying within 20 minutes of logging on. This 20 minutes may be needed to work out some of the key functions of the software that may be unfamiliar, or to work out how the course Web site is organized and navigated. This is more of an orientation period though than learning new skills of computing. If there is a need to introduce new software that may take a little time to learn, for instance, a synchronous ‘chat’ facility, or video streaming, it should be introduced at the point where it is needed. It is important though to provide time within the course for the students to learn how to do this.

9.3.4 Interface design

The critical factor in making technology transparent is the design of the interface between the user and the machine. Thus an educational program or indeed any Web site should be well structured, intuitive for the user to use, and easy to navigate.

Interface design is a highly skilled profession, and is based on a combination of scientific research into how humans learn, an understanding of how operating software works, and good training in graphic design. This is one reason why it is often wise to use software or tools that have been well established in education, because these have been tested and been found to work well.

The traditional generic interface of computers – a keyboard, mouse, and graphic user interface of windows and pull-down menus and pop-up instructions – is still extremely crude, and not isomorphic with most people’s preferences for processing information. It places very heavy emphasis on literacy skills and a preference for visual learning. This can cause major difficulties for students with certain disabilities, such as dyslexia or poor eyesight. However, in recent years, interfaces have started to become more user friendly, with touch screen and voice activated interfaces.

Nevertheless a great deal of effort often has to go into the adaptation of existing computer or mobile interfaces to make them easy to use in an educational context. The Web is just as much a prisoner of the general computer interface as any other software environment, and the educational potential of any Web site is also restricted by its algorithmic or tree-like structure. For instance, it does not always suit the inherent structure of some subject areas, or the preferred way of learning of some students.

There are several consequences of these interface limitations for teachers and instructors:

- it is really important to choose teaching software or other technologies that are intuitively easy to use, both by the students in particular, but also for the teacher/instructor in creating materials and interacting with students;

- when creating materials for teaching, the teacher needs to be aware of the issues concerning navigation of the materials and screen lay-out and graphics. While it is possible to add stimulating features such as audio and animated graphics, this comes at the cost of bandwidth. Such features should be added only where they serve a useful educational function, as slow delivery of materials is extremely frustrating for learners, who will normally have slower Internet access that the teacher creating the materials. Furthermore, web-based layout on desktop or laptop computers does not automatically transfer to the same dimensions or configurations on mobile devices, and mobile devices have a wide range of standards, depending on the device. Given that the design of Web-based materials requires a high level of specialized interface design skill, it is preferable to seek specialist help, especially if you want to use software or media that are not standard institutionally supported tools. This is particularly important when thinking of using new mobile apps, for instance;

- third, we can expect in the next few years some significant changes in the general computer interface with the development of speech recognition technology, adaptive responses based on artificial intelligence, and the use of haptics (e.g. hand-movement) to control devices. Changes in basic computer interface design could have as profound an impact on the use of technology in teaching as the Internet has.

9.3.5 Reliability

The reliability and robustness of the technology is also critical. Most of us will have had the frustration of losing work when our word programming software crashes or working 'in the cloud' and being logged off in the middle of a piece of writing. The last thing you want as a teacher or instructor is lots of calls from students saying they cannot get online access, or that their computer keeps crashing. (If the software locks up one machine, it will probably lock up all the others!) Technical support can be a huge cost, not just in paying technical staff to deal with service calls, but also in lost time of students and teachers.

'Innovation in teaching' will certainly bring rewards these days as institutions jostle for position as innovative institutions. It is often easier to get funding for new uses of technology than funding to sustain older but successful technologies. Although podcasts combined with a learning management system can be a very low-cost but highly effective teaching medium if good design is used, they are not sexy. It will usually be easier to get support for much more costly and spectacular technologies such as xMOOCs or virtual reality.

On the other hand, there is much risk in being too early into a new technology. Software may not be fully tested and reliable, or the company supporting the new technology may go out of business. Students are not guinea pigs, and reliable and sustainable service is more important to them than the glitz and glamour of untried technology. It is best to wait for at least a year for new apps or software to be fully tested in general applications before adopting them for teaching. It is wise then not to rush in and buy the latest software update or new product – wait for the bugs to be ironed out. Also if you plan to use a new app or technology that is not generally supported by the institution, check first with IT services to ensure there are not security, privacy or institutional bandwidth issues. Thus it is better to be at the leading edge, just behind the first wave of innovation, rather than at the bleeding edge.

A feature of online learning is that peak use tends to fall outside normal office hours. Thus it is really important that your course materials sit on a reliable server with high-speed access and 24 hour, seven days a week reliability, with automatic back-up on a separate, independent server located in a different building. Ideally, the servers should be in a secure area (with for instance emergency electricity supply) with 24 hour technical support, which probably means locating your servers with a central IT service or 'in the cloud', which means it is all the more important to ensure that materials are safely and independently backed up.

However, the good news is that most commercial educational software products such as learning management systems and lecture capture, as well as servers, are very reliable. Open source software too is usually reliable but probably slightly more at risk of technical failure or security breaches. If you have good IT support, you should receive very few calls from students on technical matters. The main technical issue that faculty face these days appears to be software up-grades to learning management systems. This often means moving course materials from one version of the software to the new version. This can be costly and time-consuming, particularly if the new version is substantially different from the previous version. Overall, though, reliability should not be an issue.

In summary, ease of use requires professionally designed commercial or open source course software, specialized help in graphics, navigation and screen design for your course materials, and strong technical support for server and software management and maintenance. Certainly in North America, most institutions now provide IT and other services focused specifically on supporting technology-based teaching. However, without such professional support, a great deal of your time as a teacher will be spent on technical issues, and to be blunt, if you do not have easy and convenient access to such support, you would be wise not to get heavily committed to technology-based teaching until that support is available.

9.3.6 Questions for consideration

Ease of use is another critical factor in the successful use of technology for teaching. Some of the questions then that you need to consider are:

1. How intuitively easy to use, both by students and by yourself, is the technology you are considering?
2. How reliable is the technology?
3. How easy is it to maintain and upgrade the technology?
4. The company that is providing the critical hardware or software you are using: is it a stable company that is not likely to go out of business in the next year or two, or is it a new start-up? What strategies are in place to secure any digital teaching materials you create should the organisation providing the software or service cease to exist?
5. Do you have adequate technical and professional support, both in terms of the technology and with respect to the design of materials?
6. How fast developing is this subject area? How important is it to regularly change the teaching materials? Which technology will best support this?
7. To what extent can the changes be handed over to someone else to do, and/or how essential is it for you to do them yourself?
8. What rewards am I likely to get for using new technology in my teaching? Will use of a new technology be the only innovation, or can I also change my way of teaching with this technology to get better results?
9. What are the risks in using this technology?

Activity 9.3 Ease of use

1. what would be the main challenges of just putting a web cam in the lecture hall and recording your lecture on your computer for streaming later for students who can’t get to a lecture?

2. how would you rank these technologies for ease of use (a) by you as a teacher/instructor (b) by students?:
    - a learning management system
    - live video (e.g. a streamed, live lecture using video-conferencing software such as Zoom, GoToMeeting, Microsoft Team)
    - books
    - virtual reality
    - a podcast (a digital audio recording)

Click on the podcast below for my feedback on this activity:

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9.4 Cost

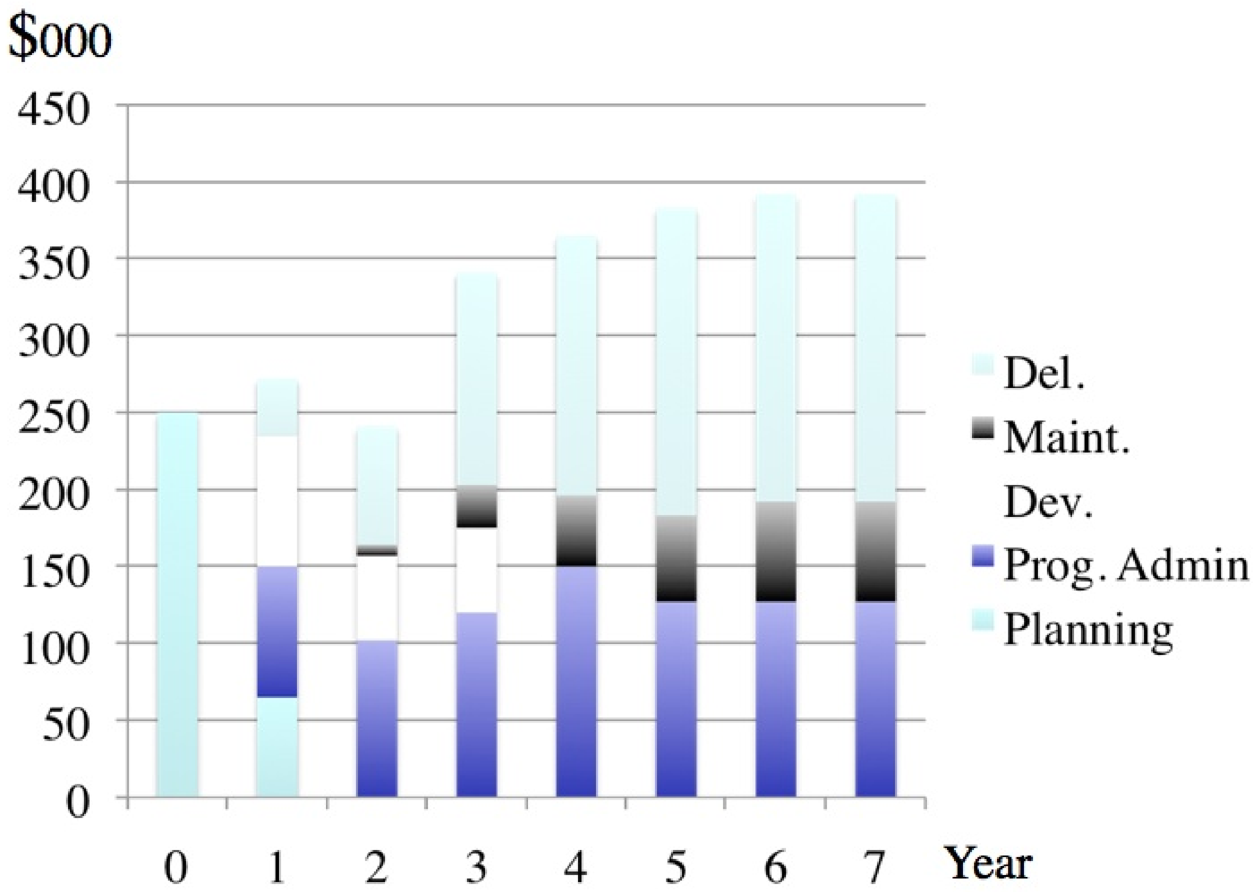

Figure 9.4.1 Total cost of a fully online masters' course over 7 years (from Bates and Sangrà, 2011). For an explanation of this graph, click on the podcast below

An audio element has been excluded from this version of the text. You can listen to it online here: https://pressbooks.bccampus.ca/teachinginadigitalagev2/?p=230

9.4.1 A revolution in media

Until as recently as ten years ago, cost was a major discriminator affecting the choice of technology (Hülsmann, 2000, 2003; Rumble, 2001; Bates, 2005). For instance, for educational purposes, audio (lectures, radio, audio-cassettes) was far cheaper than print, which in turn was far cheaper than most forms of computer-based learning, which in turn was far cheaper than video (television, cassettes or video-conferencing). All these media were usually seen as either added costs to regular teaching, or too expensive to use to replace face-to-face teaching, except for purely distance education on a fairly large scale.

However, there have been dramatic reductions in the cost of developing and distributing all kinds of media (except face-to-face teaching) in the last ten years, due to several factors:

- rapid developments in consumer technologies such as smartphones that enable text, audio and video to be both created and transmitted by end users at low cost;
- compression of digital media, enabling even high bandwidth video or television to be carried over wireless, landlines and the Internet at an economic cost (at least in economically advanced countries);
- improvements in media software, making it relatively easy for non-professional users to create and distribute all kinds of media;
- increasing amounts of media-based open educational resources, which are already developed learning materials that are free for teachers and students alike to use.

The good news then is that in general, and in principle, *cost should no longer be an automatic discriminator in the choice of media*. If you are happy to accept this statement at face value, than you can skip the rest of this chapter. *Choose the mix of media that best meets your teaching needs, and don't worry about which medium is likely to cost more*. Indeed, a good case could be made that it would now be cheaper to replace face-to-face teaching with purely online learning, if cost was the only consideration.

In practice however costs can vary enormously both between and within media, depending once again on context and design. Since the main cost from a teacher's perspective is their time, it is important to know what are the 'drivers' of cost, that is, what factors are associated with increased costs, depending on the context and the medium being used. These factors are less influenced by new technological developments, and can therefore be seen as 'foundational' principles when considering the costs of educational media.

Unfortunately there are many different factors that can influence the actual cost of using media in education, which makes a detailed discussion of costs very complex (for a more detailed treatment, see Bates and Sangrà, 2011). As a result, I will try to identify the main cost drivers, then provide a table that provides a simplified guide to how these factors influence the costs of different media, including face-to-face teaching. This guide again should be considered as a heuristic device, so see this section as Media Costs 101.

9.4.2 Cost categories

The main cost categories to be considered in using educational media and technologies, and especially blended or online learning, are as follows:

9.4.2.1 Development

These are the costs needed to pull together or create learning materials using particular media or technologies. There are several sub-categories of development costs:

- *production costs*: making a video or building a course section in a learning management system, or creating a virtual world. Included in these costs will be the time of specialist staff, such as web designers or media or computer specialists, as well as any costs in web design or video production;
- *your time as an instructor*: the work you have to do as part of developing or producing materials. This will include planning/course design as well as development. Your time is money, and probably the largest single cost in using educational technologies, but more importantly, if you are developing learning materials you are not doing other things, such as research or interacting with students, so there is a real cost, even if it is not expressed in dollar terms;
- *copyright clearance* if you are using third party materials such as photos or video clips. Again, this is more likely to be thought of as time in finding and clearing copyright more than money;
- probably the cost of an *instructional designer* in terms of their time.

Development costs are usually *fixed* or 'once only' and are independent of the number of students. Once media are developed, they are usually scalable, in that once produced, they can be used by any number of learners without increased development costs. Using open educational resources can greatly reduce media development costs.

9.4.2.2 Delivery

This includes the cost of the educational activities needed during offering the course and would include instructional time spent interacting with students, instructional time spent on marking assignments, and would include the time of other staff supporting delivery, such as teaching assistants, adjuncts for additional sections and instructional designers and technical support staff.

Because of the cost of human factors such as instructional time and technical support needed in media-based teaching, delivery costs tend to increase as student numbers increase, and also have to be repeated each time the course is on offer. In other words, they are *recurrent*. However, increasingly with Internet-based delivery, there is usually a zero direct *technology* cost in delivery.

9.4.2.3 Maintenance costs

Once materials for a course are created, they need to be maintained. Urls go dead, set readings may go out of print or expire, and more importantly new developments in the subject area may need to be accommodated. Thus once a course is offered, there are ongoing maintenance costs.

Instructional designers and/or media professionals can manage some of the maintenance, but nevertheless teachers or instructors will need to be involved with decisions about content replacement or updating. Maintenance is not usually a major time consumer for a single course, but if an instructor is involved in the design and production of several online courses, maintenance time can build to a significant amount.

Maintenance costs are usually independent of the number of students, but are dependent on the number of courses an instructor is responsible for, and are recurrent each year.

9.4.2.4 Overheads

These include infrastructure or overhead costs, such as the cost of licensing a learning management system, lecture capture technology and servers for video streaming. These are real costs but not ones that can be allocated to a single course but will be shared across a number of courses. Overheads are usually considered to be institutional costs and, although important, probably will not influence a teacher's decision about which media to use, provided these services are already in place and the institution does not directly charge for such services.

However, if a new online program is to be offered on a full cost-recovery basis, then other institutional overheads will also need to be added. Some will be the same as for on-campus courses (for example, a contribution towards the President's Office), but other overheads applied to on-campus students, such as building maintenance, will not apply to a fully online program (which is the main reason that the net cost of an online program is usually less than that of a campus-based program).

8.4.3 Cost drivers

The primary factors that drive cost are:

- the development/production of materials;
- the delivery of materials;
- number of students/scalability;
- the experience of an instructor working with the medium;
- whether the instructor develops materials alone (self-development) or works with professionals.

Production of technology-based materials such as a video program, or a Web site, is a fixed cost, in that it is not influenced by how many students take the course. However, production costs can vary depending on the design of the course. Engle (2014) showed that depending on the method of video production, the development costs for a MOOC could vary by a factor of six (the most expensive production method – full studio production – being six times that of an instructor self-recording on a laptop).

Nevertheless, once produced, the cost is independent of the number of students. Thus the more expensive the course to develop, the greater the need to increase student numbers to reduce the average cost per student. (Or put another way, the greater the number of students, the more reason to ensure that high quality production is used, whatever the medium). In the case of MOOCs (which tend to be almost twice as expensive to develop as an online course for credit using a learning management system – University of Ottawa, 2013) the number of learners is so great that the average cost per student is very small. Thus there are opportunities for economies of scale from the development of digital material, provided that student course enrolments can be increased (which may not always be the case). This can be described as the potential for the *scalability* of a medium.

Similarly, there are costs in teaching the course once the course is developed. These tend to be *variable* costs, in that they increase as class size increases. If student-teacher interaction, through online discussion forums and assignment marking, is to be kept to a manageable level, then the teacher-student ratio needs to be kept relatively low (for instance, between 1:25 to 1:40, depending on the subject area and the level of the course). The more students, the more time a teacher will need to spend on delivery, or additional contract instructors will need to be hired. Either way, increased student numbers generally will lead to increased costs. MOOCs are an exception. Their main value proposition is that they do not provide direct learner support, so have zero delivery costs. However, this is probably the reason why such a small proportion of participants successfully complete MOOCs.

There may be benefits then for a teacher or for an institution in spending more money up front for interactive learning materials if this leads to less demand for teacher-student interaction. For instance, a mathematics course might be able to use automated testing and feedback and simulations and diagrams, and pre-designed answers to frequently asked questions, with less or even no time spent on individual assignment marking or communication with the teacher. In this case it may be possible to manage teacher-student ratios as high as 1:200 or more, without significant loss of quality.

Also, experience in using or working with a particular medium or delivery method is also important. The first time an instructor uses a particular medium such as podcasting, it takes much longer than subsequent productions or offerings. Some media or technologies though need much more effort to learn to use than others. Thus a related cost driver is whether the instructor works alone (self-development) or works with media professionals. Self-developing materials will usually take longer for an instructor than working with professionals.

There are advantages in teachers and instructors working with media professionals when developing digital media. Media professionals will ensure the development of a quality product, and above all can save teachers or instructors considerable time, for instance through the choice of appropriate software, editing, and storage and streaming of digital materials. Instructional designers can help in suggesting appropriate applications of different media for different learning outcomes. Thus as with all educational design, a team approach is likely to be more effective, and working with other professionals will help control the time teachers and instructors spend on media development.

Lastly, design decisions are critical. Costs are driven by design decisions within a medium. For instance cost drivers are different between lectures and seminars (or lab classes) in face-to-face teaching. Similarly, video can be used just to record talking heads, as in lecture capture, or can be used to exploit the affordances of the medium (see Chapter 8), such as demonstrating processes or location shooting. Computing has a wide and increasing range of possible designs, including online collaborative learning (OCL), computer-based learning, animations, simulations or virtual worlds.

Figure 9.4.3 attempts to capture the complexity of cost factors, focusing mainly on the perspective of a teacher or instructor making decisions. Again, this should be seen as a heuristic device, a way of thinking about the issue. Other factors could be added (such as social media, or maintenance of materials). I have given my own personal ratings for each cell, based on my experience. I have taken conventional teaching as a medium or 'average' cost, then ranked cells as to whether there is a higher or lower cost factor for the particular medium. Other readers may well rate the cells differently.

			Cost drivers (for instructors)				
			develop-ment	***delivery***	***scal-able***	***experi-ence***	***self-dev.***
Medium	***Face-to-face***	lectures	medium	medium	partly	low	low
		semi-nars	low	high	no	medium	low
	Print	books	high	high	yes	high	high
	Audio	pod-casts	low	low	yes	low	low
	Video	talking heads	medium	low	yes	low	medium
		afford-ances	high	low	yes	high	high
	Com-puting	OCL	low	high	no	medium	low
		CBL	high	low	yes	medium	medium
		ans. or sims	high	low	yes	high	high
		virtual worlds	high	low	?	high	high

Figure 9.4.3 Cost drivers for educational media

Although the time it takes to develop and deliver learning using different technologies is likely to influence an instructor's decision about what technology to use, it is not a simple equation. For instance, developing a good quality online course using a mix of video and text materials may take much more of the instructor's time to prepare than if the course was offered through classroom teaching. However, the online course may take less time in delivery over several years, because students may be spending more time on task online, and less time in direct interaction with the instructor. Once again, we see that design is a critical factor in how costs are assessed.

In short, from an instructor perspective, time is the critical cost factor. Technologies that take a lot of time to use are less likely to be used than those that are easy to use and thus save time. But once again design decisions can greatly affect how much time teachers or instructors need to spend on any medium, and the ability of teachers and students to create their own educational media is becoming an increasingly important factor.

9.4.4 Issues for consideration

9.4.4.1 Lecture capture vs LMS: cost factors

In recent years, university faculty have generally gravitated more to lecture capture and video streaming for online course delivery, particularly in institutions where online or distance learning is relatively new, because it is 'simpler' to do than redesign and create mainly text based materials in learning management systems. Lecture capture also more closely resembles the traditional classroom method, so less change is required of the instructor.

Pedagogically though (depending on the subject area) lecture capture may be less effective than an online course using collaborative learning and online discussion forums. Also, from an institutional perspective lecture capture has a much higher technology cost than a learning management system. And, of course, lecture capture is often used in conjunction with an LMS. What different technologies tend to do though is change the spread of an instructors time between development and delivery. Media such as an LMS can have higher initial development costs but much lower annual delivery and maintenance costs than face-to-face teaching, for instance.

9.4.4.2 The student factor

Also, students themselves can now use their own devices to create multimedia materials for project work or for assessment purposes in the form of e-portfolios. Media allow instructors, if they wish, to move a lot of the hard work in teaching and learning from themselves to the students. Media allow students to spend more time on task, and low cost, consumer media such as mobile phones or tablets enable students themselves to create media artefacts, enabling them to demonstrate their learning in concrete ways. This does not mean that instructor 'presence' is no longer needed when students are studying online, but it does enable a shift in where and how a teacher or instructor can spend their time in supporting learning.

9.4.5 Conclusion

Cost is a critical factor influencing media choice. For instructors, the main cost will be their time. However it is important to look at time over the length of a course over several years, not just in the initial production or preparation of materials. Carefully produced media may take more time in production, but can save a great deal of time in delivery, especially if student activities and automated feedback can be built into the design. This is why some institutions have a special fund for innovative teaching or technology-based teaching and learning, to free up instructor time for design and development.

Media also differ considerably in the balance of costs between development, delivery, maintenance and overheads. Face-to-face teaching has minimal development costs, but heavy delivery costs in terms of instructor time; an LMS-based online course is has more of an equal balance between development and delivery costs. Serious games usually have high development costs but very low delivery costs.

Whatever the balance, cost is still a critical factor in media choice.

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Activity 9.4 How will cost affect your decision about what media to use?

1. Are concerns about the possible cost/demands on your time influencing your decisions on what media to use? If so in what ways? Has this section on costs changed your mind?
2. How much time do you spend preparing lectures? Could that time be better spent preparing learning materials, then using the time saved from delivering lectures on interaction with students (online and/or face-to-face)?
3. What kind of help can you get in your institution from instructional designers and media professionals for media design and development? What media decisions will the answer to this question suggest to you? For instance, if you are in a k-12 school with little or no chance for

professional support, what kind of media and design decisions are you likely to make?

4. If you were filling in the cells for Figure 9.4.3, what differences would there be with my entries? Why?
5. In Figure 9.4.3, add the following media: e-portfolios (in computing) and add another section under computing: social media. Add blogs, wikis and cMOOCs. How would you fill in the cells for each of these for development, delivery, etc.? Are there other media you would also add?
6. Do you agree with the statement: *It would now be cheaper to replace face-to-face teaching with purely online learning, if cost was the only consideration*? What are the implications for your teaching if this is really true? What considerations would still justify face-to-face teaching?

For my feedback on some of these questions, click on the podcast below:

An audio element has been excluded from this version of the text. You can listen to it online here: https://pressbooks.bccampus.ca/teachinginadigitalagev2/?p=230

9.5 Teaching and media selection

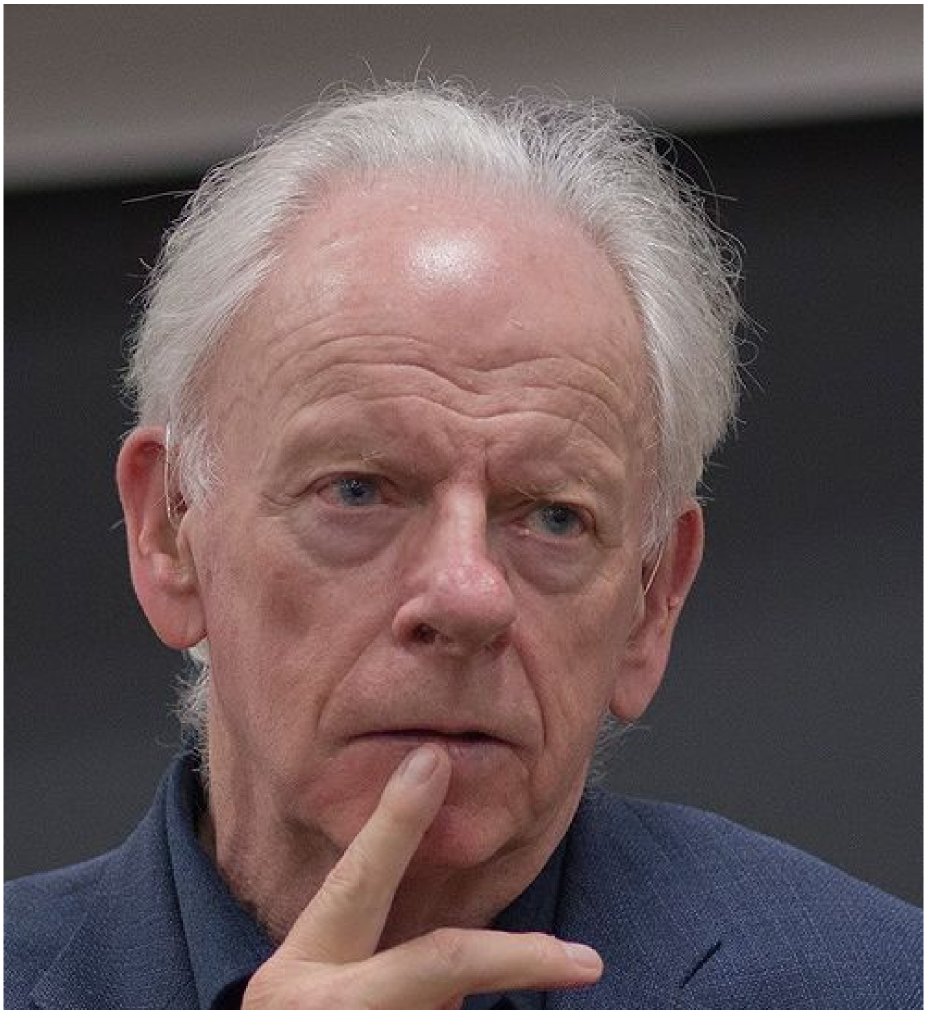

Figure 9.5.1 People do not necessarily learn better … when the speaker's image is added to the screen (Mayer, 2009).

9.5.1 The importance of design in multimedia teaching

Chapter 8 discussed the various pedagogical differences between media. Identifying appropriate uses of media is both an increasingly important requirement of teachers and instructors in a digital age, and a very complex challenge. This is one reason for working closely with instructional designers and media professionals whenever possible. Teachers working with instructional designers will need to decide which media they intend to use on pedagogical as well as operational grounds, which was the purpose of Chapter 8.

However, once the choice of media has been made, by focusing on design issues we can provide further guidelines for making appropriate use of media. In particular, having gone through the process suggested in Chapter 8 of identifying possible teaching roles or functions for different media, we can then draw on the work of Mayer (2012) and Koumi (2006, 2015) to ensure that whatever choice or mix of media we have decided on, the design leads to effective teaching.

Mayer's research focused heavily on cognitive overload in rich, multimedia teaching. From all his research over many years, Mayer identified 12 principles of multimedia design, based on how learners cognitively process multimedia:

9.5.1.1 Coherence

People learn better when extraneous words, pictures and sounds are excluded rather than included. Basically, keep it simple in media terms.

9.5.1.2 Signalling

People learn better when cues that highlight the organization of the essential material are added. This replicates earlier findings by Bates and Gallagher (1977). Students need to know what to look for in multimedia materials.

9.5.1.3 [Avoid] Redundancy

People learn better from graphics + narration, than from graphics, narration and on-screen text.

9.5.1.4 Spatial contiguity

People learn better when corresponding words and pictures are presented near rather than far from each other on the page or screen

9.5.1.5 Temporal contiguity

People learn better when corresponding words and pictures are presented simultaneously rather than successively.

9.5.1.6 Segmenting

People learn better when a multimedia lesson is presented in user-paced segments rather than as a continuous lesson. Thus several 'YouTube' length videos are more likely to work better than a 50 minute video.

9.5.1.7 Pre-training

People learn better from a multimedia lesson when they know the names and the characteristics of the main concepts. This suggests a design feature for flipped classrooms, for instance. It may be better to use a lecture or readings that provide a summary of key concepts and principles before showing more detailed examples or applications of such principles in a video.

9.5.1.8 Modality

People learn better from graphics and narration than from animation and on-screen text. This reflects the importance of learners being able to combine both hearing and viewing at the same time to reinforce each other in specific ways.

9.5.1.9 Multimedia

People learn better from words and pictures than from words alone. This also reinforces what I wrote in 1995: *Make all four media available to teachers and learners* (Bates, 1995, p.13).

9.5.1.10 Personalization

People learn better from multimedia lessons when words are in conversational style rather than formal style. I would go even further than Mayer here. Multimedia can enable learners (particularly distance learners) to relate to the instructor, as suggested by Durbridge's research (1983, 1984) on audio combined with text. Providing a 'human voice and face' to the teaching helps motivate learners, and makes multimedia teaching feel that it is directed solely at the individual learner, if a conversational style is adopted.

9.5.1.11 Voice

People learn better when the narration in multimedia lessons is spoken in a friendly human voice rather than a machine voice.

9.5.1.12 [No] image

People do not necessarily learn better from a multimedia lesson when the speaker's image is added to the screen.

In re-reading Mayer's work, I am struck by the similarities in findings, using different research methods, different multimedia technologies, and different contexts, to the research from the Audio-Visual Media Research Group at the British Open University in the 1970s and 1980s (Bates, 1984).

More recently, the University of British Columbia has done an excellent job of suggesting how Mayer's design principles could be operationalised. Staff at the University of British Columbia have combined Mayer's findings with Robert Talbert's experience from developing a series of successful screencasts on mathematics, into a set of practical design guidelines for multimedia production.

Talbert's key design principles are:

- keep it Simple: focus on one idea at a time.
- keep it Short: keep videos to a length 5-6 minutes max. to maximize attention.
- keep it Real: model the decision making and problem solving processes of expert learners.
- keep it Good: be intentional about planning the video; strive to produce the best video and audio quality possible.

Thus design decisions are critical in influencing the effectiveness of a particular technology. Well-designed lectures will teach better than a poorly designed online course, and vice versa.

9.5.2 Teaching as a weak discriminator in media selection

Chapter 8 was exclusively focused on the best uses of each medium. Section 9.5.1 above then goes on to look at effective design of multimedia. Most teachers and instructors would put the effectiveness of a medium for teaching and learning as the first criterion for media selection. If the technology is not educationally effective, why would you use it? Why do we need the other parts of the SECTIONS model?

However, if a student cannot access or use a technology, there will be no learning from that technology, no matter how useful the educational affordances or how well the medium is designed. Furthermore, motivated teachers will overcome educational weaknesses or shortcomings in a particular technology, or conversely teachers inexperienced in using media will often under-exploit the potential of a medium (such as using video for talking heads).

Similarly, students will respond differently to different technologies due to preferred learning styles or differences in motivation. Students who work hard can overcome poor use of learning technologies. It is not surprising then that with so many variables involved, teaching and learning is a relatively weak discriminator for selecting and using technologies. Access (and ease of use) are stronger *discriminators* than teaching effectiveness in selecting media. This explains why teaching that does not really exploit the educational affordances of a medium can often still get good results. Nevertheless, ideally one should try to make best use of the pedagogical features of a medium because when it is then combined with the other SECTIONS criteria, the teaching is likely to be more effective.

9.5.3 Questions for consideration

Therefore, it is not enough to focus just on the design of multimedia materials, as important as design is, even considering just the pedagogical context. The choice and use of media need to be related to other factors (what Mayer calls ‘boundary conditions’), such as individual differences between learners, the complexity of the content, and the desired learning outcomes. Thus when considering media from a strictly teaching perspective, the following questions need to be considered:

1. Who are my students?
2. What content needs to be covered?
3. What are the desired learning outcomes from the teaching in terms of skills development?
4. What instructional strategies or approaches to learning do I plan using?
5. What are the unique pedagogical characteristics of different media? How might different media help with the presentation of content and development of student skills in this course?
6. What is the best way to present the content to be covered in this course? How can media help with the presentation of content? Which media for what content?
7. What skills am I trying to develop on this course? How can media help students with the development of the requisite skills for this course? Which media for which skills?
8. What principles do I need to use when designing multimedia materials for their most

effective use?

Working through these questions is likely to be an iterative rather than a sequential process. Depending on the way you prefer to think about and make decisions, it may help to write down the answers to each of the questions, but going through the process of thinking about these questions is probably more important, leaving you with the freedom to make choices on a more intuitive basis, having first taken all these – and other – factors into consideration.

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Mayer, R. E. (2009). *Multimedia learning* (2nd ed). New York: Cambridge University Press

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Activity 9.5 Multimedia design principles

1. How well do you think Mayer's design principles (9.5.1 to 9.5.12) would apply to classroom teaching?

For feedback on this question, click on the podcast below.

An audio element has been excluded from this version of the text. You can listen to it online here: https://pressbooks.bccampus.ca/teachinginadigitalagev2/?p=233

9.6 Interaction

Figure 9.6.1 Computers enable learners to interact with learning materials (also 'inherent' interaction)

The fifth element of the SECTIONS model for selecting media is interaction. How do different media enable interaction? The extent to which a medium enables interaction – and the kind of interaction – is critically important, as there is now an overwhelming amount of research evidence to suggest that students learn best when they are 'active' in their learning. But what does this mean? And what role can or do new technologies play in supporting active learning?

9.6.1. Types of learner interaction

There are three different ways learners can interact when studying (Moore, 1989), and each of these ways requires a somewhat different mix of media and technology.

9.6.1.1 Interaction with learning materials

This is the interaction generated when students work on a particular medium, such as a printed textbook, a learning management system, or a short video clip, without direct intervention from an instructor or other students. This interaction can be 'reflective', without any overt actions, or it can be 'observable', in the form of an assessed response, such as a multiple choice test, or as notes to assist memory and comprehension.

Computer technology can greatly facilitate learners' interaction with learning resources. Self-administered online tests can provide feedback to students on their comprehension or coverage of a subject area. Such tests can also provide feedback to teachers on topic areas where students are having difficulty, and can also be used for grading of students on their comprehension. Using standard test software built into learning management systems, students can be automatically assessed and graded on their comprehension of course materials. More advanced activities might include composing music using software that converts musical notation to audio, entering data to test concepts through online simulations, or participating in games or decision-making scenarios controlled by the computer. Thus computer-managed learner interaction is particularly good for developing comprehension and understanding of concepts and procedures, but it has limitations in developing the higher order learning skills of analysis, synthesis and critical thinking, without additional human intervention of some kind.

There are other ways besides computer-managed learning to facilitate interaction between learners and learning material. *Textbooks* may include activities set by the author (as in this textbook), or instructors can set student activities around set readings. Other student activities might include reading text or watching videos embedded in a learning management system, conducting a structured approach to finding and analyzing web-based materials, or downloading and editing information from the web to create e-portfolios of work. These activities may or may not be assessed, although evidence suggests that students, and in particular students studying online, tend to focus more an assessed activities.

In other words, with good design and adequate resources, technology-based instruction can provide high levels of student interaction with the learning materials. There are strong economic advantages in exploiting the possibilities of learners' interaction with learning materials, because intense student-interaction with learning resources increases the time students spend on learning ('time-on-task'), which tends to lead to increased learning (see Means et al., 2010). Perhaps more importantly, such activity, when well designed, can reduce the time the teacher needs to spend on interacting with each student.

9.6.1.2 Interaction between students and teacher

Figure 9.6.2 Student-teacher interaction Image: © Joseph Mehling, DartmouthLife, 2007

Student-teacher interaction is often needed though in order to develop many of the higher order learning outcomes, such as analysis, synthesis, and critical thinking. This is particularly important for developing academic learning, where students are challenged to question ideas, and to acquire deep understanding. This often requires dialogue and conversation, either one-on-one between instructor and students, or between an instructor and a group of students. The role of the teacher in for instance either face-to-face seminars or online collaborative learning is therefore critical.

Some technologies, such as online discussion forums, enable or encourage such dialogue or discourse between students and instructors at a distance. The main limitation of student-teacher interaction is that it can be time-demanding for the teacher, and therefore does not scale easily.

9.6.1.3 Student – student interaction

Figure 9.6.3 A student directed seminar at UBC Image: © University of British Columbia, 2014

High quality student-student interaction can be provided equally well both in face-to-face and online learning contexts. Asynchronous online discussion forums built into learning management systems can enable this kind of interaction. Connectivist MOOCs and communities of practice also enable student-student interaction.

Again though quality depends on good design. Merely putting students together in a group, whether online or face-to-face, is not likely to lead to either high levels of participation or high quality learning without careful thought being given to the educational goals of discussion within a course, the topics for discussion and their relationship to assessment and learning outcomes, and without strong preparation of the students by the instructor for self-directed discussions (see Chapter 4, Section 4, for more on this.)

In a technologically rich learning environment, then, a key decision for a teacher or course designer is choosing the best mix of these three different kinds of interaction, taking into consideration the epistemological approach, the amount of time available for both students and instructor, and the desired learning outcomes. Technology can enable all three kinds of interaction.

9.6.2 The interactive characteristics of media and technologies

Different technologies can enhance or inhibit each of the three types of interactivity outlined above. This again means looking at the dimension of interactivity as it applies to different media and technology. This dimension has three components or points on the dimension in terms of the extent an active response from a user is required when a medium or technology is used for teaching.

9.6.2.1 Inherent interactivity

Some media are inherently 'active' in that they 'push' learners to respond. An example is adaptive learning, where students cannot progress to the next stage of learning without interacting through a test that ascertains whether they have learned sufficiently to progress to the next stage, or what ‘corrective’ learning they still need to do. Behaviourist computer-based learning is inherently interactive, as it forces learners to respond. Technologies that control how a learner responds are often associated with more behaviourist approaches to teaching and learning.

9.6.2.2 Designed interactivity

Although some media or technologies are not inherently interactive, they can be explicitly designed to encourage interaction with learners. For instance, although a web page is not inherently interactive, it can be designed to be interactive, by adding a comment box or by requiring users to enter information or make choices. In particular, teachers or instructors can add or suggest activities within a particular medium. A podcast can be designed so that students stop the podcast every few minutes to do an activity based on the content of the podcast. This approach can be applied just as much to textbooks, where activities can be included, as to web pages.

In many cases, though, a medium will require the intervention of a teacher or instructor both to set activities around the learning materials and to provide appropriate feedback, thus adding to rather than reducing the workload of instructors. Thus where instructors have to intervene either to design activities or to provide feedback, the cost or time demands on the instructor are likely to be greater than if the other two kinds of interaction are used.

9.6.2.3 User-generated interaction

Some media may not have explicit interaction built in, but end users may still voluntarily interact with the medium, either cognitively and/or through some physical response. For instance someone in an art gallery may cognitively or emotionally respond to a particular painting (while others may just glance at it or pass it by). Students may choose to make sketches or drawings from the painting. Learners may respond in similar ways to reading a novel or poem.

The creators of the work may in fact deliberately design the work to encourage reflection or analysis, but not in explicit ways, leaving the interpretation of a work to the viewer or reader. (This of course is a constructivist approach to learning.) Media that encourage learners independently to be active without the necessary intervention of a teacher or instructor also have cost advantages, although the quality of the interaction will be more difficult to monitor or assess.

9.6.2.4 Who’s in control?

Thus one dimension of interactivity is control: to what extent is interaction controlled or enabled by the technology, by the creators/instructors, or by the users/learners? It can be seen that this is a complex dimension, once again influenced by epistemological positions, and also by design decisions on the teacher’s part. These categories of interactivity are in no way ‘fixed’, with different levels or types of interaction possible within the same medium or technology. In the end, interaction needs to be linked to desired learning outcomes. What kind of interaction will best lead to a particular type of learning outcome, and what technology or medium best provides this kind of interaction?

9.6.3 Interaction and feedback

Feedback is an important aspect of interaction, and timely and appropriate feedback on learner activities is often essential for effective learning. In particular, to what extent is feedback possible within a particular medium? Although for instance a learner may respond actively to a poem in a book, feedback on that interaction is usually not available just from the reading. Some other medium will need to be used to provide that feedback, such as a face-to-face poetry class or an online discussion forum.

On the other hand, with computer-based learning, once a student has responded to a multiple-choice question, the computer can mark the question and give almost instant feedback. However, with some technologies such as print, providing appropriate or immediate feedback to learners on their activities may be difficult or impossible. Although 'model' or 'correct' answers might be provided in a text on another page, quality feedback on activities must be provided by a teacher or instructor when using a printed medium.

Thus media and technologies again differ in their capacity to provide various kinds of feedback. From a teaching perspective, it is important to be clear about what kind of feedback is likely to be most effective, and then the most effective way to provide that feedback. In particular, under what circumstances is it appropriate to automate feedback, and when should feedback be provided by a teacher/instructor, or perhaps a teaching assistant, or even by other students?

9.6.4 Analysing the interactive qualities of different media

In Figure 9.6.4 I have analysed the interactive qualities of different educational media along two different dimensions: different types of student interaction; and characteristics of the medium, in terms of whether interaction is built into the medium, or needs to be added through deliberate design, or whether it is left to the learner to decide how to interact.

		Media interaction characteristics		
		Inherent	*Designed*	*Learner-generated*
Types of student interaction	*Learner-materials*	• adaptive learning • xMOOCs • simulations • computer-marked assignments	• textbooks • LMSs • podcasts	• TV broadcasts • novels • podcasts • YouTube videos
	Learner-teacher	• face-to-face seminars	• online discussion forums (OCL) • face-to-face lectures • e-portfolios	• e-mail • e-portfolios
	Learner-learners	• cMOOCs • virtual worlds	• group work	• social media • wikis

Figure 9.6.4 Media and student interaction

I have allocated a number of different media here according to the type of learner activity they help generate. The actual location though of some of these media will be dependent on design decisions made by the instructor. For instance, a podcast could be accompanied by an activity (designed), or just be a straight broadcast, with the student left to interpret its meaning and purpose in the course (learner-generated). In some cases, an activity may be triggered by one medium (such as a podcast) but the actual activity and the feedback may take place in another medium (such as through an online assessment).

9.6.5 Summary

Thus it can be seen that media and technology are somewhat slippery when it comes to categorising them in terms of interaction, because instructors and learners often have a choice in how the medium will actually be used, and that will affect how learner interaction and feedback takes place within a single medium. Thus once again the quality of the design of the interactive experiences is as important as the medium of choice for enabling the activity, although an inappropriate choice of technology can reduce the level of activity and/or the quality of the interactions. In reality teachers and learners are likely to use a combination of media and technologies to ensure high quality interactivity. However, using a number of different media is likely to increase cost and workload for both instructors and learners.

Once again, there is no evaluative judgement on my part in terms of which media or characteristics provide the 'best' interactivity. The choice of medium should depend on the kind of activities that are judged important by a teacher or instructor within the overall context of the teaching. The purpose of this analysis is to sensitize you to the differences between educational media in generating or facilitating different types of interactivity, so that you can make informed decisions. In this case, though, there are no clear media or technology 'winners' in terms of interactivity. Design decisions are likely to be more important than technology choice. Nevertheless, technology can enable students separated from their instructors still to get quality activities and feedback, and when appropriately used, technology used to support activities can result in more time on task for students.

9.6.6 Questions for consideration

1. In terms of the skills I am trying to develop, what kinds of interaction will be most useful? What media or technology could I use to facilitate that kind of interaction?
2. In terms of the effective use of my time, what kinds of interaction will produce a good balance between on the one hand student comprehension and student skills development, and on the other the amount of time I will be interacting personally or online with students?

Activity 9.6 Using media to promote student activity

1. Go to YouTube and type in your subject area into the 'search' box.
2. Choose a YouTube video from the list that comes up that you might recommend to your students to watch.
3. What kind of interaction would the YouTube video require from your students? Does it force them to respond in some way (inherent)?
4. In what way are they likely to respond to the YouTube on their own, e.g. make notes, do an activity, think about the topic (learner-generated)?
5. What activity could you suggest that they do, after they have watched the YouTube video (designed)? What type of knowledge or skill would that activity help develop? What medium or technology would students use to do the activity?
6. How would students get feedback on the activity that you set? What medium or technology would they and/or you use for getting and giving feedback on their activity?
7. How much work for you would that activity cause? Would the work be both manageable and worthwhile? Could the activity be scaled for larger numbers of students?
8. How could the YouTube video have been designed to generate more or better activity from viewers or students?

There is no feedback from me for this activity, which requires user-generated activity (that is, you have to do the work!)

Reference

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Moore, M.G. (1989) Three types of interaction *American Journal of Distance Education*, Vol.3, No.2

9.7 Organisational issues

Figure 9.7.1 A video production studio at University of Illinois Urbana-Champaign Image: UIUC. Just as important as the technical facilities are the media professionals who can help with the design of good quality educational videos.

9.7.1 Institutional readiness for teaching with technology

One of the critical issues that will influence the selection of media by teachers and instructors is:

- the way the institution structures teaching activities;
- the instructional and technology services already in place;
- the support for media and technology use that their institution provides.

If an institution is organised around a set number of classroom periods every day, and the use of physical classrooms, the teachers are likely to focus mainly on classroom delivery. As Mackenzie was quoted in Chapter 9 Section 1:

> '*Teachers have always made the best of whatever they've got at hand, but it's what we have to work with. Teachers make due*.'

The reverse is equally true. If the school or university does not support a particular technology, teachers and instructors quite understandably won't use it. Even if the technology is in place, such as a learning management system or a video production facility, if instructors are not trained or oriented to its use and potential, then it will either be under used or not used at all. Furthermore, if 'core' technologies' such as learning management systems or lecture capture facilities are not properly managed or if the services are understaffed, teachers and instructors lose patience and confidence in the technology.

Because of the inertia in institutions, there is often a bias towards those technologies that can be introduced with the minimum of organisational change, although these may not be the technologies that would have maximum impact on learning. These organisational challenges are extremely difficult, and are often major reasons for the slow implementation of new technologies for teaching in education (see Marshall, 2009) for a method for assessing the readiness of institutions for online learning).

Most institutions that have successfully introduced media and technology for teaching on a large scale have recognized the need for adequate professional support for faculty, by providing instructional designers, media designers and IT support staff to support teaching and learning. Some institutions also provide funding for innovative teaching projects.

9.7.2 Work with professionals

Figure 8.7.2 Chris Crowley is an Instructional Designer/Project Manager for UBC's Centre for Teaching, Learning and Technology. He is involved in the design, development and delivery of online courses and learning resources in a number of subject areas including Soil Science.

Even those experienced in using media for teaching and learning would be wise to work with instructional designers and professional media producers when creating any of the media discussed in this chapter (with the possible exception of social media). It is important for the choice of technology to be driven by educational goals, rather than starting with a particular medium or technology in mind.

There are several reasons for working with professionals:

- they understand the technology and as a result will enable you to develop a better product more quickly than working alone;
- two heads are better than one: working collaboratively will result in new and better ideas about how you could be using the medium;
- instructional designers and professional media producers will usually be familiar with project management and budgeting for media production, enabling resources to be developed in time and on budget. This is important as it is easy for teachers or instructors to get sucked into spending far more time than necessary on producing media.

The key point here is that although it is now possible for teachers and instructors to produce reasonably good quality audio and video on their own, they will always benefit from the input of professionals in media production.

9.7.3 Questions for consideration

1. How much and what kind of help can I get from the institution in choosing and using media for teaching? Is help easily accessible? How good is the help? Do the support people have the media professionalism I will need? Are they up to date in the use of new technologies for teaching?
2. Is there possible funding available to 'buy me out' for a semester and/or to fund a teaching assistant so I can concentrate on designing a new course or revising an existing course? Is there funding for media production?
3. To what extent will I have to follow 'standard' technologies, practices and procedures, such as using a learning management system, or lecture capture system, or will I be encouraged and supported to try something new?
4. Are there already suitable media resources freely available that I can use in my teaching, rather than creating everything from scratch? Can I get help from the library for instance in identifying these resources and dealing with any copyright issues (see Chapter 11, Section 2)?

If the answers are negative for each of these questions, you would be wise to set very modest goals initially for using media and technology.

Nevertheless the good news is that it is increasingly easy to create and manage your own media such as web sites, blogs, wikis, podcasts and simple video production using a desktop computer or even a mobile phone. Furthermore students themselves are often capable and interested in participating or helping with creating learning resources, if given the chance. Getting students involved in media production is a very good way for them to get a deeper understanding of a subject. Above all, there is an increasing amount of really good educational media coming available for free use for educational purposes, as we shall see in Chapter 11, so it is not necessary always to create media from scratch.

References

Bates, A. and Sangrà, A. (2011) *Managing Technology in Higher Education* San Francisco: Jossey-Bass

Marshall, S. (2009) *E-Learning Maturity Model Version Two: New Zealand Tertiary Institution E-Learning Capability: Informing and Guiding E-Learning Architectural Change and Development* Wellington NZ: Victoria University of Wellington

Activity 9.7

There is no activity provided for this section. The issues covered here are discussed in more depth in Bates and Sangrà (2011).

9.8 Networking (and novelty)

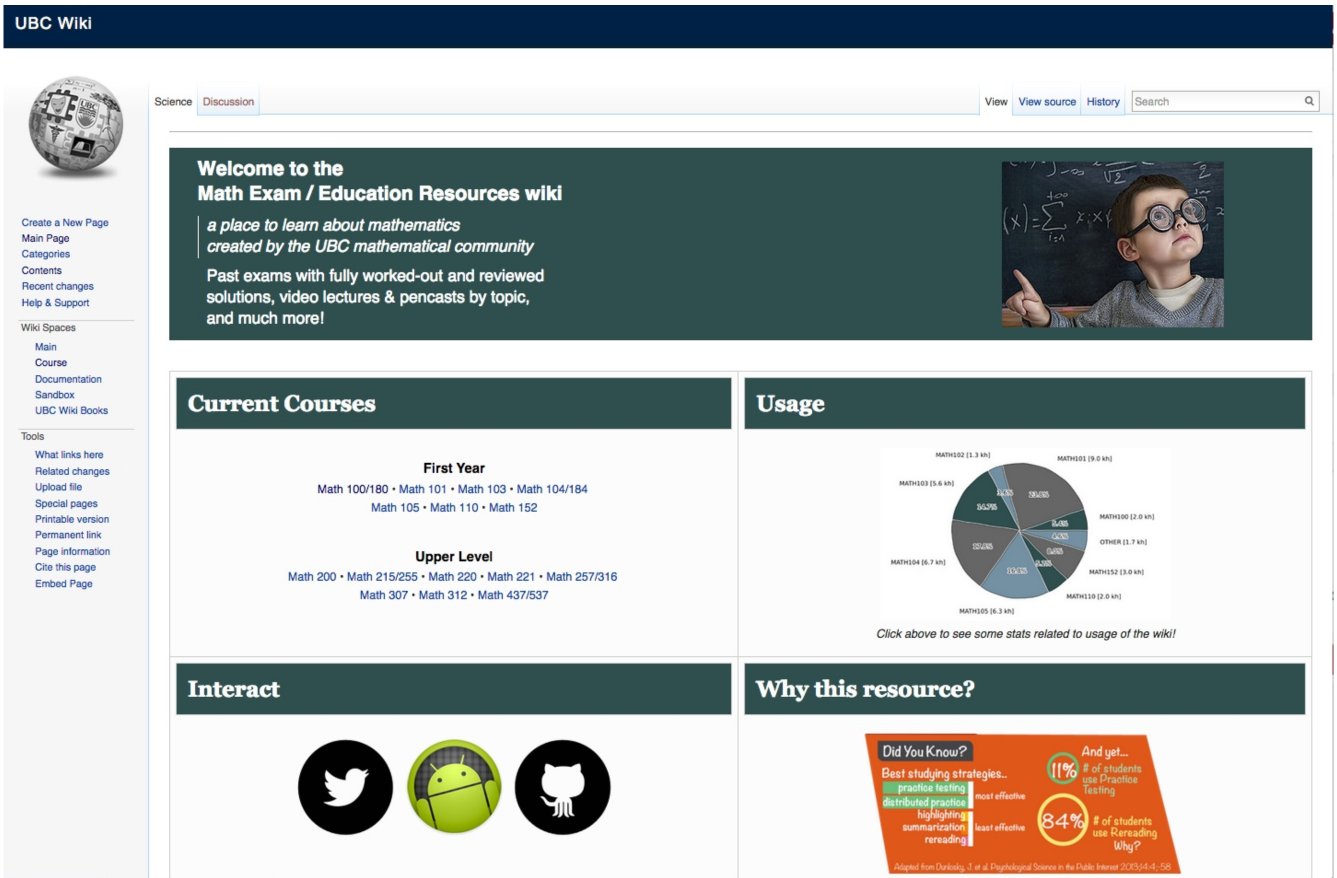

Figure 9.8.1 UBC's Math Exam Wiki (click on image to go to web page)

9.8.1 Networking and novelty in course design

In earlier versions of the SECTIONS model, 'N' stood for novelty. This was to recognise the importance of teachers and instructors trying something new to improve on their practice, in this case to try a new technology and see how well it worked for them. Also the 'hype' surrounding new developments in technology often provides a supportive environment for innovative teaching. This is still an important issue; without experiment and trying new ways of teaching and new technologies for teaching, there will be no improvement in practice.

However, more recent developments in social media raise another, increasingly important, question that needs to be asked when selecting media:

> *how important is it to enable learners to network beyond a course, with others such as subject specialists, professionals in the field, and relevant people in the community? Can the course, or student learning, benefit from such external connections?*

If the answer to this is an affirmative, then this will affect what media to use, and in particular will suggest the use of social media such as blogs, wikis, Facebook, LinkedIn, or Google Hangout.

Five different ways social media are influencing the application of networking in course design are described below.

9.8.2 Supplementing 'standard' learning technologies

Some instructors are combining social media for external networking with 'standard' institutional technologies such as a learning management system or video delivery. The LMS, which is password protected and available only to the instructor and other enrolled students, allows for 'safe' communication within the course. The use of social media allows for connections with the external world (contributions can still be screened by the course blog or wiki administrator by monitoring and approving contributions.)

For instance, a course on Middle Eastern politics could have an internal discussion forum focused on relating current events directly to the themes and issues that are the focus of the course, but students may manage their own, public wiki that encourages contributions from Middle East scholars and students, and indeed anyone from the general public. Comments may end up being moved into and out of the more closed class discussion forum as a result.

9.8.3 Exclusive use of social media for credit courses

Other instructors are moving altogether away from 'standard' institutional technology such as learning management systems and lecture capture into the use of social media for managing the whole course. For instance, UBC's course ETEC 522 uses WordPress, YouTube videos and podcasts for instructor and student contributions to the course. Indeed the choice of social media on this course changes every year, depending on the focus of the course, and new developments in social media. Jon Beasley-Murray at the University of British Columbia built a whole course around students creating a high level (featured-article) Wikipedia entry on Latin American literature (Latin American literature WikiProject – see Beasley-Murray, 2008).

9.8.4 Student generated learning resources

This is a particularly interesting development where students themselves use social media to create resources to help other students. For instance, graduate math students at UBC have created the Math Exam/Education Resources wiki, which provides '*past exams with fully worked-out and reviewed solutions, video lectures & pencasts by topic*'. Such sites are open to anyone needing help in their studying, not just UBC students. The project involves voluntary collaboration between graduate students for the benefit of undergraduate students.

9.8.5 Self-managed learning groups

cMOOCs are an obvious example of self-managed learning groups using social media such as webinars, blogs and wikis.

9.8.6 Instructor-led open educational resources

YouTube in particular is becoming increasingly popular for instructors to use their knowledge to create resources available to anyone. The best example is still the Khan Academy, but there are many other examples, such as MIT's OpenCourseWare. xMOOCs are another example. This will be discussed more in Chapter 11.

Once again, the decision to 'open up' teaching is as much a philosophical or value decision as a technology decision, but the technology is now there to encourage and enable this philosophy.

9.8.7 Questions for consideration

1. How important is it to enable learners to network beyond a course, with others such as subject specialists, professionals in the field, and relevant people in the community? Can the course, or student learning, benefit from such external connections?
2. If this is important, what's the best way to do this? Use social media exclusively? Integrate it with other standard course technology? Delegate responsibility for its design and/or administration to students or learners?

References

Beasley-Murray, J. (2008) Was introducing Wikipedia to the classroom an act of madness leading only to mayhem if not murder? *Wikipedia*, March 18

Activity 9.8 Networking (and novelty)

1. How could you use social media in one of your courses to enable students in the course to connect to the outside world? How would it improve their learning? What would be the risks as well as the benefits?

For my feedback on this, click on the podcast below:

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9.9 Security and privacy

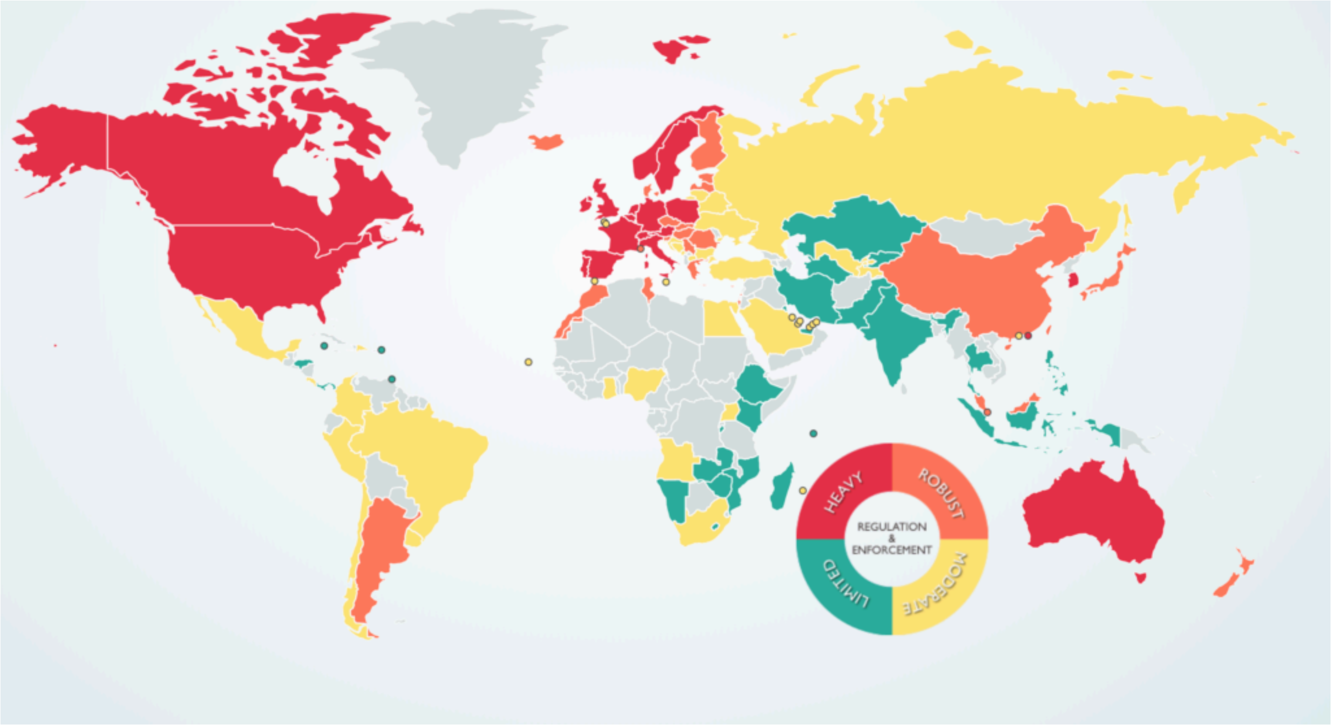

Figure 9.9.1 Strength of data protection laws. Click on image for more information.
Image: © 2019 DLA Piper

'S' too is a change from the earlier ACTIONS model, where 'S' stood for speed, in terms of how quickly a technology enabled a course to be developed. However, the issues previously raised under speed have also been included in SECTIONS 'Ease of Use' (Chapter 9, Section 2). This allows 'Speed' to be replaced with 'Security and privacy', issues which have become increasingly important for education in a digital age.

9.9.1 The need for privacy and security when teaching

Teachers, instructors and students need a private place to work online. Instructors want to be able to criticize politicians or corporations without fear of reprisal; students may want to keep rash or radical comments from going public or will want to try out perhaps controversial ideas without having them spread all over Facebook. Institutions want to protect students from personal data collection for commercial purposes by private companies, tracking of their online learning activities by government agencies, or marketing and other unrequested commercial or political interruption to their studies. In particular, institutions want to protect students, as far as possible, from online harassment or bullying. Creating a strictly controlled environment enables institutions to manage privacy and security more effectively.

Learning management systems provide password protected access to registered students and authorised instructors. Learning management systems were originally housed on servers managed by the institution itself. Password protected LMSs on secure servers have provided that protection. Institutional policies regarding appropriate online behaviour can be managed more easily if the communications are managed 'in-house.'

9.9.2 Cloud based services and privacy

However, in recent years, more and more online services have moved 'to the cloud', hosted on massive servers whose physical location is often unknown even to the institution's IT services department. Contract agreements between an educational institution and the cloud service provider are meant to ensure security and back-ups.

Nevertheless, Canadian institutions and privacy commissioners have been particularly wary of data being hosted out of country, where it may be accessed through the laws of another country. There has been concern that Canadian student information and communications held on cloud servers in the USA may be accessible via the U.S. Patriot Act. For instance, Klassen (2015) writes:

> *Social media companies are almost exclusively based in the United States, where the provisions of the Patriot Act apply no matter where the information originates. The Patriot Act allows the U.S. government to access the social media content and the personally identifying information without the end users' knowledge or consent. The government of British Columbia, concerned with both the privacy and security of personal information, enacted a stringent piece of legislation to protect the personal information of British Columbians. The Freedom of Information and Protection of Privacy Act (FIPPA) mandates that no personally identifying information of British Columbians can be collected without their knowledge and consent, and that such information not be used for anything other than the purpose for which it was originally collected.*

Concerns about student privacy have increased even more when it became known that countries were sharing intelligence information, so there remains a risk that even student data on Canadian-based servers may well be shared with foreign countries.

Perhaps of more concern though is that as instructors and students increasingly use social media, academic communication becomes public and 'exposed'. Bishop (2011) discusses the risks to institutions in using Facebook:

- privacy is different from security, in that security is primarily a technical, hence mainly an IT, issue. Privacy needs a different set of policies that involves a much wider range of stakeholders within an institution, and hence a different (and more complex) governance approach from security;
- many institutions do not have a simple, transparent set of policies for privacy, but different policies set by different parts of the institution. This will inevitably lead to confusion and difficulties in compliance;

- there is a whole range of laws and regulations that aim to protect privacy; these cover not only students but also staff; privacy policy needs to be consistent across the institution and be compliant with such laws and regulation;
- Facebook's current privacy policy (2011) leaves many institutions using Facebook at a high level of risk of infringing or violating privacy laws – merely writing some kind of disclaimer will in many cases not be sufficient to avoid breaking the law.

The controversy at Dalhousie University where dental students used Facebook for violent sexist remarks about their fellow women students is an example of the risks endemic in the use of social media.

9.9.3 The need for balance

Although there may well be some areas of teaching and learning where it is essential to operate behind closed doors, such as in some areas of medicine or areas related to public security, or in discussion of sensitive political or moral issues, in general though there have been relatively few privacy or security problems when teachers and instructors have opened up their courses, have followed institutional privacy policies, and above all where students and instructors have used common sense and behaved ethically. Nevertheless, as teaching and learning becomes more open and public, the level of risk does increase.

9.9.4 Questions for consideration

1. What student information am I obliged to keep private and secure? What are my institution's policies on this?

2. What is the risk that by using a particular technology my institution's policies concerning privacy could easily be breached? Who in my institution could advise me on this?

3. What areas of teaching and learning, if any, need I keep behind closed doors, available only to students registered in my course? Which technologies will best allow me to do this?

References

Bishop, J. (2011) Facebook Privacy Policy: Will Changes End Facebook for Colleges? *The Higher Ed CIO*, October 4

Klassen, V. (2015) *Privacy and Cloud-Based Educational Technology in British Columbia* Vancouver BC: BCCampus

See also:

Bates, T. (2011) Cloud-based educational technology and privacy: a Canadian perspective, *Online Learning and Distance Education Resources*, March 25

Activity 9.9 Security and privacy

1. Who in your institution can advise you on the institution's policy or the state law on the use of social media or indeed any network outside your institution's private internal network(s)?

Click on the podcast for my personal comments on this issue:

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9.10 Deciding

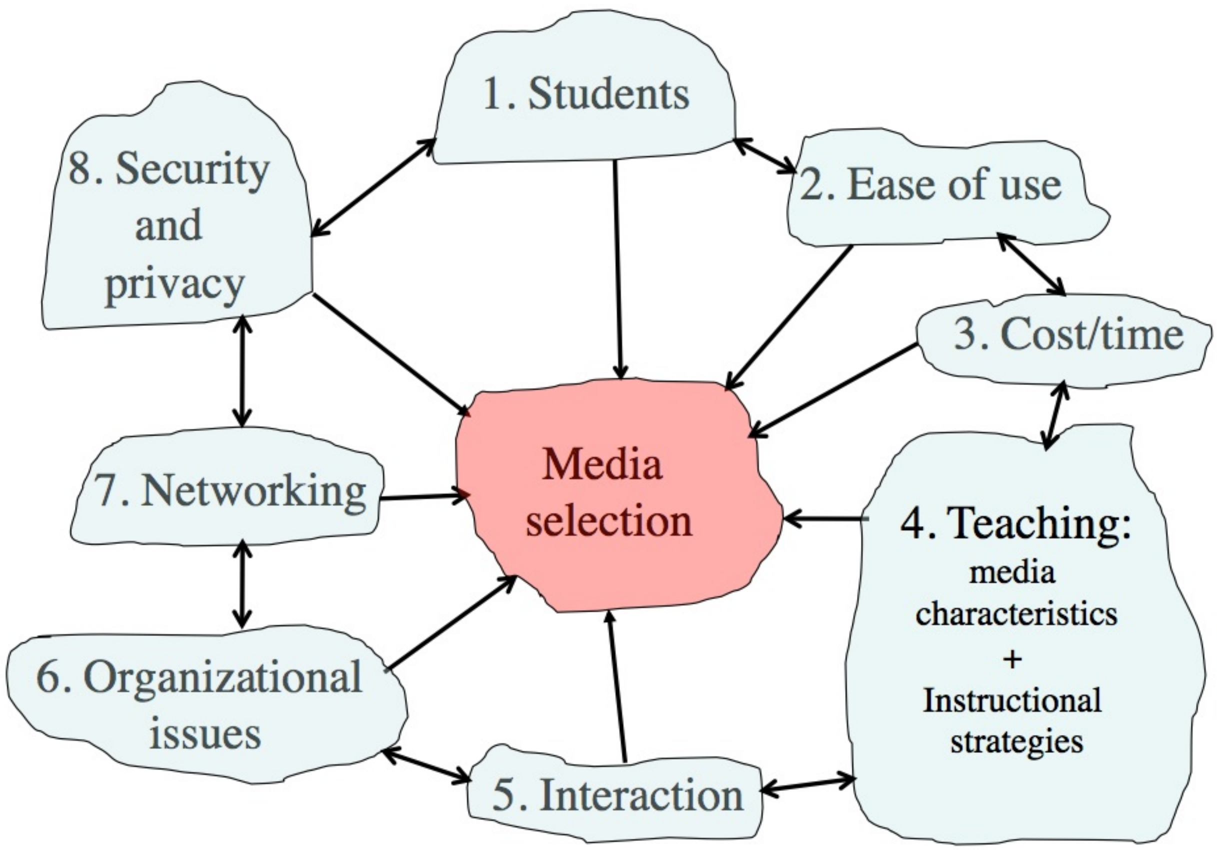

Figure 9.9 The SECTIONS model

If you've worked your way right through the last three chapters, you are probably feeling somewhat overwhelmed by all the factors to take into consideration when selecting media. It is a complex issue, but if you have read all the previous sections, you are already in a good position to make well informed decisions. Let me explain.

9.10.1 Deductive versus inductive decision-making

Many years ago, when I first developed the ACTIONS model, I was approached by a good friend who worked for a large international computer company. (This was so long ago that data were entered to computers using punched cards). We sat down over a cup of coffee, and he outlined his plan. Here's how the conversation went.

> *Pierre*. Tony. I'm very excited about your model. We could take it and apply it in every school and university in the world.
>
> *Tony*. Really? Now how would you do that?
>
> *Pierre*. Well, you have a set of questions that teachers have to ask for each of the criteria. There is probably a limited set of answers to these questions. You could either work out what those answers are, or collect answers from a representative sample of teachers. You could then give scores to each technology depending on the answers they give. So when a teacher has to make a choice of technology, they would sit down, answer the questions, then depending on their answers, the computer would calculate the best choice of technology. Voilà!
>
> *Tony*. I don't think that's going to work, Pierre.
>
> *Pierre*: But why not?
>
> *Tony*. I'm not sure, but I have a gut feeling about this.
>
> *Pierre*. A gut feeling? My English is not so good. What do you mean by a gut feeling?
>
> *Tony*. Pierre, your English is excellent. My response is not entirely logical, so let me try and think it through now, both for you and me, why I don't think this will work. First, I'm not sure there is a limited number of possible answers to each question, but even if there is, it's not going to work.
>
> *Pierre*. Well, why not?
>
> *Tony*. Because I'm not sure how a teacher would score their response to each question and in any case there's going to be interaction between the the answers to the questions. It's not the addition of each answer that will determine what technology they might use, but how those answers combine. From a computing point of view, there could be very many different combinations of answers, and I'm not sure what the significant combinations are likely to be with regard to choosing each technology.
>
> *Pierre*. But we have very big and fast computers, and we can simplify the process through algorithms.
>
> *Tony*. Yes, but you have to take into account the context in which teachers will make media selections. They are going to be making decisions about media all the time, in many different contexts. It's just not practical to sit down at a computer, answer all the questions, then wait for the computer's recommendation.
>
> *Pierre*. But won't you give this a try? We can work through all these problems.

> *Tony*. Pierre, I really appreciate your suggestion, but my gut tells me this won't work, and I really don't want to waste your time or mine on this.
>
> *Pierre*. Well, what are you going to tell teachers then? How will they make their decisions?
>
> *Tony*. I will tell them to use their gut instinct, Pierre – when they have read and applied the ACTIONS model.

This really is a true story, although the actual words spoken may have been different. The fact that we do have artificial intelligence these days that technically could do this hasn't changed my mind, because what we have in this scenario is a conflict between deductive reasoning (Pierre) and inductive reasoning (Tony).

9.10.1.1 Deductive reasoning

With deductive reasoning, you would do what Pierre suggests: start without any prior conceptions about which technology to use, answer each of the questions I posed at the end of each part of the SECTIONS model, then write down all the possible technologies that would fit the answers to each question, see what technology would best match each of the questions/criteria, and 'score' each technology on a recommended scale for each criterion. You would then try to find a way to add all those answers together, perhaps by using a very large matrix, and then end up with a decision about what technology to use.

A major problem though is that every teacher and every learning context is somewhat different each time a decision needs to be made. Experienced teachers in particular will bring a whole lot of knowledge with them – ideas about effective teaching methods, knowledge of the students, the requirement of the content and the skills they are trying to develop at the moment of decision, and above all the context in which the medium will be used (home, classroom, etc.) – before they have to make a decision.

9.10.1.2 Inductive reasoning

My solution is very different from Pierre's. Mine is a more inductive approach to decision making. The main criterion for inductive logic is as follows:

> *As evidence accumulates, the degree to which the collection of true evidence statements comes to support a hypothesis, as measured by the logic, should tend to indicate that false hypotheses are probably false and that true hypotheses are probably true.*
>
> Stanford Encyclopedia of Philosophy

In terms of selecting media, you probably start with a number of possible technologies in mind at the beginning of the process (hypotheses – or your gut feeling). My suggested process is start with your gut feeling about which technologies you're thinking of using, but keeping an open mind, then move through all the questions suggested in each of the SECTIONS criteria (that is, collecting evidence for or against your initial 'gut feeling'.) You then start building more evidence to support or reject the use of a particular medium or technology. By the end of the process you have a 'probabilistic' view of what combinations of media will work best for you and why. This is not an exercise you would have to do in detail or even consciously every time. Once you have done it just a few times, the choice of medium or technology in each 'new' situation will be quicker and easier, because the brain stores all the previous information and you have a framework (the SECTIONS model) for organising new information as it arrives and integrating it with your previous knowledge.

9.10.1.3 Rapid decision-making

Now you've read this chapter you already have a set of questions for consideration (I have listed them all together in Appendix 1 for easy reference). You are now in the same position as the king who asked the alchemist how to make gold. 'It's easy', said the alchemist, 'so long as you don't think about elephants.' Well, having read the three chapters on media in full, you now have the elephants in your head. It will be difficult to ignore them. The brain is in fact a wonderful instrument for making intuitive or inductive decisions of this kind. The trick though is to have all this information somewhere in your head, so you can pull it all out when you need it. The brain does this very quickly. Your decisions won't always be perfect, but they will be a lot better than if you hadn't already thought about all these issues, and in life, rough but ready usually beats perfect but late.

9.10.2 Grounding media selection within a course development framework

Media selection does not happen in a vacuum. There are many other factors to consider when designing teaching. In particular, embedded within any decision about the use of technology in education and training will be assumptions about the learning process. We have already seen earlier in this book how different epistemological positions and theories of learning affect the design of teaching, and these influences will also determine a teacher's or an instructor's choice of appropriate media. Media selection is just one part of the course design process. It has to fit within the broader framework of course design.

In Figure 9.10.2 below, Hibbitts and Travin's modification of the ADDIE model (see Chapter 4, Section 3) presents the following learning and technology development model that incorporates the various stages of course design:

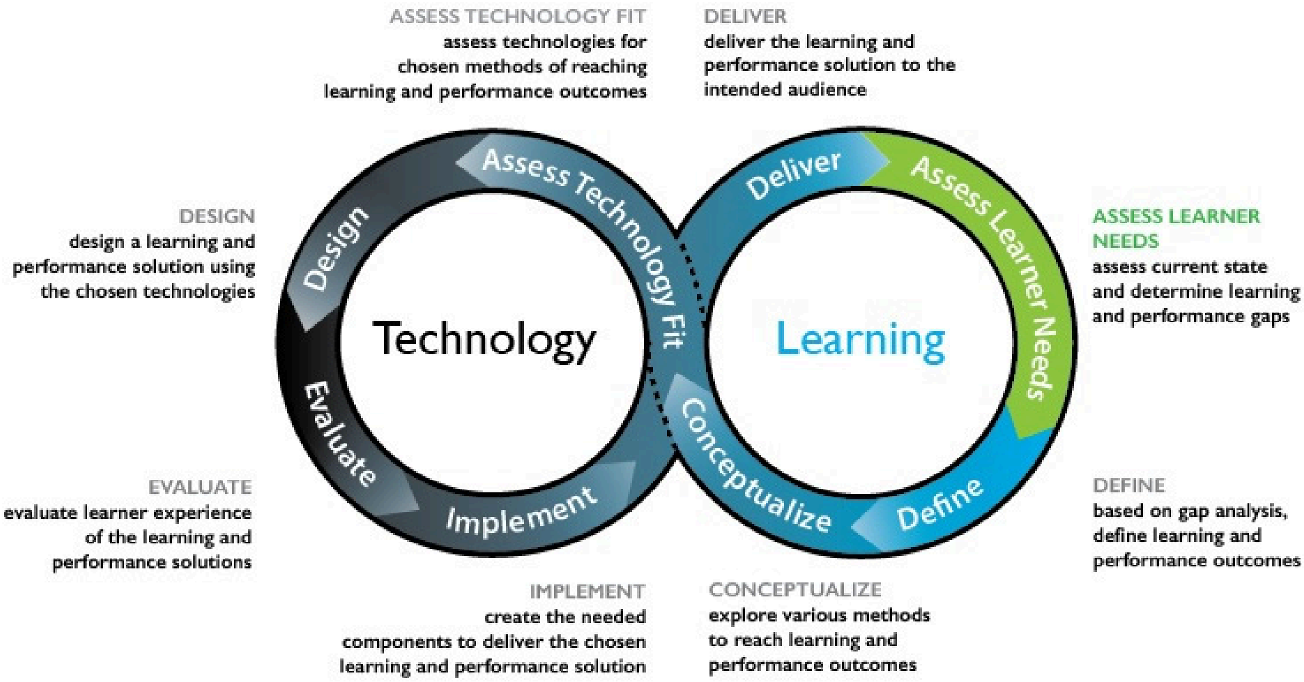

Figure 9.10.2 Hibbitts and Travin's Learning + technology development model

The SECTIONS model is strategy that could be used for assessing the technology fit within this course development process. Whether you are using ADDIE or an agile design approach, then, media selection will be influenced by the other factors in course design, adding more information to be considered. This will all be mixed in with your knowledge of the subject area and its requirements, your beliefs and values about teaching and learning, and a lot of emotion as well.

All this further reinforces the inductive approach to decision making that I have suggested. Don't underestimate the power of your brain – it's far better than a computer for this kind of decision-making. But it's important to have the necessary information, as far as possible. So if you skipped a part of this chapter, or the previous two chapters on media, you might want to go back over it!

Activity 9.10: Choosing media and technologies

1. Choose the same course that you chose for Activity 9.1.

2. Go to Appendix 1, and see how many of the questions you can answer. Use Chapter 9 to help, if necessary, including your answers to some the activities in Chapter 9.

3. When you have answered as many questions as you can from Appendix 1, what media or technologies will you now think of using. How does this differ from your original list? If there are changes, why?

Again, no feedback is provided as each context will be different.

Chapter 9 Key Takeaways

1. Selecting media and technologies is a complex process, involving a very wide range of interacting variables.

2. There is currently no generally accepted theory or process for media selection. The SECTIONS model however provides a set of criteria or questions the result of which can help inform an instructor when making decisions about which media or technologies to use.

3. Because of the wide range of factors influencing media selection and use, an inductive or intuitive approach to decision-making, informed by a careful analysis of all the criteria in the SECTIONS framework, is one practical way to approach decision-making about media and technologies for teaching and learning.

4. However, media selection needs to be integrated within the broader framework of course design.

Chapter 10: Modes of delivery

The purpose of the chapter

When you have completed this chapter you should be able to:

- determine the most appropriate mode of delivery for any course or program you wish to offer;
- determine what factors should influence this decision;
- better identify the role of classroom teaching when students can now increasingly study most things online.

What is covered in this chapter

Also in this chapter you will find the following activities:

Key Takeaways from this chapter

1. There is a continuum of technology-based learning, from 'pure' face-to-face teaching to fully online programs. Every teacher or instructor needs to decide where on the continuum a particular course or program should be.

2. We do not have good research evidence or theories to make this decision, although we do have growing

experience of the strengths and limitations of online learning. What is particularly missing is an evidence-based analysis of the strengths and limitations of face-to-face teaching when online learning is also available.

3. In the absence of good theory, I have suggested four factors to consider when deciding on mode of delivery, and in particular the different uses of face-to-face and online learning in blended courses:

- student characteristics and needs;
- your preferred teaching strategy, in terms of methods and learning outcomes;
- the pedagogical and presentational requirements of the subject matter, in terms of (a) content and (b) skills;
- the resources available to you as an instructor (including your time).

4. The move to blended or hybrid learning in particular means rethinking the use of the campus and the facilities needed fully to support learning in a hybrid mode.

10.1 The continuum of technology-based learning

Figure 10.1.1 Why get on the bus when you can study online? (UBC bus loop)

In Chapters 7, 8 and 9, the use of media incorporated into a particular course or program was explored. In this chapter, the focus is on deciding whether a whole course or program should be offered partly or wholly online. In Chapter 11 the focus is on deciding when and how to adopt an approach that incorporates 'open-ness' in its design and delivery.

10.1.1 The many faces of online learning

Online learning, blended learning, flipped learning, hybrid learning, flexible learning, open learning and distance education are all terms that are often used inter-changeably, but there are significant differences in meaning. More importantly, these forms of education, once considered somewhat esoteric and out of the mainstream of conventional education, are increasingly taking on greater significance and in some cases becoming mainstream themselves. As teachers and instructors become more familiar and confident with online learning and new technologies, there will be more innovation in integrating online and face-to-face teaching.

10.1.1.1 Variations on blended learning

At the time of writing though it is possible to identify at least the following modes of delivery:

- *classroom teaching* with no technology at all (which is very rare these days);
- *blended learning*, which encompasses a wide variety of designs, including:
    - *technology-enhanced learning*, or technology used as classroom aids; a typical example would be the use of Powerpoint slides and/or clickers in a lecture;
    - the use of *a learning management system to support classroom teaching*, for storing learning materials, providing a course schedule of topics, for online discussion, and for submitting student assignments, but teaching is still delivered mainly through classroom sessions;
    - the use of *lecture capture for flipped classrooms*, where students watch the lecture via streamed video then come to class for discussion or other work; see for instance a calculus course offered at Queen's University, Canada;
    - one semester face-to-face on campus and two semesters online (one model at Royal Roads University);
    - *hybrid* or *flexible* learning requiring the redesign of teaching so that students can do the majority of their learning online, coming to campus only for very specific face-to-face teaching, such as lab or hands-on practical work, that cannot be done satisfactorily online (for examples, see Section 10.1.1.2 below);
- *fully online learning* with no classroom or on-campus teaching, which is one form of distance education, including:
    - courses for credit, which will usually cover the same content, skills and assessment as a campus-based version, but are available only to students admitted to a program;
    - non-credit courses offered only online, such as courses for continuing professional education;
    - fully open courses, such as MOOCs.

More than one third of higher education students in the USA now take at least one fully online course, and about 15 per cent of students are taking only online courses. While overall enrolments in the US higher education system have slowly declined (by almost 4 per cent between 2012 to 2016), online enrolments have grown by about 5 per cent over the same period (Seaman et al., 2018). In Canadian post-secondary institutions in 2017, approximately 8 per cent of all credit course registrations were fully online (Donovan et. al., 2018).

10.1.1.2 Hybrid learning

There is an important development within blended learning that deserves special mention, and that is the total re-design of campus-based classes that takes greater advantage of the potential of technology, which I call *hybrid learning*, with online learning combined with focused small group face-to-face interactions or mixing online and physical lab experiences. In such designs, the amount of face-to-face contact time is usually reduced, for instance from three classes a week to one, to allow more time for students to study online.

In hybrid learning the whole learning experience is re-designed, with a transformation of teaching on campus built around the use of technology. For instance:

- Carol Twigg at the National Center for Academic Transformation has for many years worked with universities and colleges to redesign usually large lecture class programs to improve learning and reduce costs through the use of technology. This program ran very successfully between 1999 and 2018;
- Virginia Tech many years ago created a successful program for first and second year math teaching built around 24 x 7 computer-assisted learning supported by 'roving' instructors and teaching assistants (Robinson and Moore, 2006);
- The University of British Columbia launched in 2013 what it calls a flexible learning initiative focused on *developing, delivering, and evaluating learning experiences that promote effective and dramatic improvements in student achievement. Flexible learning enables pedagogical and logistical flexibility so that students have more choice in their learning opportunities, including when, where, and what they want to learn.*

Thus 'blended learning' can mean minimal rethinking or redesign of classroom teaching, such as the use of classroom aids, or complete redesign as in flexibly designed courses, which aim to identify the unique pedagogical characteristics of face-to-face teaching, with online learning providing flexible access for the rest of the learning.

Instructors in more than three quarters of Canadian post-secondary institutions in 2017 were integrating online with classroom teaching, but no more than one in five institutions had a significant number of courses in this format. However, most institutions are predicting a rapid increase in such courses over the next few years (Donovan et al., 2019)

10.1.2 The continuum of online learning

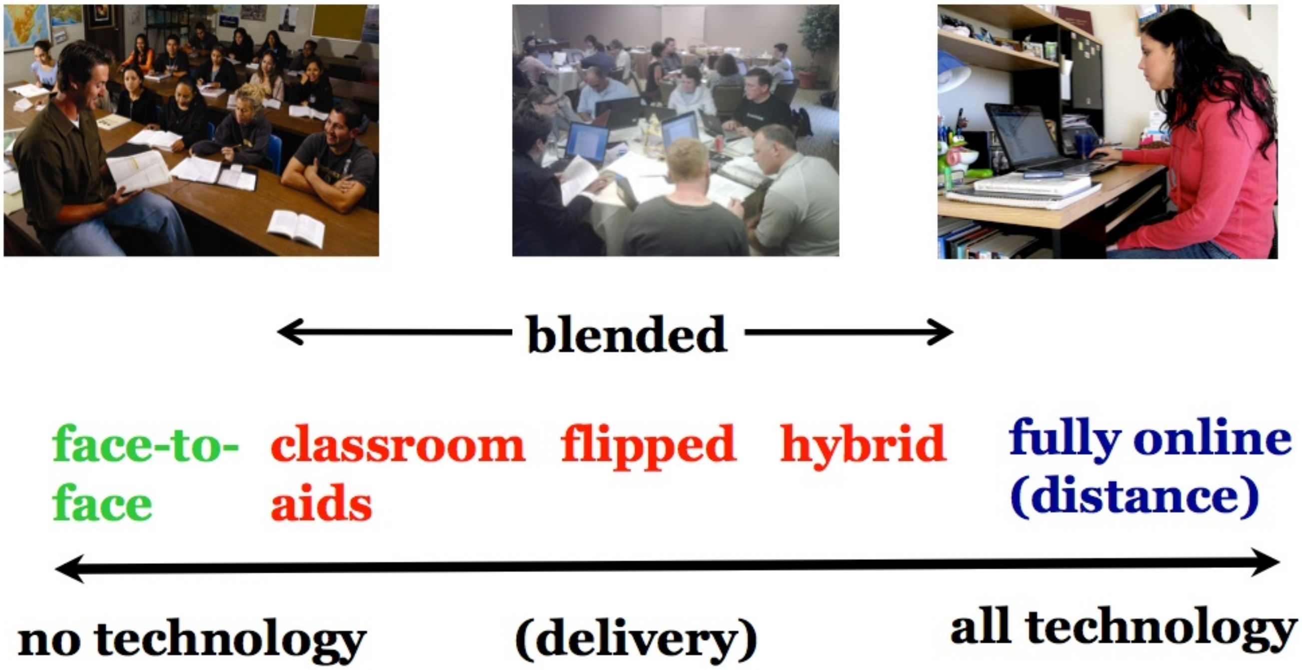

Figure 10.1.2 The continuum of technology-based learning (modes of delivery). Adapted from Bates and Poole, 2003.

Thus there is a continuum of technology-based learning, as illustrated in Figure 10.1.2 above.

10.1.3 Decisions, decisions!

These developments open up a whole new range of decisions for instructors. Every instructor now needs to decide:

- what kind of course or program should I be offering?
- what factors should influence this decision?
- what is the role of classroom teaching when students can now increasingly study most things online?
- should I open up my teaching to anyone, and if so, under what circumstances?

This chapter aims to help you answer these questions.

References

Bates, A. and Poole, G. (2003) *Effective Teaching with Technology in Higher Education: Foundations for Success* San Francisco: Jossey-Bass

Donovan, T. et al. (2019) *Tracking Online and Distance Education in Canadian Universities and Colleges: 2018* Halifax NS: Canadian Digital Learning Research Association

Robinson, B. and Moore, A. (2006) 'Virginia Tech: the Math Emporium' in Oblinger, D. (ed.) *Learning Spaces* Boulder CO: EDUCAUSE

Seaman, J., Allen, I., and Seaman, J. (2018) *Grade Increase: Tracking Distance Education in the United States* Wellesley MA: The Babson Survey Research Group

Activity 10.1 Where on the continuum are your courses?

1. If you are currently teaching, where on the continuum is each of your courses? How easy is it to decide? Are there factors that make it difficult to decide where on the continuum any of your courses should fit?

2. How was it decided what the mode of delivery would be for the courses you teach? If you decided, what were the reasons for the location of each course on the continuum?

3. Are you happy with the decision(s)?

3. What kind of students do you have in each type of course?

There is no feedback provided on this activity

10.2 Comparing modes of delivery

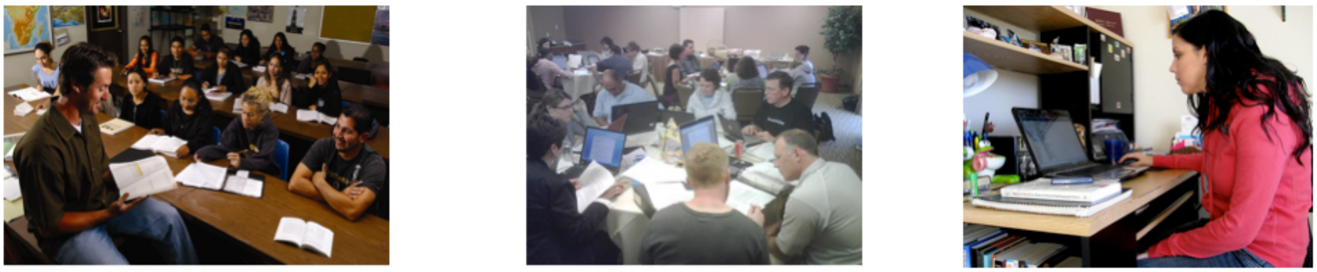

Figure 10.2.1 Which is the best?

Many surveys have found that a majority of faculty still believe that online learning or distance education is inevitably inferior in quality to classroom teaching (see for instance Jaschik and Letterman, 2014). In fact, there is no scientifically-based evidence to support this opinion. The evidence points in general to no significant differences, and if anything research suggests that blended or hybrid learning has some advantages over face-to-face teaching in terms of learning performance (see, for example, Means et al., 2010).

9.2.1 The influence of distance education on online learning

We can learn a great deal from earlier developments in distance education. Although the technology is different, fully online learning is, after all, just another version of distance education.

Much has been written about distance education (see, for instance, Wedemeyer, 1981; Peters, 1983; Holmberg, 1989; Keegan, 1990; Moore and Kearsley, 1996; Peters, 2002; Bates, 2005; Evans et al., 2008) but in concept, the idea is quite simple: students study in their own time, at the place of their choice (home, work or learning centre), and without face-to-face contact with a teacher. However, students are 'connected', today usually through the Internet, with an instructor, adjunct faculty or tutor who provides learner support and student assessment.

Distance education has been around a very long time. It could be argued that in the Christian religion, St. Paul's epistle to the Corinthians was an early form of distance education (53-57 AD). The first distance education degree was offered by correspondence by the University of London (UK) in 1858. Students were mailed a list of readings, and took the same examination as the regular on-campus students. If students could afford it, they hired a private tutor, but the Victorian novelist Charles Dickens called it the People's University, because it provided access to higher education to students from less affluent backgrounds. The program still continues to this day, but is now called the University of London (Worldwide), with more than 50,000 students in 180 countries.

In North America, historically many of the initial land-grant universities, such as Penn State University, the University of Wisconsin, and the University of New Mexico in the USA, and Memorial University, University of Saskatchewan and the University of British Columbia in Canada, had state- or province-wide responsibilities. As a result these institutions have a long history of offering distance education programs, mainly as continuing education for farmers, teachers, and health professionals scattered across the whole state or province. These programs have now been expanded to cover undergraduate and professional masters students. Australia is another country with an extensive history of both k-12 and post-secondary distance education.

Qualifications received from most of these universities carry the same recognition as degrees taken on campus. For instance, the University of British Columbia, which has been offering distance education programs since 1936, makes no distinction on student transcripts between courses taken at a distance and those taken on campus, as both kinds of students take the same examinations.

Another feature of distance education, pioneered by the British Open University in the 1970s, but later adopted and adapted by North American universities that offered distance programs, is a course design process, based on the ADDIE model, but specially adapted to serve students learning at a distance. This places a heavy emphasis on defined learning outcomes, production of high quality multimedia learning materials, planned student activities and engagement, and strong learner support, even at a distance. As a result, campus-based universities that offered distance education programs were well placed for the move into online learning in the 1990s. These universities have found that in general, students taking the online programs do almost as well as the on-campus students (course completion rates are usually within 5-10 per cent of the on-campus students – see Ontario, 2011), which is somewhat surprising as the distance students often have full-time jobs and families.

It is important to acknowledge the long and distinguished pedigree of distance education from internationally recognised, high quality institutions, because commercial diploma mills, especially in the USA, have given distance education an unjustified reputation of being of lower quality. As with all teaching, distance education can be done well or badly. However, where distance education has been professionally designed and delivered by high quality public institutions, it has proved to be very successful, meeting the needs of many working adults, students in remote areas who would otherwise be unable to access education on a full-time basis, or on-campus students wanting to fit in an extra course or with part-time jobs whose schedule clashes with their lecture schedule. However, universities, colleges and even schools have been able to do this only by meeting high quality design standards.

At the same time, there has also been a small but very influential number of campus-based teachers and instructors who quite independently of distance education have been developing best practices in online or computer-supported learning. These include Roxanne Hiltz and Murray Turoff (1978) who were experimenting with online or blended learning as early as the late 1970s at the New Jersey Institute of Technology, and Linda Harasim (2017) at Simon Fraser University, who all focused particularly on online collaborative learning and knowledge construction within a campus or school environment.

There is also plenty of evidence that teachers and instructors in many schools, colleges and universities new to online learning have not adopted these best practices, instead merely transferring lecture-based classroom practice to blended and online learning, often with poor or even disastrous results.

10.2.2 What the research tells us

There have been thousands of studies comparing face-to-face teaching to teaching with a wide range of different technologies, such as televised lectures, computer-based learning, and online learning, or comparing face-to-face teaching with distance education. With regard to online learning there have been several meta-studies. A meta-study combines the results of many 'well-conducted scientific' studies, usually studies that use the matched comparisons or quasi-experimental method (Means et al., 2010; Barnard et al., 2014). Nearly all such 'well-conducted' meta-studies find no or little significant difference between the modes of delivery, in terms of the effect on student learning or performance. For instance, Means et al. (2010), in a major meta-analysis of research on blended and online learning for the U.S. Department of Education, reported:

> *In recent experimental and quasi-experimental studies contrasting blends of online and face-to-face instruction with conventional face-to-face classes, blended instruction has been more effective, providing a rationale for the effort required to design and implement blended approaches. When used by itself, online learning appears to be as effective as conventional classroom instruction, but not more so.*

Means et al. attributed the slightly better performance of blended learning to students spending more time on task. This highlights a common finding, that where differences have been found, they are often attributed to factors other than the mode of delivery. Tamim et al. (2011) identified 'well-conducted' comparative studies covering 40 years of research. Tamim et al. found there is a slight tendency for students who study with technology to do better than students who study without technology. However, the measured difference was quite weak, and the authors state:

> *it is arguable that it is aspects of the goals of instruction, pedagogy, teacher effectiveness, subject matter, age level, fidelity of technology implementation, and possibly other factors that may represent more powerful influences on effect sizes than the nature of the technology intervention.*

Research into any kind of learning is not easy; there are just so many different variables or conditions that affect learning in any context. Indeed, it is the *variables* we should be examining, not just the technological delivery. In other words, we should be asking a question first posed by Wilbur Schramm as long ago as 1977:

> *What kinds of learning can different media best facilitate, and under what conditions?*

In terms of making decisions then about mode of delivery, we should be asking, not which is the best method overall, but:

> *What are the most appropriate conditions for using face-to-face, blended or fully online learning respectively?*

Fortunately, there is much research and best practice that provides guidance on that question, at least with respect to blended and online learning (see, for instance, Anderson, 2008; Picciano et al., 2013; Halverson et al., 2012; Zawacki-Richter and Anderson, 2014). Ironically, what we lack is good research on the unique potential of face-to-face teaching in a digital age when so much can also be done just as well online.

10.2.3 Challenging the supremacy of face-to-face teaching

Although there has been a great deal of mainly inconclusive research comparing online learning with face-to-face teaching in terms of student learning, there is very little evidence or even theory to guide decisions about what is best done online and what is best done face-to-face in a blended learning context, or about the circumstances or conditions when fully online learning is in fact a better option than classroom teaching. Generally the assumption appears to have been that face-to-face teaching is the default option by virtue of its superiority, and online learning is used only when circumstances prevent the use of face-to-face teaching, such as when students cannot get to the campus, or when classes are so large that interaction with students is at a minimum.

However, online learning has now become so prevalent and effective in so many contexts that it is time to ask:

> *what are the unique characteristics of face-to-face teaching that make it pedagogically different from online learning?*

It is possible of course that there is nothing pedagogically unique about face-to-face teaching, but given the rhetoric around 'the magic of the campus' (Sarma, 2013) and the hugely expensive fees associated with elite campus-based teaching, or indeed the high cost of publicly funded campus-based education, it is about time that we had some evidence-based theory about what makes face-to-face teaching so special. This will be discussed further in Section 5 of this chapter.

In the meantime, a method for determining which mode of delivery (face-to-face, blended or online) will be discussed in the next sections.

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Activity 10.2 Defining the magic of the campus

1. Can you define the 'magic of the campus'? What is it about face-to-face teaching that makes it special, compared with teaching online? Write down the three things you think are the most important.

2. Could you do the same for teaching online? If not, what are the things that make the campus special?

Click on the podcast below for some feedback on these questions

An audio element has been excluded from this version of the text. You can listen to it online here: https://pressbooks.bccampus.ca/teachinginadigitalagev2/?p=260

10.3 Which mode? Student needs

Figure 10.3.1 Who are your students? Image: UBC Library

When making choices about mode of delivery, teachers and instructors need to ask the following four questions:

- who are – or could be – my students?
- what is my preferred teaching approach?
- what are the content and skills that I need to teach?
- what resources will I have to support my decision?

As always, start with the learners.

10.3.1 Fully online/distance learners

Research (see for instance Dabbagh, 2007) has repeatedly shown that fully online courses suit some types of student better than others:

- older, more mature students;
- students with already high levels of education;
- part-time students who are working and/or with families.

This applies not only to MOOCs (see Chapter 5) and other non-credit courses, but even more so to courses and programs for credit. There are in fact several different markets for online learning.

10.3.1.1 Undergraduate online students

Today, ‘distance’ is more likely to be psychological or social, rather than geographical. For instance, from survey data regularly collected from students at the University of British Columbia (UBC):

- less than 20 per cent give reasons related to distance or travel for taking an online course;
- most of the more than 10,000 or so UBC students (there are over 60,000 students in total) taking at least one fully online course are not truly distant. The majority (over 80 per cent) live in the Greater Vancouver Metropolitan Area, within 90 minutes commute time to the university, and almost half within the relatively compact City of Vancouver. Comparatively few (less than 10 per cent) live outside the province (although this proportion is slowly growing each year);
- two thirds of UBC’s online students have paid work of one kind or another;
- many undergraduate students in their fourth year take an online course because the face-to-face classes are ‘capped’ because of their large size, or because they are short of the required number of credits to complete a degree. Taking a course online allows these students to complete their program without having to come back for another year;
- the main reason for most UBC students taking fully online courses is the flexibility they provide, given the work and family commitments of students and the difficulty caused by timetable conflicts for face-to-face classes.

In the USA, almost one in three undergraduate students are taking at least one online course (Allen and Seaman, 2017). At an undergraduate level, students are likely to take a maximum of three to four online courses as part of a regular campus-based degree program at universities and up to five online courses at two year colleges, in Canada (Donovan et al., 2018).

Until recently in North America, there were few undergraduate programs offered entirely online, except in specialist institutions such as the open universities in Canada (Athabasca, Téluq, Thompson Rivers Open Learning) and University of Phoenix, Western Governors University, and University of Maryland University College in the USA. However, in recent years a number of specialist online undergraduate programs have started to be offered, such as the Bachelor of Mining Engineering Technology for working miners at Queen’s University, Canada

This suggests that fully online courses are more suitable for more experienced students with a strong motivation to take such courses because of the impact they have on their quality of life. In general, online students need more self-discipline in studying and a greater motivation to study to succeed. This does not mean that other kinds of students cannot benefit from online learning, but extra effort needs to go into the design and support of such students online.

10.3.1.2 Graduate online students

Although in the USA, the proportion of students taking distance education courses at a graduate level overall is almost the same (17 per cent) as those taking on-campus graduate courses – 15 per cent, the proportion of students taking distance education courses at a graduate level is much higher for private, not-for profit – 37 per cent, and for-profit institutions – 28 per cent (Allen and Seaman, 2017). (As in Canada – Donovan. et al., 2018 – distance education now is almost synonymous with online learning in the USA).

The most rapid area of growth in online courses is for masters programs aimed at working professionals. So far, apart from MBAs and teacher education, public universities tend to be relatively slow in recognising the importance of this market, which at worse could be self-financing, and at best could bring in much needed additional revenues. The for-profit universities, though, such as the University of Phoenix, Laureate University and Capella University, and especially some of the private, not-for-profit universities in the USA have been quicker to move into this market.

10.3.1.3 Remote learners

Often it is also assumed that isolated or remote learners are the main market for distance or fully online learners in that they are a long way away from any local school, college or university. Certainly in Canada, there are such students and the ability to study locally rather than travel great distances can be very appealing. However, in many remote rural areas, Internet access can be difficult, with either slow satellite connections or telephone-based, slow-speed modems. Remote learners will also struggle if there is no easily accessible or culturally appropriate local support for their studies.

Since the vast majority of online learners are urban, living within one hour’s travel of a college or university campus, it is the flexibility rather than the distance that matters to these learners.

10.3.1.4 Lifelong learners

On the other hand, fully online courses really suit working professionals. In a digital age, the knowledge base is continually expanding, jobs change rapidly, and hence there is strong demand for on-going, continuing education, often in ‘niche’ areas of knowledge. Online learning is a convenient and effective way of providing such lifelong learning.

Lifelong learners are often working with families and really appreciate the flexibility of studying fully online. They often already have higher education qualifications such as a first degree, and therefore have learned how to study successfully. They may be engineers looking for training in management, or professionals wanting to keep up to date in their professional area. They are often better motivated, because they can see a direct link between the new course of study and possible improvement in their career prospects. They are therefore ideal students for online courses (even though they may be older and less tech savvy than students coming out of high school).

What is important for such learners is that the courses are technically well designed, in that learners do not need to be highly skilled in using computers to be able to study the courses.

10.3.1.5 Changing demographics

One other factor to consider is the impact of changing demographics. In the USA, overall higher education enrolments declined by 3 per cent between 2012-2015, while distance education enrolments increased by 4 per cent over the same period (Allen and Seaman, 2017).

In jurisdictions where the school-age population is starting to decline, expanding into lifelong learning markets may be essential for maintaining student enrolments. Although the rate of growth in distance education/online learning is not spectacular, it may eventually turn out to be a way to keep some academic departments alive.

10.3.1.6 New business models

However, to make lifelong learning online programs work, institutions need to make some important adjustments. In particular there must be incentives or rewards for faculty to move in this direction and there needs to be some strategic thinking about the best way to offer such programs.

The University of British Columbia has developed a series of very successful, fully online, self-financing professional masters' programs. Students can initially try one or two courses in the Graduate Certificate in Rehabilitation before applying to the master's program. The certificate can be completed in less than two years while working full-time, and paying per course rather than for a whole Master's year, providing the flexibility needed by lifelong learners. UBC also partnered with Tec de Monterrey in Mexico, with the same program being offered in English by UBC and in Spanish by Tec de Monterrey, as a means of kick-starting its very successful Master in Educational Technology program, which, when it opened, doubled the number of graduate students in UBC's Faculty of Education, and is still running now almost 20 years after its initial offering. We shall see these examples are important when we examine the development of modular programming in Section 11.5.2.

Online learning also offers the opportunity to offer programs where an institution has unique research expertise but insufficient local students to offer a full master's program. By going fully online, perhaps in partnership with another university with similar expertise but in a different jurisdiction, it may be able to attract students from across the country or even internationally, enabling the research to be more widely disseminated and to build a cadre of professionals in newly emerging areas of knowledge – again an important goal in a digital age.

10.3.2 Blended learning learners

In terms of blended learning, the 'market' is less clearly defined than for fully online learning. The benefit for students is increased flexibility, but they will still need to be relatively local in order to attend the campus-based sessions. The main advantage is for the 50 per cent or more of students, at least in Canada, who are working more than 15 hours a week (Marshall, 2010) to help with the cost of their education and to keep their student debt as low as possible. Also, blended learning provides an opportunity for the gradual development of independent learning skills, as long as this is an intentional teaching strategy.

The research also suggests that these skills of independent learning need to be developed while students are on campus. In other words, online learning, in the form of blended learning, should be deliberately introduced and gradually increased as students work through a program, so by the time they graduate, they have the skills to continue to learn independently – a critical skill for the digital age. In general, it is not a good idea to offer fully online courses in the early years of a university or college career, unless they are exceptionally well designed with a considerable amount of online learner support – and hence are likely to be expensive to mount, if they are to be successful.

As well as the benefits of more flexibility for students, especially those working part-time, the academic benefits of blended learning are being better understood. These will be discussed in more detail in the next section. At this point, there is evidence that in Canada, at least, more and more institutions are seeing a move by instructors to blended or hybrid learning, providing the advantages of both online and face-to-face teaching (Donovan et al., 2018)

10.3.3 Face-to-face learners

Many students coming straight from high school will be looking for social, sporting and cultural opportunities that a campus-based education provides. Also students lacking self-confidence or experience in studying are likely to prefer face-to-face teaching, providing that they can access it in a relatively personal way.

However, the academic reasons for preference for face-to-face teaching by freshmen and women are less clear, particularly if students are faced with very large classes and relatively little contact with professors in the first year or so of their programs. In this respect, smaller, regional institutions, which generally have smaller classes and more face-to-face contact with instructors, have an advantage. Also, blended or flipped learning is increasingly being used for very large classes, with lectures available online, and smaller groups meeting face-to-face with an instructor or teaching assistants.

We shall see later in this chapter that blended and fully online learning offer the opportunity to re-think the whole campus experience so that better support is provided to on-campus learners in their early years in post-secondary education. More importantly, as more and more studying is done online, universities and colleges will be increasingly challenged to identify the unique pedagogical advantages of coming to campus, so that it will still be worthwhile for students to get on the bus to campus every morning.

10.3.4 Know your learners

It is therefore very important to know what kind of students you will be teaching. For some students, it will be better to enrol in a face-to-face class but be gradually introduced to online study within a familiar classroom environment. For other students, the only way they will take the course will be if it is available fully online. It is also possible to mix and match face-to-face and online learning for some students who want the campus experience, but also need a certain amount of flexibility in their studying. Going online may enable you to reach a wider market (critical for departments with low or declining enrolments) or to meet strong demand from working professionals. Who are (or could be) your students? What kind of course will work best for them?

We shall see that identifying the likely student market for a course or program is the strongest factor in deciding on mode of delivery.

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Activity 10.3 Knowing your students

1. Choose one of your courses. Do you know the key student demographics: age, gender, working or not, single or with families, language skills? If not how could you get this information?

2. If you had this information, would it change the way you teach?

3. If you are teaching a face-to-face class, are there other kinds of students who would be interested in taking your course if it was online?

There is no feedback on this activity.

10.4 Choosing between face-to-face and online teaching on campus

Figure 10.4.1 What should students enrolled in campus courses do online? Image: UBC Library

Analysing student demographics may help to decide whether or not a course or program should be either campus-based or fully online, but we need to consider more than just student demographics to make the decision about what to do online and what to do on campus for the majority of campus-based courses and programs that will increasingly have an online component.

10.4.1 A suggested method

10.4.1.1 Finding an approach based on successful experience

It should be stated up front that there is no generally agreed theory or even best practices for making this decision. The default mode has been that face-to-face teaching must be inherently superior, and you only go online if you must. However, we have seen that online learning has over the last ten years or so demonstrated clearly that many areas of knowledge can be taught just as well or better online. I will look therefore to examples where there has been a conscious decision to identify the relative affordances of different media, including face-to-face teaching. The area where this becomes most clear is in the teaching of science.

I am going to draw on a method used initially at the U.K. Open University for designing distance education courses and programs in science in the 1970s. The challenge was to decide what was best done in print, on television, via home experiment kits, and finally in a one week residential hands-on summer school at a traditional university. Since then, Dietmar Kennepohl and Lawton Shaw, of Athabasca University, have edited an excellent book about teaching science online (Kennepohl and Shaw, 2010). Also, the Colorado Community College System has recently been using a combination of remotely operated labs for student practical work, combined with home kits, for teaching online introductory science courses (Schmidt and Shea, 2015).

Each of these initiatives has adopted a pragmatic method for making decisions about what must be done face-to-face and what can be done online. What each of these approaches had in common wais trusting the knowledge and experience of subject experts who are willing to approach this question in an open-minded way, and working with instructional designers or media producers on an equal footing.

From these experiences, I have extracted one possible process for determining when to go online and when not to, on purely pedagogical grounds, for a course that is being designed from scratch in a blended delivery mode. It is based on a five step process:

1. identify the overall instructional approach/pedagogy required
2. identify the main content to be covered
3. identify the main skills to be taught
4. analyse the resources available
5. analyse the most appropriate mode of delivery for each of the learning objectives identified above

I will choose a subject area at random: haematology (the study of blood), in which I am not an expert. But here's what I would suggest if I was working with a subject specialist in this area.

Figure 10.4.2 Can the study of haematology be done online?
Image: CC Wikimedia Commons: National Cancer Institute, USA

10.4.1.2 **Step 1**: identify the main instructional approach.

This is discussed in some detail in Chapters 2 to 4, but here are the kinds of decision to be considered:

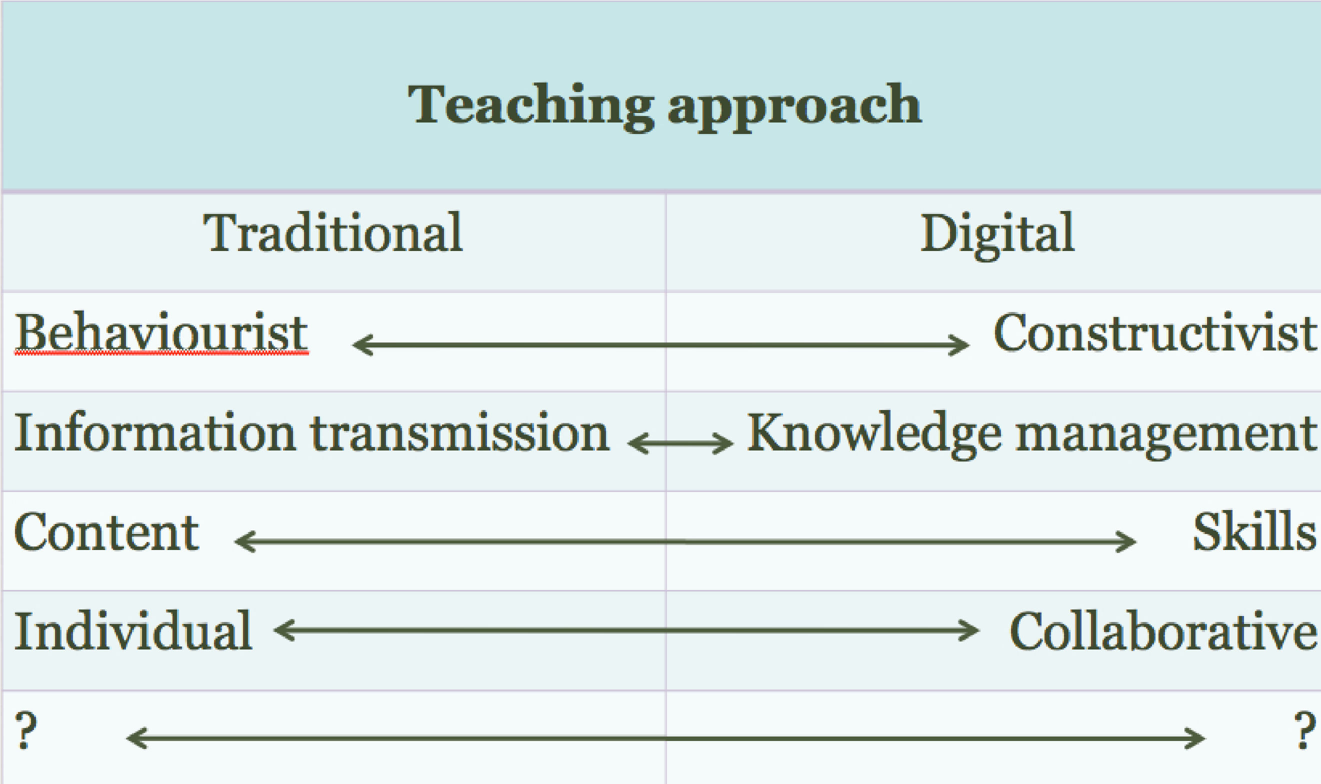

Figure 10.4.3 Which teaching approach?

This should lead to a general plan or approach to teaching that identifies the teaching methods to be used in some detail. In the example of haematology, the instructor wants to take a more constructivist approach, with students developing a critical approach to the subject matter. In particular, she wants to relate the course specifically to certain issues, such as security in handling and storing blood, factors in blood contamination, and developing student skills in analysis and interpretation of blood samples.

10.4.1.3 **Step 2**. Identify the main content to be covered

Content covers facts, data, hypotheses, ideas, arguments, evidence, and description of things (for instance, showing or describing the parts of a piece of equipment and their relationship). What do they need to know in this course? In haematology, this will mean understanding the chemical composition of blood, what its functions are, how it circulates through the body, descriptions of the relevant parts of cell biology, what external factors may weaken its integrity or functionality, and so forth, the equipment used to analyse blood and how the equipment works, principles, theories and hypotheses about blood clotting, the relationship between blood tests and diseases or other illnesses, and so on.

In particular, what are the presentational requirements of the content in this course? Dynamic activities need to be explained, and representing key concepts in colour will almost certainly be valuable. Observations of blood samples under many degrees of magnitude will be essential, which will require the use of a microscope.

There are now many ways to represent content: text, graphics, audio, video and simulations. For instance, graphics, a short video clip, or photographs down a microscope can show examples of blood cells in different conditions. Increasingly this content is already available over the web for free educational use (for instance, see the American Society of Hematology's video library). Creating such material from scratch is more expensive, but is becoming increasingly easy to do with high quality, low cost digital recording equipment. Using a carefully recorded video of an experiment will often provide a better view than students will get crowding around awkward lab equipment.

10.4.1.4 **Step 3**. Identify the main skills to be developed during the course

Skills describe how content will be applied and practiced. This might include analysis of the components of blood, such as the glucose and insulin levels, the use of equipment (where ability to use equipment safely and effectively is a desired learning outcome), diagnosis, interpreting results by making hypotheses about cause and effect based on theory and evidence, problem-solving, and report writing.

Developing *skills* online can be more of a challenge, particularly if it requires manipulation of equipment and a 'feel' for how equipment works, or similar skills that require tactile sense. (The same could be said of skills that require taste or smell). In our hematology example, some of the skills that need to be taught might include the ability to analyse analytes or particular components of blood, such as insulin or glucose, to interpret results, and to suggest treatment. The aim here would be to see if there are ways these skills can also be taught effectively online. This would mean identifying the skills needed, working out how to develop such skills (including opportunities for practice) online, and how to assess such skills online.

Let's call Steps 2 and 3 the key learning objectives for the course.

10.4.1.5 **Step 4**: Analyse the most appropriate mode for each learning objective

Then create a table as in Figure 10.4.4:

	Face-to-face	Online
Content		
Learn theory and terminology		x
Video of interactions under microscope		x
Graphics of molecular structure of blood		x
Skills		
Design experimental set-up using virtual equipment		x
Observe analytes under microscope	x	
Insert glucose	x	

Figure 10.4.4 Allocating mode of delivery

In this example, the instructor is keen to move as much as possible online, so she can spend as much time as possible with students, dealing with laboratory work and answering questions about theory and practice. She was able to find some excellent online videos of several of the key interactions between blood and other factors, and she was also able to find some suitable graphics and simple animations of the molecular structure of blood which she could adapt, as well as creating with the help of a graphics designer her own graphics. Indeed, she found she had to create relatively little new material or content herself.

The instructional designer also found some software that enabled students to design their own laboratory set-up for certain elements of blood testing which involved combining virtual equipment, entering data values and running an experiment. However, there were still some skills that needed to be done hands-on in the laboratory, such as inserting glucose and using a 'real' microscope to analyse the chemical components of blood. However, the online material enabled the instructor to spend more time in the lab with students.

It can be seen in this example that most of the content can be delivered online, together with a critically important skill of designing an experiment, but some activities still need to be done 'hands-on'. This might require one or more evening or weekend sessions in a lab for hands-on work, thus delivering most of the course online, or there may be so much hands-on work that the course may have to be a hybrid of 50 per cent hands-on lab work and 50 per cent online learning.

With the development of animations, simulations and online remote labs, where actual equipment can be remotely manipulated, it is becoming increasingly possible to move even traditional lab work online. At the same time, it is not always possible to find exactly what one needs online, although this will improve over time. In other subject areas such as humanities, social sciences, and business, it is much easier to move the teaching online.

This is a crude method of determining the balance between face-to-face teaching and online learning for a blended learning course, but it least it's a start. It can be seen that these decisions have to be relatively intuitive, based on instructors' knowledge of the subject area and their ability to think creatively about how to achieve learning outcomes online. However, we have enough experience now of teaching online to know that in most subject areas, a great deal of the skills and content needed to achieve quality learning outcomes can be taught online. It is no longer possible to argue that the default decision must always be to do the teaching in a face-to-face manner.

Thus every instructor now needs to ask the question: if I can move most of my teaching online, what are the unique benefits of the campus experience that I need to bring into my face-to-face teaching? Why do students have to be here in front of me, and when they are here, am I using the time to best advantage?

10.4.2 Analyse the resources available

There is one more consideration besides the type of learners, the overall teaching method, and making decisions based on pedagogical grounds, and that is to consider the resources available. (This should really be Step 4, before allocating learning objectives to different modes, but it will be difficult to avoid in any case.).

10.4.2.1 The time of the instructor

In particular, the key resource is the time of the teacher or instructor. Careful consideration is needed about how best to spend the limited time available to an instructor. It may be all very well to identify a series of videos as the best way to capture some of the procedures for blood testing, but if these videos do not already exist in a format that can be freely used, shooting video specially for this one course may not be justified, in terms of either the time the instructor would need to spend on video production, or the costs of making the videos with a professional crew.

Time to learn how to do online teaching is especially important. There is a steep learning curve and the first time will take much longer than subsequent online courses. The institution should offer some form of training or professional development for instructors thinking of moving online or into blended learning. Ideally instructors should get some release time (up to one semester from one class) in order to do the design and preparation for an online course, or a re-designed hybrid course. This however is not always possible, but one thing we do know. Instructor workload is a function of course design. Well designed online courses should require less rather than more work from an instructor.

10.4.2.2. Learning technology support staff.

If your institution has a service unit for faculty development and training, instructional designers and web designers for supporting teaching, use them. Such staff are often qualified in both educational sciences and computer technology. They have unique knowledge and skills that can make your life much easier when teaching online. (This will be discussed further in Chapter 13.)

The availability and skill level of learning technology support from the institution is a critical factor.

Can you get the support of an instructional designer and media producers? If not, it is likely that much more will be done face-to-face than online, unless you are already very experienced in online learning.

10.4.2.3 Readily available technology

Most institutions now have a learning management system such as Blackboard or Moodle, or a lecture capture system for recording lessons. But increasingly, instructors will need access to media producers who can create videos, digital graphics, animations, simulations, web sites, and access to blog and wiki software. Without access to such technology support, instructors are more likely to fall back on tried and true classroom teaching.

10.4.2.4 Colleagues experienced in blended and online learning

It really helps if there are experienced colleagues in the department who understand the subject discipline and have done some online teaching. They will perhaps even have some materials already developed, such as graphics, that they will be willing to share.

10.4.2.5 Money

Are there resources available to buy you out for one semester to spend time on course design? Many institutions have development funds for innovative teaching and learning, and there may be external grants for creating new open educational resources, for instance. This will increase the practicality and hence the likelihood of more of the teaching moving online.

We shall see that as more and more learning material becomes available as open educational resources, teachers and instructors will be freed up from mainly content presentation to focusing on more interaction with students, both online and face to face. However, although open educational resources are becoming increasingly available, they may not exist in the topics required or they may not be of adequate quality in terms of either content or production standards (see Chapter 11.2 for more on OERs).

The extent to which these resources are available will help inform you on the extent to which you will be able to go online and meet quality standards. In particular, you should think twice about going online if none of the resources listed above is going to be available to you.

10.4.3 The case for multiple modes

Increasingly, it is becoming difficult to separate markets for particular courses or programs. Although the majority of students taking a first year university course are likely to be coming straight from high school, some will not. There may be a minority of students who left high school directly for work, or went to a two year college to get vocational training, but now find they need a degree. Especially in professional graduate programs, students may be a mix of those who have just completed their bachelor’s course and are still full-time students, and those that are already in the work-force but need the specialist qualification. There will be a mix of students in third and fourth year undergraduate courses, some of whom will be working over 15 hours a week, and others who are studying more or less full time. In theory, then, it may be possible to identify a particular market for mainly face-to-face, blended or fully online learning, but in practice most courses are likely to have a mix of students with different needs.

If, though, as seems likely, more and more courses will end up as blended learning, then it is worth thinking about how courses could be designed to serve multiple markets. For instance, if we take our haematology course, it could be offered to full-time third year undergraduate students studying biology, or it could also be offered either on its own or with other related courses as a certificate in blood management for nurses working in hospitals. It might also be useful for students studying medicine who have not taken this particular course as an undergraduate, or even for patients with conditions related to their blood levels, such as diabetes.

If for instance our instructor developed a course where students spent approximately 50 per cent of their time online and the rest on campus, it may eventually be possible to design this for other markets as well, with perhaps practical work for nurses being done in the hospital under supervision, or just the online part being offered as a short MOOC for patients. For some courses (perhaps not haematology), it may be possible to offer the course wholly online, in blended format or wholly face-to-face. This would allow the same course to reach several different markets.

10.4.4 Questions for consideration in choosing modes of delivery

In summary, here are some questions to consider, when designing a course from scratch:

1. What kind of learners are likely to take this course? What are their needs? Which mode(s) of delivery will be most appropriate to these kinds of learners? Could I reach more or different types of learners by choosing a particular mode of delivery?

2. What is my view of how learners can best learn on this course? What is my preferred method(s) of teaching to facilitate that kind of learning on this course?

3. What is the main content (facts, theory, data, processes) that needs to be covered on this course? How will I assess understanding of this content?

4. What are the main skills that learners will need to develop on this course? What are the ways in which they can develop/practice these skills? How will I assess these skills?

5. How can technology help with the presentation of content on this course?

6. How can technology help with the development of skills on this course?

7. When I list the content and skills to be taught, which of these could be taught:

- fully online
- partly online and partly face-to-face
- can only be taught face-to-face?

8. What resources do I have available for this course in terms of:

- professional help from instructional designers and media producers;
- possible sources of funding for release time and media production;
- good quality open educational resources.

9. What kind of classroom space will I need to teach the way I wish? Can I adapt existing spaces or will I need to press for major changes to be made before I can teach the way I want to?

10. In the light of the answers to all these questions, which mode of delivery makes most sense?

References

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Schmidt, S. and Shea, P. (2015) *NANSLO Web-based Labs: Real Equipment, Real Data, Real People!* WCET Frontiers

Activity 10.4 Deciding on the mode of delivery

1. Try following the process above for a possible new course that you would like to teach or for revising a course you are already teaching.

There is no feedback on this activity.

10.5 The future of the campus

Figure 10.5.1 The magic of the campus?
Image: © Cambridge Advanced Studies Program, Cambridge University, U.K., 2015

As more and more teaching is moved online, even for campus-based students, it will become increasingly important to think about the function of face-to-face teaching and the use of space on campus.

10.5.1 Identifying the unique characteristics of face-to-face teaching in a digital world

Sanjay Sarma, Director of MIT's Office of Digital Learning, made an attempt at MIT's LINC 2013 conference to identify the difference between campus-based and online learning, and in particular MOOCs. He made the distinction between MOOCs as open courses available to anyone, reflecting the highest level of knowledge in particular subject areas, and the 'magic' of the on-campus experience, which he claimed is distinctly different from the online experience (Sarma, 2013).

He argued that it is difficult to define or pin down the magic that takes place on-campus, but referred to:

- 'in-the-corridor' conversations between faculty and staff;
- hands-on engineering with other students outside of lectures and scheduled labs;
- the informal learning that takes place between students in close proximity to one another.

There are a couple of other characteristics that Sarma hinted at but did not mention explicitly in his presentation:

- the very high standard of the students admitted to MIT, who 'push' each other to even higher standards;
- the importance of the social networks developed by students at MIT that provide opportunities later in life.

Easy and frequent access to laboratories is a serious contender for the uniqueness of campus-based learning, as this is difficult to provide online, although there is an increasing number of developments in remote labs and the use of simulations. Opportunities for finding future spouses is another contender. Probably the most important though is access to social contacts that can further your career (see my podcast feedback on Activity 10.2 for more on the 'unique affordances' of campus-based teaching.).

I leave it to you to judge whether these are unique features of face-to-face teaching, or whether the key advantages of a campus experience are more specific to expensive and highly selective elite institutions. For most teachers and instructors, though, more concrete and more general pedagogical advantages for face-to-face teaching need to be identified.

10.5.2 The law of equal substitution

In the meantime, we should start from the assumption that *from a strictly pedagogical perspective, most courses can be taught equally well online or face-to-face*, what I call the law of equal substitution. This means that other factors, such as cost, convenience for teachers, social networking, the skills and knowledge of the instructor, the type of students, or the context of the campus, will be stronger determinants of whether to teach a course online or on campus than the academic demands of the subject matter. These are all perfectly justifiable reasons for privileging the campus experience.

At the same time, there are likely to be some critical areas where there is a strong pedagogical rationale for students to learn in a face-to-face or hands-on context. In other words, we need to identify the *exceptions* to the law of equal substitution. These unique pedagogical characteristics of campus-based teaching need to be researched more carefully, or at least be more theory-based than at present, but currently there is no powerful or convincing method or rationale to identify what the uniqueness is of the campus experience in terms of learning outcomes. The assumption appears to be that the campus experience must be better, at least for some things, because this is the way we have always done things. We need to turn the question on its head: what is the academic or pedagogical justification for the campus, when students can learn most things online?

10.5.3 The impact of online learning on the campus experience

This question becomes particularly important when we examine how an increased move to blended or hybrid learning is going to impact on learning spaces. In some ways, this may turn out to be a ticking time bomb for schools, colleges and universities.

10.5.3.1 Rethinking the design of classrooms

As we move from lectures to more interactive learning, we will need to think about the spaces in which learning will take place, and how pedagogy, online learning and the design of learning spaces influence one another. To make it worthwhile for students to come to campus when they can do an increasing amount of their study online, the on-campus activities must be meaningful. If for instance we want students to come to campus for interpersonal communication and intense group work, will there be sufficiently flexible and well-equipped spaces for students to do this, remembering that they will want to combine their online work with their classroom activities?

In essence, new technology, hybrid learning and the desire to engage students and to develop the knowledge and skills needed in a digital age are leading some teachers and architects to rethink the classroom and the way it is used.

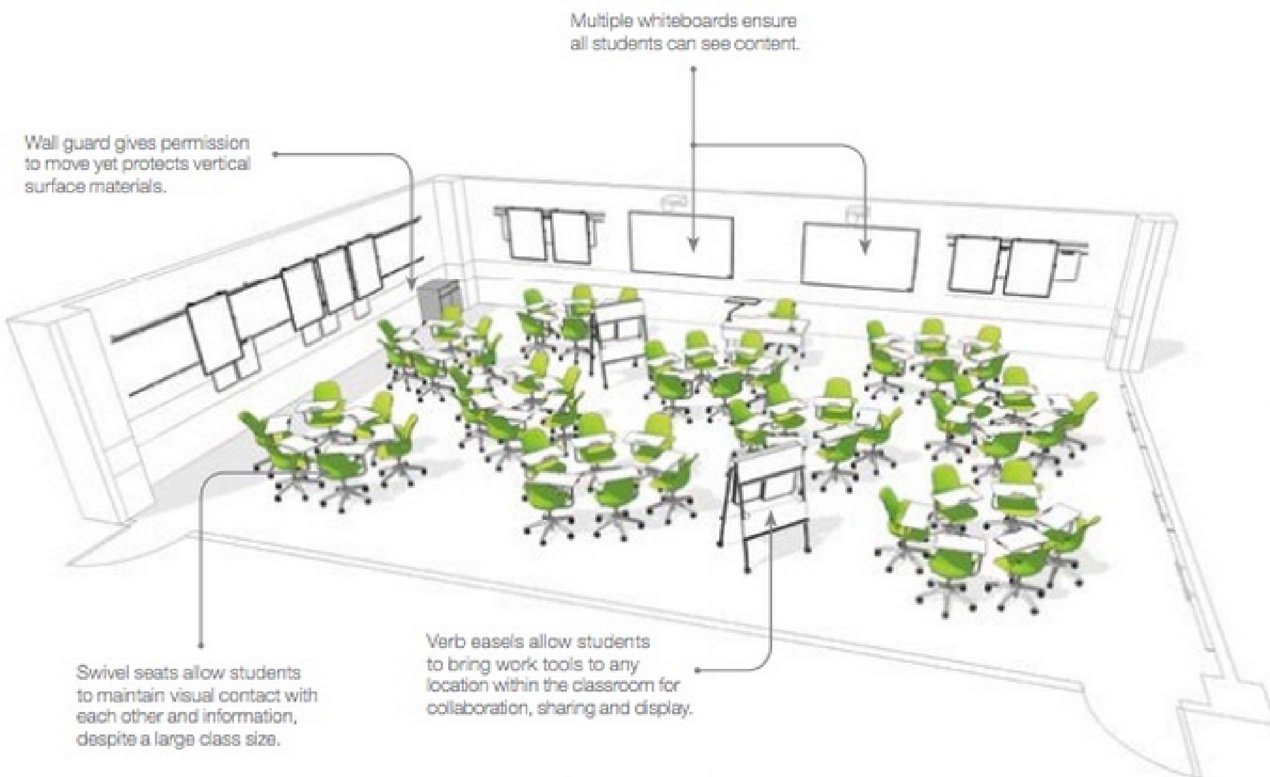

Figure 10.5.2 Design for an interactive classroom from Steelcase (© Steelcase, 2013)

Steelcase, a leading American manufacturer of office and educational furniture, is not only conducting impressive research into learning environments, but is way ahead of many of our post-secondary institutions in thinking through the implications of online learning for classroom design. Their educational research website, and two of their reports: Active Learning Spaces and Rethinking Space: Sparking Creativity are documents that all post-secondary institutions and even k-12 planners should be looking at.

In Active Learning Spaces, Steelcase reports:

> *Formal learning spaces have remained the same for centuries: a rectangular box filled with rows*

of desks facing the instructor and writing board….As a result, today's students and teachers suffer because these outmoded spaces inadequately support the integration of the three key elements of a successful learning environment: pedagogy, technology and space.

Change begins with pedagogy. Teachers and teaching methods are diverse and evolving. From one class to the next, sometimes during the same class period, classrooms need change. Thus, they should fluidly adapt to different teaching and learning preferences. Instructors should be supported to develop new teaching strategies that support these new needs.

Technology needs careful integration. Students today are digital natives, comfortable using technology to display, share and present information. Vertical surfaces to display content, multiple projection surfaces and whiteboards in various configurations are all important classroom considerations.

Space impacts learning. More than three-quarters of classes include class discussions and nearly 60 percent of all classes include small group learning, and those percentages are continuing to grow. Interactive pedagogies require learning spaces where everyone can see the content and can see and interact with others. Every seat can and should be the best seat in the room. As more schools adopt constructivist pedagogies, the "sage on the stage" is giving way to the "guide on the side." These spaces need to support the pedagogies and technology in the room to allow instructors who move among teams to provide real-time feedback, assessment, direction and support students in peer-to-peer learning. Pedagogy, technology and space, when carefully considered and integrated, define the new active learning ecosystem.

In Rethinking Space: Sparking Creativity, Andrew Kim, Steelcase Education Researcher, states:

Creative work is most effective in learning spaces that support team work flow and sharing of information.

Figure 10.5.4 Interactive classroom at Queen's University, Kingston, Ontario

The design of classroom spaces now needs to take into account that students are doing an increasing amount of their work online (and often outside the classroom). The classroom must support opportunities for accessing, working on, sharing and demonstrating knowledge gained both within and outside the classroom. Thus if the classroom is organized into 'clusters' of furniture and equipment to support small group work, these clusters will also require power so students can plug in their devices, wireless Internet access, and the ability to transmit work to shared screens around the room (in other words, a class Intranet). Students also need quiet places or breakout spaces where they can work individually as well as in groups. When faculty are presented with such use of space, they naturally adopt more active learning approaches.

10.5.3.2 The impact of flipped classrooms and hybrid learning on classroom design

These classrooms designs assume that students are learning in relatively small classes. However, we are also seeing the redesign of large lecture classes using hybrid designs such as flipped classrooms. Indeed Mark Valenti (2013) of the Sextant Group (an audio-visual company) is reported as saying: '*We're basically seeing the beginning of the end of the lecture hall.*'

Nevertheless, given the current financial context, we should not assume that the classroom time for these redesigned large lectures classes will be spent in small groups in individual classrooms (there are probably not enough small classrooms to accommodate these classes which often have over a thousand students). Larger spaces that can be organized into smaller working groups, then easily reconvened into a large, single group, will be needed. What the space for these large classes certainly should *not* be is the raked rows of benches which now are now the norm in most large lecture theatres.

Steelcase is also doing research on appropriate spaces for faculty. For instance, if a university or department is planning a learning commons or common area for students, why not locate faculty offices in the same general area instead of in a separate building? Indeed, a case could be made for integrating faculty office space with more open teaching areas.

10.5.3.3 The impact on capital building plans

It is obvious why a company such as Steelcase is interested in these developments. There is a tremendous commercial opportunity for selling new and better forms of classroom furniture that meets these needs. However, that is the problem. Universities, colleges and especially schools simply do not have the money to move quickly towards new classroom designs, and even if they did, they should do some careful thinking first about:

- what kind of campus will be needed over the next 20 years, given the rapid moves to hybrid and online learning;
- how much they need to invest in physical infrastructure when students can do much of their studies online.

Nevertheless, there are several opportunities for at least setting priorities for innovation in classroom design:

- where new campuses or major buildings are being built or renewed;

- where large first and second year classes are being redesigned: maybe a prototype classroom design could be tried for one of these large lecture redesigns and tested; if successful the model could be added slowly to other large lecture classes;
- where a department or program is being redesigned to integrate online learning and classroom teaching in a major way; they would receive priority for funding a new classroom design;
- all major new purchases of classroom furniture to replace old or worn out equipment should first be subject to a review of classroom designs.

The important point here is that investment in new or adapted physical classroom space should be driven by decisions to change pedagogy/teaching methods. This will mean bringing together academics, IT support staff, instructional designers and staff from facilities, as well as architects and furniture suppliers. Second, as Winston Churchill said: 'we shape our buildings and afterwards our buildings shape us.' Providing teachers and instructors with a flexible, well-designed learning environment is likely to encourage major changes in their teaching; stuffing them into rectangular boxes with rows of desks will do the opposite.

Perhaps most important of all, institutions need to start re-examining their future growth plans for buildings on campus. In particular:

- will we need additional classrooms and additional lecture theatre buildings if students will be spending up to half their time studying online or in flipped classes?
- do we have enough learning areas where large numbers of students can work in small groups and can then quickly reconvene?
- do we have the technical facilities that will allow students seamlessly to work and study both face-to-face and online, and to share and capture the work when working physically together on campus?
- would we be better investing in the re-design of existing space rather than building new learning spaces?

What is clear is that institutions now need to do some hard thinking about online learning, its likely impact on campus teaching, and above all what kind of campus experience we want students to have when they can do much of their studying online. It is this thinking that should shape our investment in buildings, desks and chairs.

10.5.4 Re-thinking the role of the campus

If we accept the principle of equal substitution for many academic purposes, then this brings us back to the student on the bus question. If students can learn most things equally well (and more conveniently) online, what can we offer them on campus that will make the bus journey worthwhile? This is the real challenge that online learning presents.

It is not just a question of what teaching activities need to be done in a face-to-face class or lab, but the whole cultural and social purpose of a school, college or university. Students in many of our large, urban universities have become commuters, coming in just for their lectures, maybe using the learning commons between lectures, getting a bite to eat, then heading home. As we have 'massified' our universities, the broader cultural aspects have been lost.

Online and hybrid learning provides a chance to re-think the role and purpose of the whole campus, as well as what we should be doing in classrooms when students have online learning available any time and anywhere. Of course we could just close up shop and move everything online (and save a great deal of money), but we should at least explore what would be lost before doing that.

References

Sarma, S. (2013) *The Magic Beyond the MOOCs* Boston MA: LINC 2013 conference

Steelcase Education (undated) *Active Learning Spaces* Michigan: Grand Rapids

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Valenti, M. (2013), in Williams, L., 'AV trends: hardware and software for sharing screens, *University Business*, June

Activity 10.5 Redesigning your classroom space

Where the caretaker determines pedagogy: I worked in one school where every morning the chairs and desks were laid out in neat rows facing the front. The caretaker would get furious if they were left arranged in any other layout by the end of the day. I therefore spent too much lesson time with students re-arranging the desks for group work then tidying up afterwards. (I was young and didn't dare defy the caretaker, who was quite formidable).

1. If you were designing from scratch a learning space for a group of 40 students (maximum), what would the learning space look like, given all the potential technology and teaching methods you and the students could be using?

2.If you have a lecture class of 200 students and wanted to change your teaching method, how would you redesign the teaching and what kind of space(s) would you need?

Key Takeaways from Chapter 10

1. There is a continuum of technology-based learning, from 'pure' face-to-face teaching to fully online programs. Every teacher or instructor needs to decide where on the continuum a particular course or program should be.

2. We do not have good research evidence or theories to make this decision, although we do have growing experience of the strengths and limitations of online learning. What is particularly missing is an evidence-based analysis of the strengths and limitations of face-to-face teaching when online learning is also available.

3. In the absence of good theory, I have suggested four factors to consider when deciding on mode of delivery, and in particular the different uses of face-to-face and online learning in blended courses:

- student characteristics and needs
- your preferred teaching strategy, in terms of methods and learning outcomes
- the pedagogical and presentational requirements of the subject matter, in terms of (a) content and (b) skills
- the resources available to an instructor (including the instructor's time).

4. The move to blended or hybrid learning in particular means rethinking the use of the campus and the facilities needed fully to support learning in a hybrid mode.

Chapter 11: Trends in open education

The purpose of this chapter

When you have completed this chapter you should be able to determine:

- how your role as an instructor is likely to be changed by developments in open learning;
- when you should create your own material and when you should use open educational resources;
- how to maximise the use of digital materials once created, in terms of the design of courses.

What is covered in this chapter

- Scenario H: Watershed management
- 11.1 Open learning
- 11.2 Open educational resources (OER)
- 11.3 Open textbooks, open research and open data
- 11.4 Open pedagogy
- 11.5 The implications of 'open' for course and program design: towards a paradigm shift?

Also in this chapter you will find the following activities:

- Activity 11.1 Should access to post-secondary education be completely open to everyone?
- Activity 11.2 Deciding on OER
- Activity 11.3 Using other open resources
- Activity 11.4 Contemplating open pedagogy
- Activity 11.5 Build your own scenario

Key Takeaways

1. Open educational resources offer many benefits but they need to be well designed and embedded within a rich learning environment to be effective.

2. The increasing availability of OER, open textbooks, open research and open data means that in future, almost all academic content will be open and freely accessible over the Internet.

3. As a result, students will increasingly look to institutions for learning support and help with the

development of skills needed in a digital age rather than with the delivery of content. This will have major consequences for the role of teachers/instructors and the design of courses.

4. OER and other forms of open education will lead to increased modularization and disaggregation of learning services, which are needed to respond to the increasing diversity of learner needs in a digital age.

5. MOOCs are essentially a dead end with regard to providing learners who do not have adequate access to education with high quality qualifications. The main value of MOOCs is in providing opportunities for non-formal education and supporting communities of practice.

6. OER, MOOCs, open textbooks and other digital forms of open-ness are important in helping to widen access to learning opportunities, but ultimately these are enhancements rather than a replacement for a well-funded public education system, which remains the core foundation for enabling equal access to educational opportunities.

Scenario H: Watershed management

Figure 11.H The Hart River, Yukon.
Image: © www.protectpeel.ca, CC BY-NC

Over a number of years, research faculty in the Departments of Land Management and Forestry at the University of Western Canada had developed a range of digital graphics, computer models and simulations about watershed management, partly as a consequence of research conducted by faculty, and partly to generate support and funding for further research.

At a faculty meeting several years ago, after a somewhat heated discussion, faculty members voted, by a fairly small majority, to make these educational resources openly available for re-use for educational purposes under a Creative Commons license that requires attribution and prevents commercial use without specific written permission from the copyright holders, the faculty responsible for developing the artefacts.

What swayed the vote is that the majority of the faculty actively involved in the research wanted to make these resources more widely available. The agencies responsible for funding the work that resulted in the development of the learning artefacts (mainly national research councils) welcomed the move to makes these artefacts more widely available as open educational resources.

Initially, the researchers just put the graphics and simulations up on the research group's web site. It was left to individual faculty members to decide whether to use these resources in their teaching. Over time, faculty started to introduce these resources into a range of on-campus undergraduate and graduate courses.

After a while, though, word seemed to get out about these OER. Research members began to receive e-mails and phone calls from other researchers around the world. It became clear that there was a network or community of researchers in this field who were creating digital materials as a result of their research, and it made sense to share and re-use materials from other sites. This eventually led to an international web 'portal' of learning artefacts on watershed management.

The researchers also started to get calls from a range of different agencies, from government ministries or departments of environment, local environmental groups, First Nations/aboriginal bands, and, occasionally, major mining or resource extraction companies, leading to some major consultancy work for the faculty in the departments. At the same time, the faculty were able to attract further research funding from non-governmental agencies such as the Nature Conservancy and some ecological groups, as well as from their traditional funding source, the national research councils, to develop more OER.

By this time, the departments had access to a fairly large amount of OER. There were already two fourth and fifth level fully online courses built around the OER that were being offered successfully to undergraduate and graduate students. A proposal was therefore put forward to create initially a fully online post-graduate certificate program on watershed management, built around existing OER, in partnership with a university in the USA and another one in Sierra Leone. This certificate program was to be self-funding from tuition fees, with the tuition fees for the 25 Sierra Leone students to be initially covered by an international aid agency.

The Dean, after a period of hard negotiation, persuaded the university administration that the departments' proportion of the tuition fees from the certificate program should go directly to the departments, who would hire additional tenured faculty from the revenues to teach or backfill for the certificate, and the departments would pay 25 per cent of the tuition revenues to the university as overheads.This decision was made somewhat easier by a fairly substantial grant from Foreign Affairs Canada to make the certificate program available in English and French to Canadian mining and resource extraction companies with contracts and partners in African countries.

Although the certificate program was very successful in attracting students from North America, Europe and New Zealand, it was not taken up very well in Africa beyond the partnership with the university in Sierra Leone, although there was a lot of interest in the OER and the issues raised in the certificate courses. After two years of running the certificate, then, the departments made two major decisions:

- another three courses and a research project would be added to the certificate courses, and this would be offered as a fully cost recoverable online master in watershed resource management. This would attract greater participation from managers and professionals in African countries in particular, and provide a recognised qualification that many of the certificate students were requesting;
- drawing on the very large network of external experts now involved one way or

another with the researchers, the university would offer a series of MOOCs on watershed management issues, with volunteer experts from outside the university being invited to participate and provide leadership in the MOOCs. The MOOCs would be able to draw on the existing OER.

Five years later, the following outcomes were recorded by the Dean at an international conference on sustainability:

- the online master's program had doubled the total number of graduate students in her Faculty;
- the master's program was fully cost-recoverable from tuition fees;
- there were 120 graduates a year from the master's program;
- the degree completion rate was 64 per cent;
- six new tenured faculty had been hired, plus another six post-doctoral research staff;
- several thousand students had registered and paid for at least one course in the certificate or master's program, of which 45 per cent were from outside Canada;
- over 100,000 students had taken the MOOCs, almost half from developing countries;
- there were now over 1,000 hours of OER on watershed management available and downloaded many times across the world;
- the university was now internationally recognised as a world leader in watershed management.

Although this scenario is purely a figment of my imagination, it is influenced by real and exciting work being done by the following at the University of British Columbia:

- Dr. Hans Schreier, Watershed Management Courses, Institute of Resources, Environment and Sustainability, UBC
- Virtual Soil Science Learning Resources (developed by a consortium of British Columbian universities)
- Graduate Certificate in Technology-Based Learning, Division of Continuing Studies/Faculty of Education, UBC
- International Master in Educational Technology, Faculty of Education, UBC

11.1 Open learning

Figure 11.1.1 'I'm just a committed and even stubborn person who wants to see every child getting quality education…'
Malala Yousafzai's Nobel Prize speech, 2014. Click on image to see the speech.

In recent years, there has been a resurgence of interest in open learning, mainly related to open educational resources and MOOCs. Although in themselves open educational resources (OER) and MOOCs are important developments, they tend to cloud other developments in open education that are likely have even more impact on education as a whole. It is therefore necessary to step back a little to get a broader understanding of not just OER and MOOCs, but open learning in general. This will help us better understand the significance of MOOCs, OER and other developments in open education, and their likely impact on teaching and learning now and in the future.

11.1.1 Open education as a concept

Open education can take a number of forms:

- *education for all*: free or very low cost school, college or university education available to everyone within a particular jurisdiction, usually funded primarily through the state;
- *open access to programs* that lead to full, *recognised qualifications*. These are offered by national open universities or more recently by the OERu;
- *open access to courses or programs* that are *not for formal credit*, although it may be possible to acquire badges or certificates for successful completion. MOOCs are a good example;
- *open educational resources* that instructors or learners can use for free. MIT's OpenCourseware, which provides free online downloads of MIT's video recorded lectures and support material, is one example;
- *open textbooks*, online textbooks that are free for students to use (such as this one);
- *open research*, whereby research papers are made available online for free downloading (see for instance Open Research Central);
- *open data*, that is, data open to anyone to use, reuse, and redistribute, subject only, at most, to the requirement to attribute and share; see for example the World Bank's Open Data Bank;
- *open pedagogy*, a method of teaching and learning that builds on principles of open-ness and learner participation

Each of these developments is discussed in more detail in this chapter, except for MOOCs, which are discussed extensively in Chapter 5.

11.1.2 Education for all – except higher education

Open education is primarily a goal, or an educational policy. An essential characteristic of open education is the removal of barriers to learning. It can mean no prior qualifications to study, no discrimination by gender, race, age or religion, affordability for everyone, and for students with disabilities, through a determined effort to provide education in a suitable form that overcomes the disability (for example, audio recordings for students who are visually impaired). Ideally, no-one should be denied access to an open educational program. Thus open learning must be scalable as well as flexible.

11.1.2.1 State-funded schools

State-funded public education for the education of children from around the age of five through to sixteen or in some countries eighteen is the most extensive and widespread form of open education. For example, the British government passed the 1870 Education Act that set the framework for schooling of all children between the ages of 5 and 13 in England and Wales. Although there were some fees to be paid by parents, the Act established the principle that education would be paid for mainly through taxes and no child would be excluded for financial reasons. Schools would be administered by elected local school boards (Living Heritage, undated).

Over time, access to publicly funded education in most economically developed countries has been widened to include all children up to the age of 18. UNESCO's Education for All (EFA) movement is a global commitment to provide quality basic education for all children, youth and adults, supported, at least in principle, by 164 national governments. Nevertheless today there are over 250 million of 'out-of-school' children, adolescents and youth worldwide (UNESCO, 2018), or roughly one in five.

11.1.2.2 Post-secondary education

Access to post-secondary or higher education has been more limited than access to schools, partly on financial grounds, but also in terms of 'merit'. Universities have required those applying for university to meet academic standards determined by prior success in school examinations or institutional entry exams. This has enabled elite universities in particular to be highly selective.

However, after the Second World War, the demand for an educated population, both for social and economic reasons, in most economically advanced countries resulted in the gradual expansion of universities and post-secondary education in general. In most OECD countries, roughly 35-60 per cent of an age cohort will go on to some form of post-secondary education. Especially in a digital age, there is an increasing demand for highly qualified workers, and post-secondary education is a necessary gateway to most of the best jobs. Therefore there is increasing pressure for full and free open access to post-secondary, higher or tertiary education.

11.1.2.3 The cost of widening access

However, as we saw in Chapter 1, the cost of widening access to ever increasing numbers results in increased financial pressure on governments and taxpayers. Following the financial crisis of 2008, many states in the USA found themselves in severe financial difficulties, which resulted in substantial funding cuts to the U.S. higher education system (see for instance, Rivera, 2012), which in turn resulted in a rapid increase in tuition fees.

It is probably more than co-incidental that other forms of open education such as MOOCs and OER arose at a time of increasing cuts to the funding of public education in the USA. Solutions that enable increased access without a proportionate increase in funding or tuition fees are almost desperately being sought by governments and institutions. It is against this background that the renewed interest in open education should be framed.

11.1.3 Open access in higher education

11.1.3.1 Open universities

In the 1970s and 1980s, there was a rapid growth in the number of open universities that required no or minimal prior qualifications for entry. In the United Kingdom, for instance, in 1969, less than 10 per cent of students leaving secondary education went on to university. This was when the British government established the Open University, a distance teaching university open to all, using a combination of specially designed printed texts, and broadcast television and radio, with one week residential summer schools on traditional university campuses for the foundation courses (Perry, 1976; Weinbren, 2015).

The Open University started in 1971 with 25,000 students in the initial entry intake, and now has over 200,000 registered students. It has been consistently ranked by government quality assurance agencies in the top ten U.K. universities for teaching, and in the top 30 for research, and number one for student satisfaction (out of over 180). It currently has over 200,000 registered students (Weinbren, 2015). However, it can no longer cover the full cost of its operation from government grants and there is now a range of different fees to be paid. In addition access to higher education has now widened to the point where 50% of a high school cohort now enter some form of higher education in the UK (UK Department of Education, 2018).

There are now nearly 100 publicly funded open universities around the world, including Canada (Athabasca University and Téluq). These open universities are often very large. The Open University of China has over one million enrolled undergraduate students and 2.4 million junior high school students, Anadolou Open University in Turkey has over 1.2 million enrolled undergraduate students, the Open University of Indonesia (Universitas Terbuka) almost half a million, and the University of South Africa 350,000. These large, degree awarding national open universities provide an invaluable service to millions of students who otherwise would have no access to higher education (see Daniel, 1998, and more recently, Contact North, 2019, for a good overview).

11.1.3.2 Alternatives to open universities

It should be noted however that there is no publicly funded open university in the USA, which is one reason why MOOCs have received so much attention there. The Western Governors' University is the most similar to an open university, and private, for-profit universities such as the University of Phoenix fill a similar niche in the market.

As well as the national open universities, which usually offer their own degrees, there is also the OERu, which is basically an international consortium of mainly British Commonwealth and U.S. universities and colleges offering open access courses that enable learners either to acquire full credit for transfer into one of the partner universities or to build towards a full degree, offered by the university from which most credits have been acquired. Students pay a fee for assessment.

11.1.4 Limitations of open learning

Open, distance, flexible and online learning are rarely found in their 'purest' forms. No teaching system is completely open (minimum levels of literacy are required, for instance). Thus there are always degrees of openness. Openness has particular implications for the use of technology. If no-one is to be denied access, then technologies that are available to everyone need to be used. If an institution is deliberately selective in its students, it has more flexibility with regard to choice of technology. It can for instance require all students who wish to take an online or blended course to have their own computer and Internet access. It cannot do that if its mandate is to be open to all students. Truly open universities then will always be behind the leading edge of educational applications of technology.

Despite the success of many open universities, open universities often lack the status of a campus-based institution. Their degree completion rates are often very low. The U.K. OU's degree completion rate is 22 per cent (Woodley and Simpson, 2014), but nevertheless still higher for whole degree programs than for most single MOOC courses.

Lastly, some of the open universities have been established for more than 40 years and have not always quickly adapted to changes in technology, partly because of their large size and their substantial prior investment in older technologies such as print and broadcasting, and partly because they do not wish to deny access to potential students who may not have access to the latest technology.

Thus open universities are now increasingly challenged by both an explosion in access to higher education generally, and in the use of online learning by conventional universities. For instance, in Canada, Donovan et. (2018) report that nearly all universities and most colleges are now offering fully online courses (although access is still mainly based on prior qualifications). New developments such as

MOOCs, and open educational resources, the topic of the next section, are further challenges for open universities.

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Activity 11.1 Should access to post-secondary education be completely open to anyone?

1. Should access to post-secondary or higher education be open to everyone?

If yes, what are reasonable limitations on this principle?

What should be the government's role, if any, in making this possible?

If your answer is no to the first part of this question, why should education up to post-secondary education be open, but not afterwards? Is it simply money, or are there other reasons?

2. Are open universities still relevant in a digital age?

11.2 Open educational resources (OER)

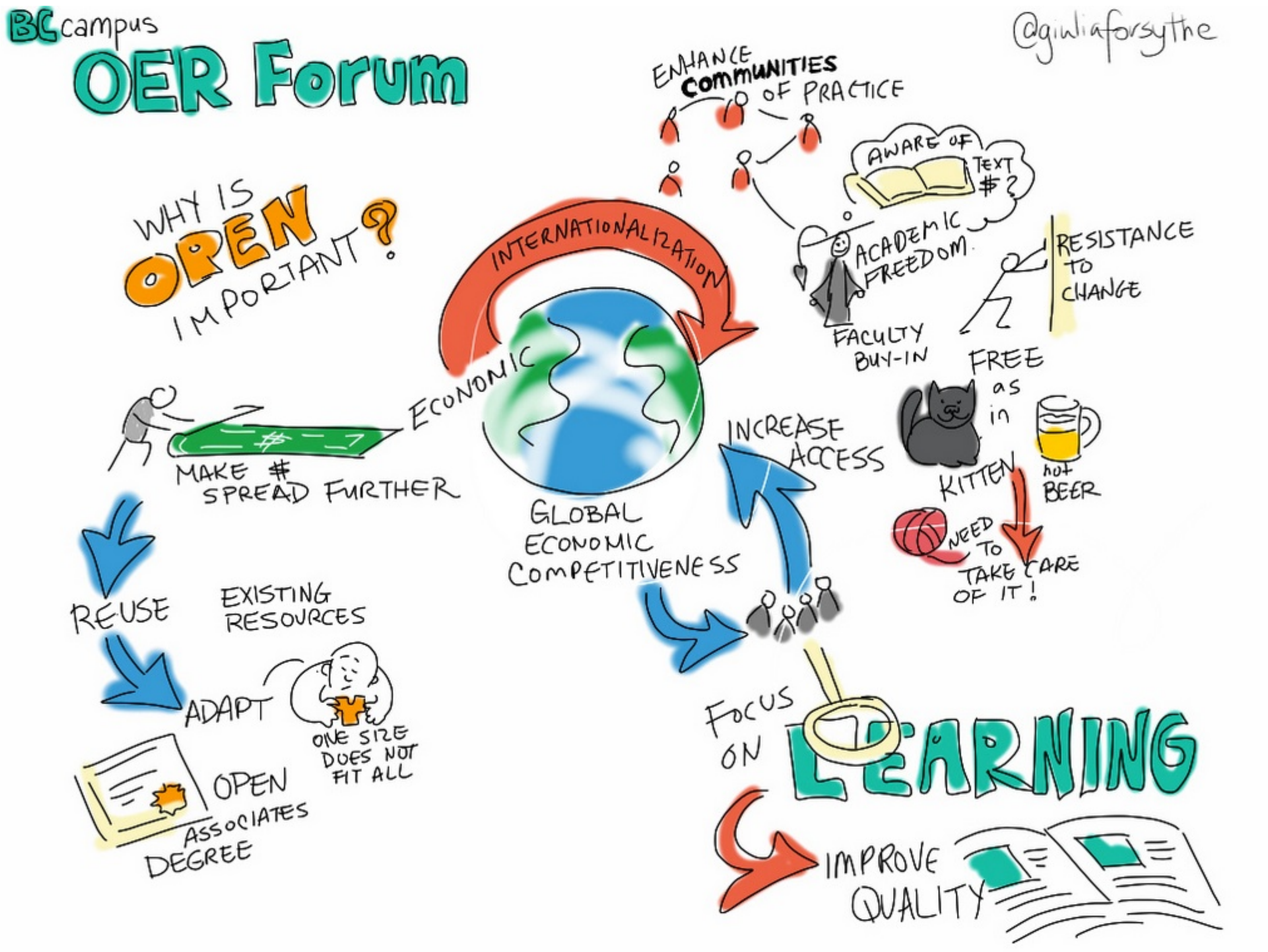

Figure 11.2.1 © Giulia Forsyth, 2012

Open educational resources are somewhat different from open learning, in that they are primarily content, while open learning includes both content and educational services, such as specially designed online materials, in-built learner support and assessment.

Open educational resources cover a wide range of online formats, including online textbooks, video recorded lectures, YouTube clips, web-based textual materials designed for independent study, animations and simulations, digital diagrams and graphics, some MOOCs, or even assessment materials such as tests with automated answers. OER can also include Powerpoint slides or pdf files of lecture notes. In order to be open educational resources, though, they must be freely available for at least educational use.

11.2.1 Principles of OER

David Wiley is one of the pioneers of OER. He and colleagues have suggested (Hilton et al., 2010) that there are five core principles (the 5Rs) of open publishing:

- **re-use**: The most basic level of openness. People are allowed to use all or part of the work for their own purposes (for example, download an educational video to watch at a later time);
- **re-distribute:** People can share the work with others (for example, send a digital article by-email to a colleague);
- **revise:** People can adapt, modify, translate, or change the work (for example, take a book written in English and turn it into a Spanish audio book);
- **re-mix:** People can take two or more existing resources and combine them to create a new resource (for example, take audio lectures from one course and combine them with slides from another course to create a new derivative work);
- **retain:** No digital rights management restrictions (DRM); the content is yours to keep, whether you're the author, an instructor using the material, or a student.

This open textbook you are reading meets all five criteria (it has a CC BY-NC license – see Section 11.2.2 below). Users of OER though need to check with the actual license for re-use, because sometimes there are limitations, as with this book, which cannot be reproduced for commercial purposes without permission. For example, the origin of the work must be accurately attributed to the original author (BY), and it cannot be converted by a commercial publisher into a printed book to be sold at a profit (NC), at least without written permission from the author. To protect your rights as an author of OER usually means publishing under a Creative Commons or other open license.

11.2.2 Creative Commons licenses

This seemingly simple idea, of an 'author' creating a license enabling people to freely access and adapt copyright material, without charge or special permission, is one of the great ideas of the 21st century. This does not take away the author's copyright, but the license gives permission automatically for different kinds of use of the material without charge or any paperwork or written permissions.

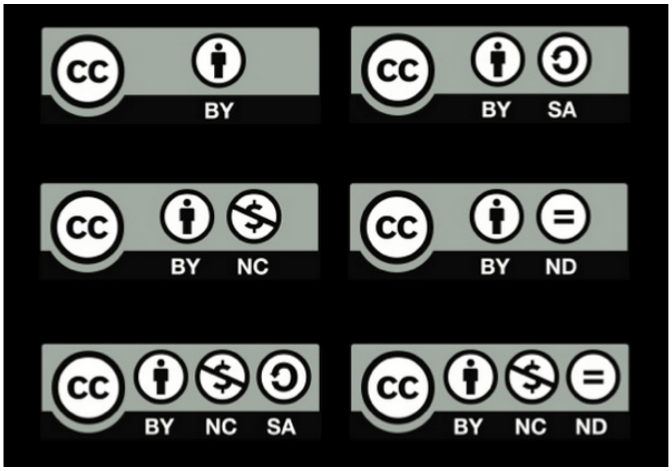

Figure 11.2.2 The spectrum of Creative Commons licenses
© The Creative Commons, 2013

There are several possible Creative Commons licenses:

- **CC BY Attribution**: lets others distribute, remix, tweak, and build upon your work, even commercially, as long as they credit you for the original creation. This is the most accommodating of licenses offered. Recommended for maximum dissemination and use of licensed materials;
- **CC BY-SA**: lets others remix, tweak, and build upon your work even for commercial purposes, as long as they credit you and license their new creations under the identical terms. This is particularly important if your work also includes other people's materials licensed through the Creative Commons;
- **CC BY-ND**: allows for redistribution, commercial and non-commercial, as long as it is passed along unchanged and in whole, with credit to you;

- **CC BY-NC**: lets others remix, tweak, and build upon your work non-commercially, and although their new works must also acknowledge you and be non-commercial, they don't have to license their derivative works on the same terms;
- **CC BY-NC-SA**: lets others remix, tweak, and build upon your work non-commercially, as long as they credit you and license their new creations under the identical terms;
- **CC BY-NC-ND**: the most restrictive of the six main licenses, only allowing others to download your works and share them with others as long as they credit you, but they can't change them in any way or use them commercially.

If you wish to offer your own materials as open educational resources, it is a relatively simple process to choose a licence and apply it to any piece of work (see Creative Commons Choose a License). If in doubt, check with a librarian.

11.2.3 Sources of OER

There are many 'repositories' of open educational resources (see for instance, for post-secondary education, MERLOT, OER Commons, and for k-12, Edutopia).The Open Professionals Education Network has an excellent guide to finding and using OER.

However, when searching for possible open educational resources on the web, check to see whether or not the resource has a Creative Commons license or a statement giving permission for re-use. It may be common practice to use free (no cost) resources without worrying unduly about copyright, but there are risks without a clear license or permission for re-use. For instance, many sites, such as OpenLearn, allow only individual, personal use for non-commercial purposes, which means providing a link to the site for students rather than integrating the materials directly into your own teaching. If in any doubt about the right to re-use, check with your library or intellectual property department.

11.2.4 Limitations of OER

The take-up of OER, other than open textbooks (see next section), by instructors is still minimal, other than by those who created the original version. For instance, in Canada in 2017, less than half the institutions reported use of OER (Donovan et al., 2018).

11.2.4.1 Quality issues

The main criticism is of the poor quality of many of the OER available at the moment – reams of text with no interaction, often available in PDFs that cannot easily be changed or adapted, crude simulation, poorly produced graphics, and designs that fail to make clear what academic concepts they are meant to illustrate.

Falconer (2013), in a survey of potential users' attitudes to OER in Europe, came to the following conclusion:

> *The ability of the masses to participate in production of OER – and a cultural mistrust of getting something for nothing – give rise to user concerns about quality. Commercial providers/publishers who generate trust through advertising, market coverage and glossy production, may exploit this mistrust of the free. Belief in quality is a significant driver for OER initiatives, but the issue of*

> *scale-able ways of assuring quality in a context where all (in principle) can contribute has not been resolved, and the question of whether quality transfers unambiguously from one context to another is seldom [addressed]. A seal of approval system is not infinitely scale-able, while the robustness of user reviews, or other contextualised measures, has not yet been sufficiently explored.*

If OER are to be taken up by others than the creators of the OER, they will need to be well designed. It is perhaps not surprising then that the most used OER on iTunes University were the Open University's, until the OU set up its own OER portal, OpenLearn, which offers as OER mainly textual materials from its courses designed specifically for online, independent study. Once again, design is a critical factor in ensuring the quality of an OER.

11.2.4.2 Instructors' professional self-image

Hampson (2013) has suggested another reason for the slow adoption of OER, mainly to do with the professional self-image of many faculty. Hampson argues that faculty don't see themselves as 'just' teachers, but creators and disseminators of new or original knowledge. Therefore their teaching needs to have their own stamp on it, which makes them reluctant to openly incorporate or 'copy' other people's work.

OER can easily be associated with 'packaged', reproductive knowledge, and not original work, changing faculty from 'artists' to 'artisans'. It can be argued that this reason is absurd – we all stand on the shoulders of giants – but it is the self-perception that's important, and for research professors, there is a grain of truth in the argument. It makes sense for them to focus their teaching on their own research. But then how many Richard Feynmans are there out there?

11.2.4.3 Free or open?

There is also considerable confusion between 'free' (no financial cost) and 'open', which is compounded by lack of clear licensing information on many OER. For instance, some Coursera MOOCs are free, but not 'open': it is a breach of copyright to re-use the material in most Coursera MOOCs within your own teaching without permission. The edX MOOC platform is open source, which means other institutions can adopt or adapt the portal software, but institutions even on edX tend to retain copyright. However, there are exceptions on both platforms: a few MOOCs do have an open licence.

11.2.4.4 Situating OER

There is also the issue of the context-free nature of OER. Research into learning shows that content is best learned within context (situated learning), when the learner is active, and that above all, when the learner can actively construct knowledge by developing meaning and 'layered' understanding. Content is not static, nor a commodity like coal. In other words, content is not effectively learned if it is thought of as shovelling coal into a truck. Learning is a dynamic process that requires questioning, adjustment of prior learning to incorporate new ideas, testing of understanding, and feedback. These 'transactional' processes require a combination of personal reflection, feedback from an expert (the teacher or instructor) and even more importantly, feedback from and interaction with friends, family and fellow learners.

The weakness with open content is that by its nature, at its purest it is stripped of these developmental, contextual and 'environmental' components that are essential for effective learning. In other words, OER are just like coal, sitting there waiting to be loaded. Coal of course is still a very valuable product. But it has to be mined, stored, shipped and processed.

More attention needs to be paid to those contextual elements that turn OER from raw 'content' into a useful learning experience. This means instructors need to build learning experiences or environments into which the OER will fit. (See Chapter 11, Section 4 for more discussion of this issue)

11.2.4.5 Study the research

For a useful overview of the research on OER, see the Review Project from the Open Education Group. Another important research project is ROER4D, which aims to provide evidence-based research on OER adoption across a number of countries in South America, Sub-Saharan Africa and Southeast Asia.

11.2.5 How to use OER

Despite these limitations, teachers and instructors are increasingly creating open educational resources, or making resources freely available for others to use under a Creative Commons license. There are increasing numbers of repositories or portals where faculty can access open educational resources. As the quantity of OER expands, it is more likely that teachers and instructors will increasingly be able to find the resources that best suit their particular teaching context.

There are therefore several choices:

- take OER selectively from elsewhere, and incorporate or adapt them into your own courses;
- create your own digital resources for your own teaching, and make them available to others (see for instance Creating OER and Combining Licenses from Florida State University);
- build a course around OER, where students have to find content to solve problems, write reports or do research on a topic (see Scenario H at the beginning of this chapter, and Chapter 11, Section 4.2);
- take a whole course from OERu, then build student activities and assessment and provide learner support for the course.

Learners can use OER to support any type of learning. For instance, MIT's OpenCourseWare (OCW) could be used just for interest, or students who struggle with the topics in a classroom lecture for a credit course may well go to OCW to get an alternative approach to the same topic.

11.2.6 Still worth the effort

Despite some of the current limitations or weaknesses of OER, their use is likely to grow, simply because it makes no sense to create everything from scratch when good quality materials are freely and easily available. We have seen in Chapter 9 on selecting media that there is now an increasing amount of excellent open material available to teachers and instructors. This will only grow over time. We shall see in Section 11.5 that this is bound to change the way courses are designed and offered. Indeed, OER will prove to be one of the essential features of teaching in a digital age.

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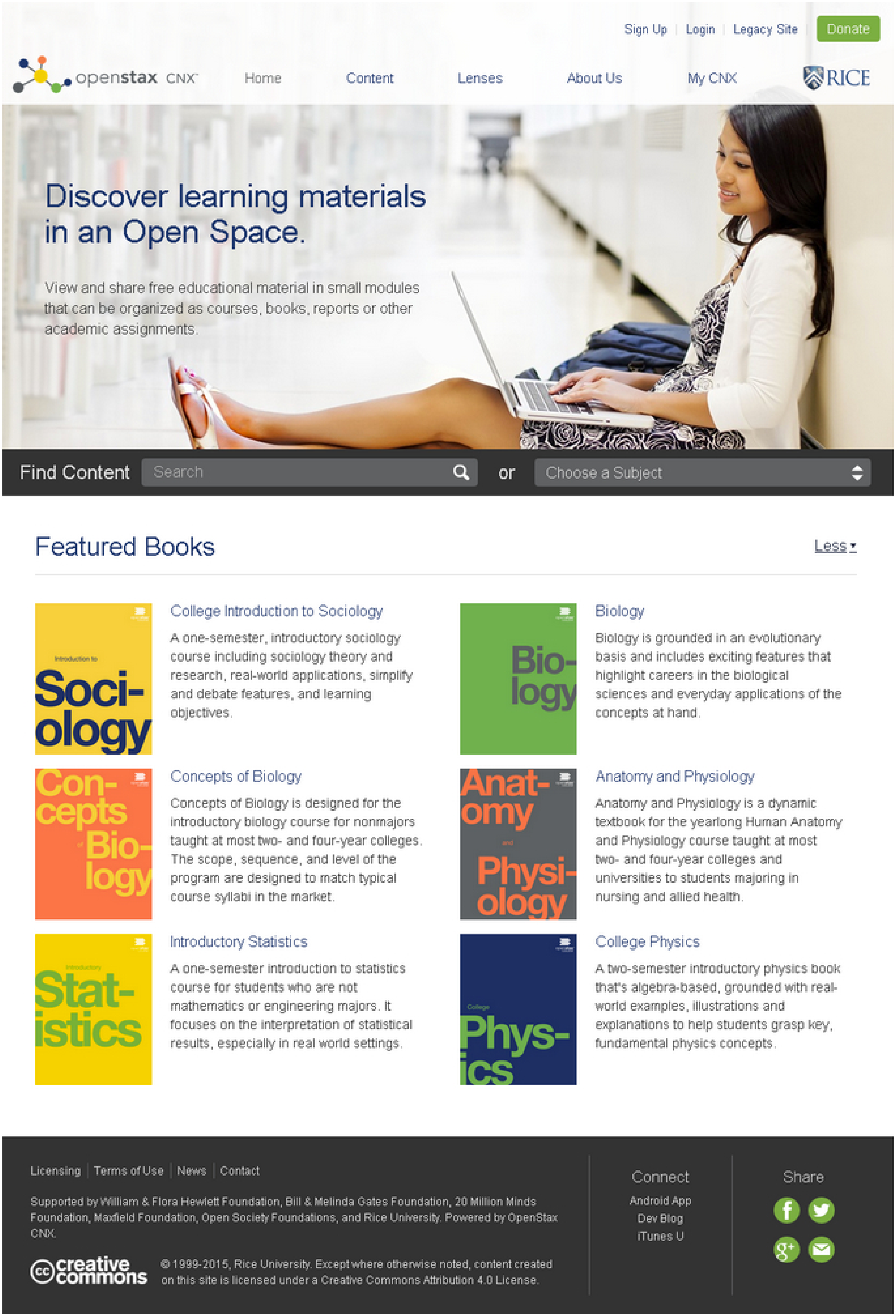
Activity 11.2 Deciding on OER

1. Have you used OER in your own course(s)? Was this a positive or negative experience?
2. If you have not used OER, what is/are the main reason(s)? Have you explored to see what is available? What is the quality like? How could they be improved?
3. Under what circumstances would you be prepared to create or convert your own material as OER?

11.3 Open textbooks, open research and open data


Sign Up | Login | Legacy Site
Donate
openstax CNX
Home
Content
Lenses
About Us
My CNX
RICE
Discover learning materials in an Open Space.
View and share free educational material in small modules that can be organized as courses, books, reports or other academic assignments.
Find Content
Search
or
Choose a Subject
Featured Books
Less
College Introduction to Sociology
A one-semester, introductory sociology course including sociology theory and research, real-world applications, simplify and debate features, and learning objectives.
Soci-ology
Biology
Biology is grounded in an evolutionary basis and includes exciting features that highlight careers in the biological sciences and everyday applications of the concepts at hand.
Bio-logy
Concepts of Biology
Concepts of Biology is designed for the introductory biology course for nonmajors taught at most two- and four-year colleges. The scope, sequence, and level of the program are designed to match typical course syllabi in the market.
Con-cepts Bio-logy
Anatomy and Physiology
Anatomy and Physiology is a dynamic textbook for the yearlong Human Anatomy and Physiology course taught at most two- and four-year colleges and universities to students majoring in nursing and allied health.
Anat-omy Physi-ology
Introductory Statistics
A one-semester introduction to statistics course for students who are not mathematics or engineering majors. It focuses on the interpretation of statistical results, especially in real world settings.
Stat-istics
College Physics
A two-semester introductory physics book that's algebra-based, grounded with real-world examples, illustrations and explanations to help students grasp key, fundamental physics concepts.
Phys-ics
Licensing | Terms of Use | News | Contact
Supported by William & Flora Hewlett Foundation, Bill & Melinda Gates Foundation, 20 Million Minds Foundation, Maxfield Foundation, Open Society Foundations, and Rice University. Powered by OpenStax CNX.
creative commons
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Connect
Android App
Dev Blog
iTunes U
Share

Figure 11.3.1 Open Stax open textbooks

11.3.1 Open textbooks

Textbooks are an increasing cost to students. Some textbooks cost $200 or more, and in the USA a university undergraduate spends on average between $530 – $640 a year on textbooks (Hill, 2015), although the cost of *recommended* textbooks is between $968 and $1221 (Caulfield, 2015).

An open textbook on the other hand is an openly-licensed, online publication free for downloading for educational or non-commercial use. You are currently reading an open textbook. There is an increasing number of sources for open textbooks, such as OpenStax College from Rice University, and the Open Academics Textbook Catalog at the University of Minnesota.

In British Columbia, the provincial government funded the B.C. open textbook project, which operates in collaboration initially with the provinces of Alberta and Saskatchewan, but now also with other provinces through the Canada OER Group. The B.C. open textbook project focuses on making available openly-licensed textbooks in the highest-enrolled academic subject areas and also in trades and skills training. In the B.C. project, as in many of the other sources, all the books are selected, peer reviewed and in some cases developed by local faculty. Often these textbooks are not 'original' work, in the sense of new knowledge, but carefully written and well illustrated summaries of current thinking in the different subject areas.

11.3.1.1 Advantages of open textbooks

Students and governments, through grants and financial aid, pay billions of dollars each year on textbooks. Open textbooks can make a significant impact on reducing the cost of education. The government of British Columbia estimates that the BC Open Textbook project has saved the roughly 300,000 post-secondary students in the province more that $4 million in textbook costs between 2012 to 2017 (Bernard, 2017).

Cable Green, the Interim CEO of the Creative Commons, has a 'vision' for open textbooks: 100 per cent of students have 100 per cent free, digital access to all course materials by day one. That is far from the case today.

DeNoyelles and Raible at the University of Central Florida found (2017) that due to high costs:

- 30 percent of [student] respondents said they have opted not to purchase a textbook at least once,
- 41 percent have delayed purchasing a textbook, and
- 15 percent have taken fewer courses or decided not take a particular class.

DeNoyelles and Raible concluded that:

- the cost of textbooks is negatively impacting student access to required materials (66.6% did not purchase the required textbook) and learning (37.6% earn a poor grade; 19.8% fail a course).

A survey of all public post-secondary students in Florida conducted by the Florida Virtual Campus (2016) found that due to the high costs of textbooks:

- time to graduation and/or access to courses is impacted by cost. Students reported that they occasionally or frequently take
    - fewer courses (47.6%);
    - do not register for a course (45.5%);
    - drop a course (26.1%), or
    - withdraw from courses (20.7%).

There are also other considerations. It is a common sight to see lengthy line-ups at college bookstores all through the first week of the first semester (which eats into valuable study time). Because students may be searching for second-hand versions of the books from other students, it may well be into the second or third week of the semester before students actually get their copy.

So why shouldn't government pay the creators of textbooks directly, cut out the middleman (commercial publishers), save over 80 per cent on the cost, and distribute the books to students (or anyone else) for free over the Internet, under a Creative Commons license?

Figure 11.3.2 Open textbooks: no bookstore line-ups! Image: The Saskatoon StarPhoenix

11.3.1.2 Limitations of open textbooks

Faculty resistance is still a problem for open textbooks. Open textbooks had been adopted in between half and two thirds of all post-secondary institutions in Canada in 2017, and a further 20 per cent were exploring their use. However, this varied considerably by province. In British Columbia, 90 per cent of all post-secondary institutions had adopted open textbooks for some courses; in Saskatchewan and Quebec, less than a third of institutions were using open textbooks (Donovan et al., 2018). This indicates clearly the impact of government support for open textbooks. Adoption was highest in universities and large institutions. Donovan et al. also found that there was a lack of knowledge and even more so of training for instructors in the use of open textbooks and OER.

Murphy (2013) has questioned the whole idea of textbooks, whether open or not. She sees textbooks as a relic of 19th century industrialism, a form of mass broadcasting. In the 21st century, students should be finding, accessing and collecting digital materials over the Internet. Textbooks are merely packaged learning, with the authors doing the work for students. Nevertheless, it has to be recognized that textbooks are still the basic currency for most forms of education, and while this remains the case, open textbooks are a much better alternative for students than expensive printed textbooks.

Quality also remains a concern. There is an in-built prejudice that 'free' must mean poor quality.Thus the same arguments about quality of OER also apply to open textbooks. In particular, the expensive commercially published textbooks usually include in-built activities, supplementary materials such as extra readings, and even assessment questions. Nevertheless, Jhangiani and Jhangiani (2017), in a survey of 320 undergraduate students in British Columbia who had actually used an open textbook for one or more of their courses, found that 96% of respondents perceived the quality of their open textbook to be equal or superior to a commercial textbook.

Others (including myself) question the likely impact of 'open' publishing on creating original works that are not likely to get subsidized by government because they are either too specialized, or are not yet part of a standard curriculum for the subject; in other words will open publishing impact negatively on the diversity of publishing? What is the incentive for someone now to publish a unique work, if there is no financial reward for the effort? Writing an original, single authored book remains hard work, however it is published.

Although there is now a range of 'open' publishing services, there are still costs for an author to create original work. Who will pay, for instance, for specialized graphics, for editing or for review? I have used my blog to get sections of this book reviewed generally, and this has proved extremely useful. Nevertheless one can still approach top quality reviewers for an independent review, as was done for this book (see Appendix 3). I also received free technical support from both BCcampus and Contact North, but other potential open textbook authors may not have that kind of access.

Marketing is another issue. It takes time and specialised knowledge to market books effectively. On the other hand, my experience, having published twelve books commercially, is that publishers are very poor at properly marketing specialised textbooks, expecting the author to mainly self-market, while the publisher still takes 85-90 per cent of all sales revenues. Nevertheless there are still real costs in marketing an open textbook.

How can all these costs be recovered? Much more work still needs to be done to support the open publishing of original work in book format. If so, what does that mean for how knowledge is created, disseminated and preserved? If open textbook publishing is to be successful, new, sustainable business models will need to be developed. In particular, some form of government subsidy or financial support for open textbooks is probably going to be essential.

Nevertheless, although these are all important concerns, they are not insurmountable problems. Just getting a proportion of the main textbooks available to students for free is a major step forward. To see whether or not I felt it worthwhile to write the first edition of this book, see 'Writing an Online Book: Is it Worth it?' (Bates, 2015)

11.3.1.3 Learn how to adopt and use an open textbook

BC campus has mounted a short MOOC on the P2PU portal on Adopting Open Textbooks. Although the MOOC may not be active when you access the site, it still has most of the materials, including videos, available.

11.3.2 Open research

Governments in some countries such as the USA, Canada and the United Kingdom are requiring all research published as a result of government funding to be openly accessible in a digital format. In Canada, the Minister of State for Science and Technology announced (February 27, 2015) that:

> *The harmonized Tri-Agency Open Access Policy on Publications requires all peer-reviewed journal*

publications funded by one of the three federal granting agencies to be freely available online within 12 months.

Also in Canada, Supreme Court decisions and new legislation in 2014 means that it is much easier to access and use free of charge online materials for educational purposes, although there are still some restrictions.

Commercial publishers, who have dominated the market for academic journals, are understandably fighting back. Where an academic journal has a high reputation and hence carries substantial weight in the assessment of research publications, publishers are charging researchers for making the research openly available. The kudos of publishing in an established journal acts as a disincentive for researchers to publish in less prestigious open journals without having to pay to get published.

However, it can only be a question of time before academics fight back against this system, by establishing their own peer reviewed journals that will be perceived to be of the highest standard by the quality of the papers and the status of the researchers publishing in such journals. Once again, though, open research publishing will flourish only by meeting the highest standards of peer review and quality research, by finding a sustainable business model, and by researchers themselves taking control over the publishing process.

Over time, therefore, we can expect nearly all academic research in journals to become openly available.

11.3.3 Open data

The two main sources of open data are from science and government. Following an intense discussion with data-producing institutions in member states, the OECD published in 2007 the *OECD Principles and Guidelines for Access to Research Data from Public Funding*. In science, the Human Genome Project is perhaps the best example of open data, and several national or provincial governments have created web sites to distribute a portion of the data they collect, such as the B.C. Data Catalogue in Canada.

Again, increasing amounts of important data are becoming openly available, providing more resources with high potential for learning.

The significance for teaching and learning of the developments in open access, OER, open textbooks and open data will be explored more fully in the next section.

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OECD (2017) OECD Principles and Guidelines for Access to Research Data from Public Funding Paris FR: OECD

Activity 11.3 Using other open resources

1. Check with OpenStax College, the Open Academics Textbook Catalog and the B.C. open textbook project to see if there are any suitable open textbooks for your subject.

2. What open journals are there in your subject area? (The help of a librarian may be useful here.) Are the articles of good quality? Could your students use these if they were conducting research in this area?

3. Ask your librarian for help in looking for open data sites that might have useful data that you could use in your teaching. Would students be able to find these data sites by themselves, with just a little guidance? How could they or you use this open data in their learning?

11.4 Open pedagogy

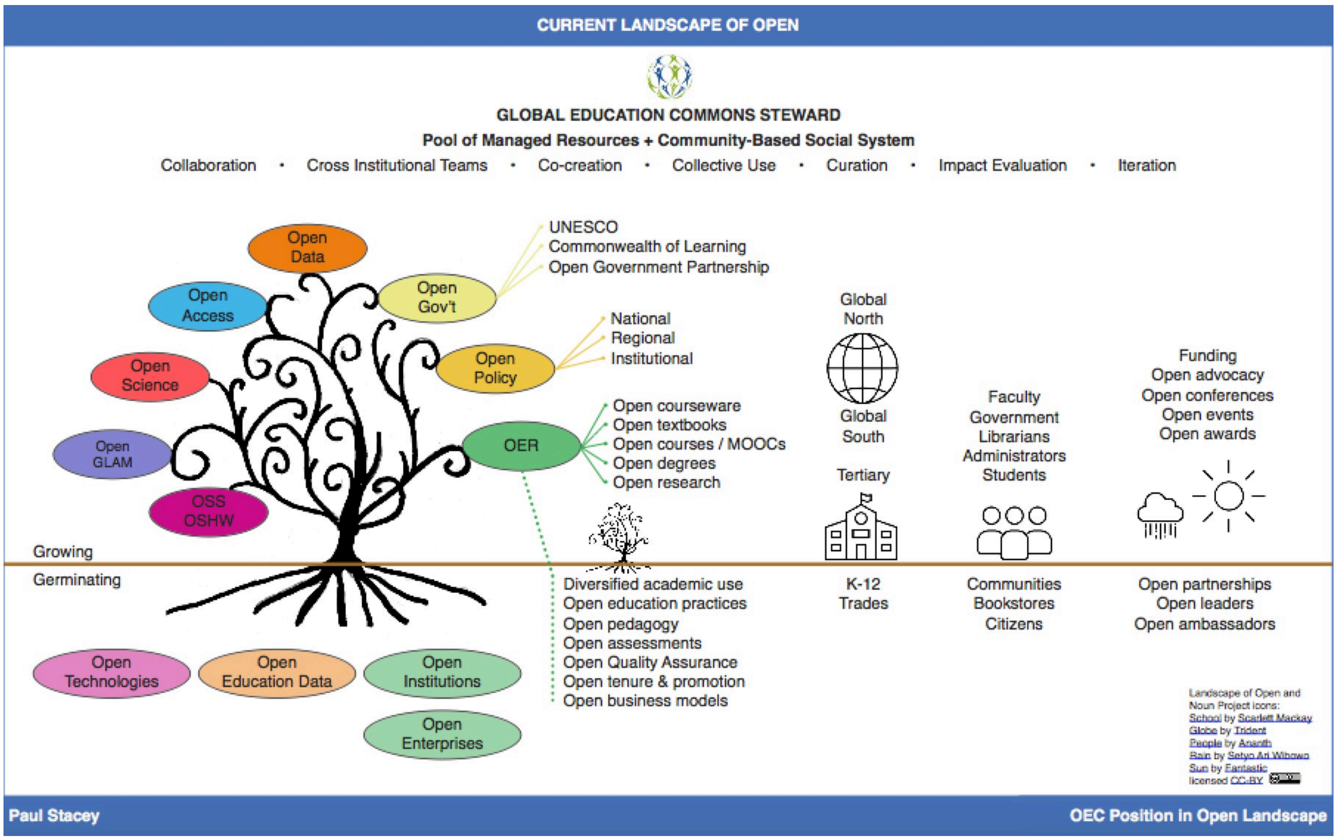

Figure 11.4.1 Current landscape of Open. Image: Paul Stacey, 2018

11.4.1 What is open pedagogy?

David Wiley (2013) originally defined open pedagogy as:

> *that set of teaching and learning practices only possible in the context of the free access and 4R permissions characteristic of open educational resources*

It will be seen later in this section that Wiley has since (2017) recanted on this definition and indeed questions the whole idea of an open pedagogy. However, this definition was influential in framing the more recent discussion of open pedagogy around the use of OER (see DeRosa and Jhangiani, 2017, for an excellent discussion about open pedagogy, its origins, and its development since 2013).