The Open University

Innovating Pedagogy 2014

Exploring new forms of teaching, learning and assessment, to guide educators and policy makers

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Open University Innovation Report 3

A full-text PDF version of this report is available to download from
http://www.open.ac.uk/innovating

Our thanks to Bea de los Arcos for writing a first draft of the Flipped Classroom section.

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Executive summary

This series of reports explores new forms of teaching, learning and assessment for an interactive world, to guide teachers and policy makers in productive innovation. This third report proposes ten innovations that are already in currency but have not yet had a profound influence on education. To produce it, a group of academics at the Institute of Educational Technology in The Open University proposed a long list of new educational terms, theories, and practices. We then pared these down to ten that have the potential to provoke major shifts in educational practice, particularly in post-school education. Lastly, we drew on published and unpublished writings to compile the ten sketches of new pedagogies that might transform education. These are summarised below, starting with two updates to last year's report, followed by eight new entries, in an approximate order of immediacy and timescale to widespread implementation.

1 **Massive open social learning:** Massive open social learning brings the benefits of social networks to the people taking massive open online courses (MOOCs). It aims to exploit the 'network effect', which means the value of a networked experience increases as more people make use of it. The aim is to engage thousands of people in productive discussions and the creation of shared projects, so together they share experience and build on their previous knowledge. A challenge to this approach is that these learners typically only meet online and for short periods of time. Possible solutions include linking conversations with learning content, creating short-duration discussion groups made up of learners who are currently online, and enabling learners to review each other's assignments. Other techniques, drawn from social media and gaming, include building links by following other learners, rating discussion comments, and competing with others to answer quizzes and take on learning challenges.

2 **Learning design informed by analytics:** Learning design is used in the development of courses or series of lessons to help educators plan a coherent sequence of media, technologies and pedagogies. The use of learning design tools and templates shifts attention away from content, towards learner activities and the learning journey. A learning design specifies intended learning outcomes, identifies the ways in which these are to be achieved, and sets out how they will be assessed. Data from tracking and management of learning activities can inform learning design by providing evidence to support the choice of media and sequence of activities. When analysis of learning data is also used to evaluate and improve

learning design, the circle is complete, so design and analytics work together to support the development of successful learning and teaching.

3 **Flipped classroom:** Flipped learning reverses the traditional classroom approach to teaching and learning. It moves direct instruction into the learner's own space. At home, or in individual study time, students watch video lectures that offer them opportunities to work at their own pace, pausing to make notes where necessary. This allows time in class to be spent on activities that exercise critical thinking, with the teacher guiding students in creative exploration of the topics they are studying. Flipped learning is sometimes seen simply as a different approach to delivering content. It also offers opportunities for the classroom to become a more flexible environment, where the physical layout can be shifted to enable group work, where students can make use of their own devices, and where new approaches to learning and assessment are put into practice.

4 **Bring your own devices:** When students bring their own smartphones and tablet computers into the classroom, this action changes their relationship with the school and with their teachers. They arrive equipped not only with individual technologies that they maintain and improve, but also with their own personal learning environments and social networks. This means that teachers become managers of technology-enabled networked learners, rather than providers of resources and knowledge. This shift opens opportunities for connecting learning inside and outside the classroom. Computer-based activities that are set in the classroom can be continued elsewhere and then shared at school. Students' personal collections and networks, gathered inside and outside school, can become resources for learning. Bring-your-own-device (BYOD) approaches have the potential to reduce the cost of ICT provision and introduce new possibilities for learners, but they also offer new challenges. Schools need to be willing to support a wide range of technologies and to open their educational networks to new devices. They must also avoid disadvantaging learners who cannot afford suitable devices, and develop ways for individuals to keep their social and learner identities apart if they prefer to do so.

5 **Learning to learn:** We are always learning. Throughout our lifetime we take on board new ideas and develop new skills. What we find difficult are learning what others want to teach us, and managing our learning in order to achieve particular goals and outcomes. Self-determined learning involves learning how to be an effective learner, and having the confidence to manage our own learning processes. 'Double-loop learning' is central to this process, for double-loop learners not only work out how to solve a problem or reach a goal, but also reflect on that process as a whole, questioning assumptions and considering how to become more effective. This helps them to become self-determined learners with the ability to seek out sources of knowledge and make use of online networks for advice and support. Web tools and activities such as reflective journals and concept mapping have been designed to support learning to learn, but these are rarely well integrated into a learner's social world. There may be more value in adapting for wider use social research environments such as ResearchGate, or question-answering communities such as StackExchange and Quora.

6 **Dynamic assessment:** Dynamic assessment focuses on the progress of the student. The assessor interacts with students during the testing phase of the process, identifying ways to overcome each person's current learning difficulties. In the dynamic assessment process, assessment and intervention are inseparable. This approach has been used with university students, with school children learning physics, and with children who have particular learning difficulties. Although labour intensive, it has the potential to be used as part of a range of assessment tools.

7 **Event-based learning:** Event-based learning runs over a few hours or days and creates a memorable sense of occasion. Examples are the 'maker fairs' that gather together enthusiasts who are keen on do-it-yourself science, engineering and crafts projects, and the 'Raspberry jams' where fans of the Raspberry Pi computer meet up and share ideas. Local events spark national gatherings and these build into international festivals. Many, like the UK's annual Springwatch week or the worldwide Scratch Day for computer programming, are initiated at national or international level, but all depend upon local enthusiasm and initiative. The time-bounded nature of an event encourages people to learn together, its local setting supports face-to-face encounters between amateurs and experts, and the scale of an event can provide access to resources that would otherwise prove inaccessible. Having such an event as a focus gives learners something concrete to work towards and to reflect upon afterwards, together with a sense of personal engagement and excitement.

8 **Learning through storytelling:** Learning requires a structure that helps learners to embed and revisit their understanding. Stories provide one way of creating this structure. Developing a narrative is part of a process of meaning making in which the narrator structures a series of events from a particular point of view in order to create a meaningful whole. Writing up an experiment, reporting on an inquiry, analysing a period of history – these are all examples of narrative supporting learning. Indeed, much of our education involves combining different things we know in order to create an understanding of what has happened and, as a consequence, what can be expected to happen in the future. These accounts can be used to link memories of events, binding them together to form larger, more coherent chunks. In a narrative approach to learning, the creation of stories is emphasised, allowing learners to navigate resources and to add coherence to different experiences. Narrative encourages the combination of historical overview and modern practice. It can provide emotional engagement and relevance for learners, together with personal involvement and immersion.

9 **Threshold concepts:** A threshold concept is something that, when learnt, opens up a new way of thinking about a problem, a subject or the world. An example is the physics concept of 'heat transfer' that can inform everyday activities such as cooking or home energy use. These concepts help to define subjects, they shift learners' perceptions of a topic area, and they usually prove difficult to unlearn. Teachers are increasingly using threshold concepts as starting points for the design of effective lessons. They can also be used as a focus for dialogue between students, teachers and educational designers. A challenging aspect of threshold concepts is that they often seem strange and unintuitive. Students who appear to have understood these troublesome concepts may be unable to put them into practice, instead falling back on common-sense, but inaccurate, beliefs. Momentum for using threshold concepts to help teaching is growing across disciplines. One approach is to develop standard sets of threshold concepts for different subject areas; another is to embed them in teaching and learning processes and practices.

10 **Bricolage:** Bricolage is a practical process of learning through tinkering with materials. It involves continual transformation, with earlier products or materials that are ready to hand becoming resources for new constructions. It is a fundamental process of children's learning through play, as they create castles out of boxes and tell stories from remembered events. It also forms a basis for creative innovation, allowing inventors to combine and adapt tools and theories to generate new insights, while also engaging with relevant communities to ensure that the innovation works in practice and in context.

Introduction

This is the third in a series of annual reports on innovations in teaching, learning and assessment. The Innovating Pedagogy reports are intended for teachers, policy makers, academics and anyone interested in how education may change over the next ten years.

As in previous years, this report has been written by a small group of academics in the Institute of Educational Technology at The Open University. It is based on our knowledge acquired from leading research projects, reading and writing educational research papers and blogs, holding conversations with colleagues worldwide, and surveying published and unpublished literature. We compiled the report by first producing a long list of new educational terms, theories, and practices, then reducing these to ten that have the potential to provoke major shifts in educational practice. For this 2014 report, we take different perspectives on two topics that were covered in the previous reports and introduce eight further pedagogies that are already being introduced into educational practice or offer opportunities for the future.

Massive open online courses (MOOCs) are still making headlines. The focus now is not on the phenomenon of free courses, but on how they are starting to transform education by offering 'nano-degrees' that teach the minimum skills needed to enter a new career, or by providing complete degree courses constructed from open access materials. MOOCs are also a giant laboratory for testing new methods of teaching, learning and assessment. Analyses of the ways in which many thousands of people are learning online are already starting to influence the design of courses in universities and workplaces.

A central theme of massive-scale courses is 'personalization'. The idea is that each learner can be given the power to choose when, where and how to study, and that the teaching adapts to the learner, either by providing instruction that is matched to a person's approach to learning, or by offering supplementary teaching if the learner makes a mistake in an online test.

Ninety years ago, Sidney Pressey developed the first adaptive teaching machine – a mechanical testing device that presented a question with a choice of multiple answers. If the student got an answer wrong, the machine removed that answer until the student selected the correct response: the first demonstration of automated 'mastery learning'. In his 1933 book, Psychology and the New Education, Pressey wrote,

> "There must be an 'industrial revolution' in education, in which educational science and the ingenuity of educational technology combine to modernize the grossly inefficient and clumsy procedures of conventional education. Work in the schools of the future will be marvelously though simply organized, so as to adjust almost automatically to individual differences and the characteristics of the learning process. There will be many laborsaving schemes and devices, and even machines – not at all for the mechanizing of education, but for the freeing of teacher and pupil from educational drudgery and incompetence."

Pressey's prediction of an industrial revolution in education by automating the teaching process never happened. Over the years, many projects have developed personalized methods of tutoring that adapt to a student's knowledge, skills, strategies and preferences. Some, such as the Cognitive Tutors® from Carnegie Learning, track each response from the learner, infer the current state of the learner's knowledge, and adapt the teaching accordingly. Each Cognitive Tutor has taken many years to develop, for a specific area of mathematics. These are promising developments, with successful outcomes, but they will not address the worldwide need for education in practical skills, arts, sciences, and humanities. In a post-industrial world of interconnecting networks of people and technologies, there is a growing realisation that social learning alongside personalized instruction may be the key to mass online education.

Pressey's Automatic Teacher, circa 1929

One new development brings the power of social networks to massive online courses, so that learners create personal profiles, engage in conversations, follow people they find interesting, seek 'study buddies' for learning together, form study groups, and build communities of shared interest. New directions in social networks are already starting to influence education. These include live feeds of current activity (such as news items relating to the course, or the learning activities of a group of study friends) and location-based activity, with people contributing video, images or sounds related to their local environment. Social learning is not just a means of sharing learning resources, but a valuable activity in itself. Learning together creates a 'shared mind' that combines different perspectives and alternative ways to solve problems.

Another major trend is towards blending learning within and outside the classroom. This is shown in flipped classrooms, where students watch video lectures at home and discuss them in class. It is also appearing with students bringing their own devices into the classroom along with their personal software and social networks. Initially seen as an unwelcome disruption, or even a threat to school discipline and a danger to children, there is now a drive to educate young people in how to use their own technologies to be inquiring and collaborative online learners. In this way the personal and the social combine, to create a new form of learning based on networked collaboration through personal technologies. Pupils are saved, in the words of Pressey, from educational drudgery and incompetence by joining online communities, asking questions, seeking answers, creating and sharing resources. But this is no online utopia. We also realize the limitations and dangers of mass networked learning, from the spreading of hate literature, to the invasion of online forums by bullies and demagogues. Teachers and leaders have an important role in helping young people learn how to learn online, and in shaping safe and engaging communities.

"Learning together creates a 'shared mind' that combines different perspectives and alternative ways to solve problems."

Resources

Nanodegrees from Udacity:

http://blog.udacity.com/2014/06/announcing-nanodegrees-new-type-of.html

Cognitive Tutor® software from Carnegie Learning:

http://www.carnegielearning.com/

Review of Sidney Pressey's contributions to learning and technology:
Petrina, S. (2004). Sidney Pressey and the automation of education, 1924-1934. *Technology and Culture*, 45 (2), 305-330.

Quotation from pages 582-583 of:
Pressey, S. L. (1933). *Psychology and the New Education*. New York: Harper & Brothers.

Massive open social learning

Free online courses based on social learning

Potential impact: high

Timescale: short (1–2 years)

In our previous reports we covered the growth of massive open online courses, where tens of thousands of people join courses offered free to access online. Some early MOOC experiments were based on a pedagogy of connectivist learning, connecting many people and their ideas in a loose online network that enables them to learn together. While this approach harnesses the power of many voices and technologies, it is difficult to manage at large scale and requires learners to know how to navigate the web resources and engage with their peers.

More recent MOOCs have taken an instructivist approach, with course materials created by a university and delivered by video and text. While this allows the learner to control where and when to learn, pausing and reflecting on the material, it can be a lonely experience. There are forums where learners can discuss the course and some people may get together in scheduled meetings, but there is more that can be done to engage people as active learners, sharing their ideas and discussing their different perspectives as they learn online.

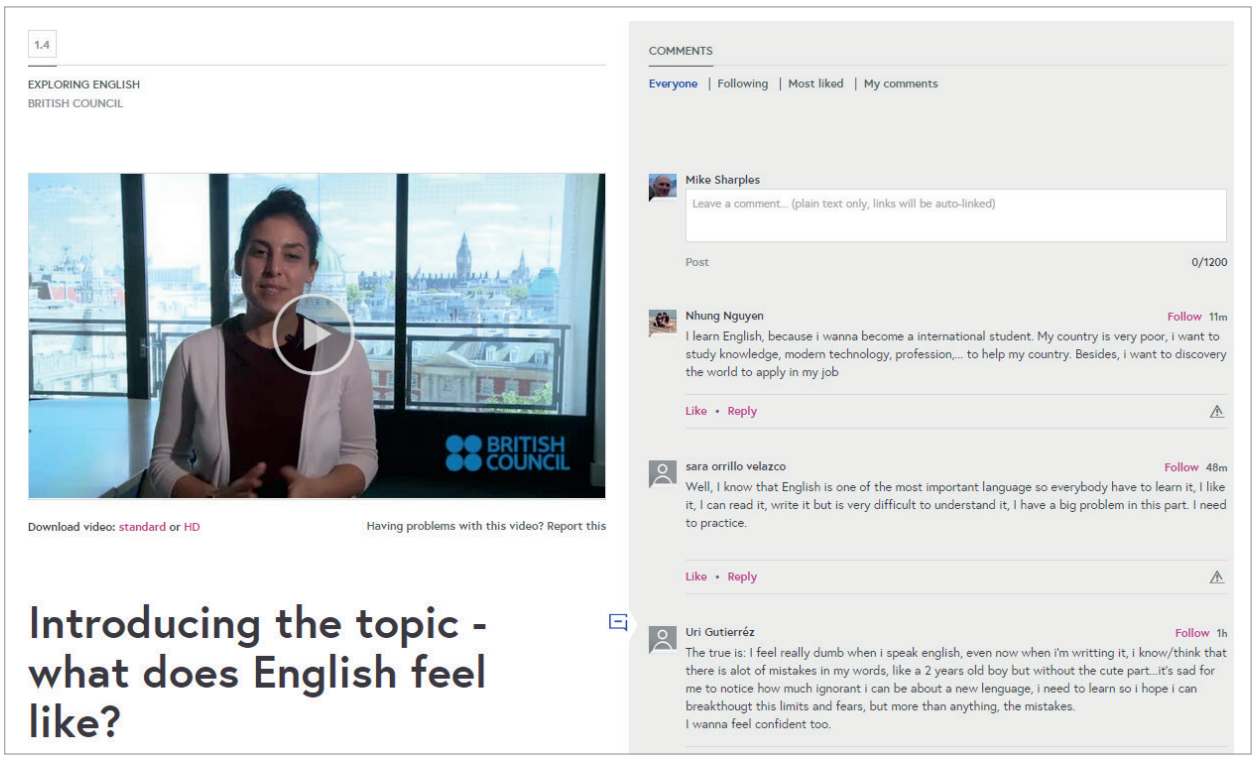
> “Which successful pedagogies can improve with scale?”

The social learning effect

The big question is, ‘Which successful pedagogies can improve with scale?’ Some effective methods of teaching, such as personal tutoring, cannot scale up to thousands of learners without huge costs (although researchers in artificial intelligence have been attempting for many years to develop computer-based tutors). By contrast, methods of direct instruction scale well – a good educational television programme can inform a hundred people, or a million – but they are not very effective in engaging people in active and reflective learning.

There is a general theory of scale that can be applied to education. The Network Effect proposes that the value of a networked product or service increases with the number of people using it. For example, a telephone system becomes more valuable when we are able connect to millions, or billions, of phone users worldwide. The worldwide web benefits from interconnecting millions of people and their computers. But people are not just points in a network, we have knowledge and perspectives to share. So the Social Learning Effect can be stated as ‘the value of a networked learning system increases as it enables people to learn easily and successfully from each other’.

In our previous reports we have given the example of StackExchange, with over 5 million users, which exploits the power of social learning. It is an example of problem-led massive social learning. When people have a problem to solve in the relevant field they pose it online. Other people in the community provide answers. Yet more people expand the answers and rate the contributions, so the most interesting questions and best answers become more visible to all users. Other sites with similar approaches include e-How and Answers.com.



A free-flowing discussion alongside a learning element in a FutureLearn course

Another approach to massive open social learning is to support many lines of conversation. On the FutureLearn MOOC platform, rather than sending learners off to separate discussion forums, each piece of learning content is linked to a free-flowing 'water cooler' discussion. Any learner can see the flow of discussion about a topic and add a quick contribution or reply. The more people who engage with the course, the faster the discussion flows and the more the content is expanded with different perspectives.

Encouraging learners to review assignments submitted by their peers, forming learners into teams (as on the NovoEd MOOC platform), creating online virtual worlds such as heritage sites that people can explore together, and creating re-enactments of historical events – these are all examples of social learning that improve with scale.

Overload and disorientation

Just as telephone networks can become congested and faulty and we may receive nuisance calls, so massive open social learning has its problems. The most obvious of these is overload. Some videos on FutureLearn courses have attracted over 15,000 comments. If these are just seen as a flow of conversation, then there is no issue, but if learners feel overwhelmed or believe they may have missed an important comment, then massive scale can cause anxiety. For this reason, these discussions are initially hidden and only shown at the click of a button. In addition, learners can 'like' a reply so that others can filter the comments to find ones that are most liked.

Another difficulty, experienced by many who have participated in connectivist MOOCs, is the feeling of being 'lost in hyperspace', of having too many options and possibilities and not knowing where they are in a learning activity, who to engage with, and where to go next. Challenges for designers of such open social environments include lessening the initial shock of joining them for the first time and providing clear guidelines and pathways to progress.

Conclusions

Many consumer technologies have started small, then expanded, then engaged people in networked social interactions. Television, telephones, computers, and electronic games are examples of this development pathway. In a similar way, innovative pedagogies generally start small and then increase in scale and sociability, for example MOOCs, seamless learning, game-based learning, inquiry learning and geo-learning are all now developing as large-scale social activities. This means they face the issues of how to reap the benefits of the Social Learning Effect while avoiding congestion, overload, and mass disorientation.

Resources

cMOOCS and xMOOCS: Learners on cMOOCs build understanding by connecting with others. Those on xMOOCs learn mainly from prepared course materials such as videos and text.

http://www.connectivistmoocs.org/what-is-a-connectivist-mooc/

The Network Effect, popularized by Robert Metcalfe, states that some network goods or services increase in value as more people are connected.

http://www.forbes.com/forbes/2007/0507/052.html

Social Learning Effect:

Downes, S. (2007). *The Personal Network Effect*. Blog posting, 4 November 2007. Accessed online, 14 October, 2014, at

http://halfanhour.blogspot.co.uk/2007/11/personal-network-effect.html

Massive-scale social learning in MOOCs:

Ferguson, R. & Sharples, M. (2014). Innovative pedagogy at massive scale: Teaching and learning in MOOCs.
In C. Rensing, S. de Freitas, T. Ley & P. J. Muñoz-Merino (Eds.) *Open Learning and Teaching in Educational Communities*, Proceedings of 9th European Conference on Technology Enhanced Learning, Graz, Austria, September 16-19. Heidelberg: Springer, pp. 98-111.

Answers:

http://www.answers.com/

eHow:

http://www.ehow.com/

FutureLearn:

http://www.futurelearn.com

NovoEd:

https://novoed.com/

StackExchange:

http://stackexchange.com/

Hypertext and lost in hyperspace:

Conklin, J. (1987). Hypertext: an introduction and survey, *IEEE Computer*, 20 (9), 17-41.

http://www.cognexus.org/Hypertext-_An_Introduction_and_Survey_(1987).pdf

Learning design informed by analytics

A productive cycle linking design and analysis of effective learning

Potential impact: high

Timescale: medium (2–5 years)

As learning is taken online, there are opportunities to collect data on student activities and analyse these, both to inform the design of new courses and to improve the learning experience. The data can also be linked with test results to show which learning activities produce good results and to identify where learners are struggling.

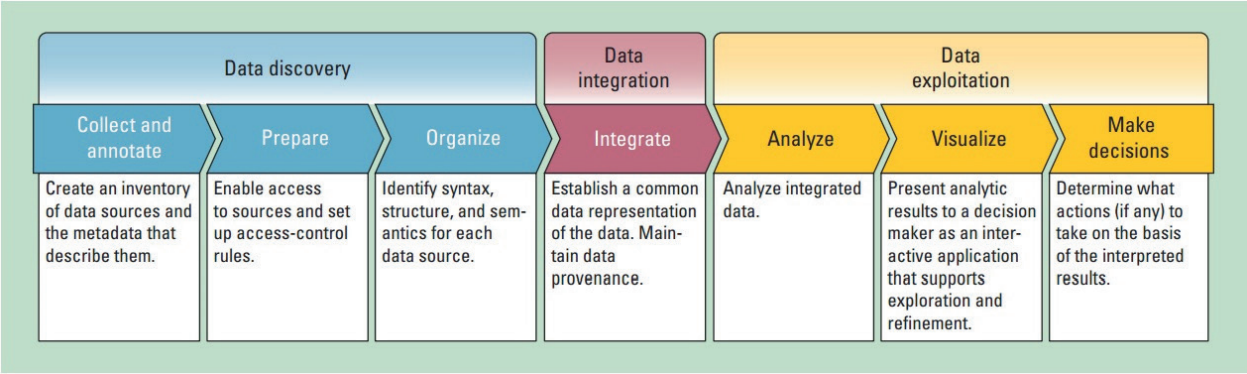
These kinds of user behaviour data can be supplemented with background information from student admission systems, showing prior education, registration to courses, or number of credits obtained in a year. Easily obtained but low-quality data, such as log-files of test scores and details of which materials students have viewed, can be combined with information gathered directly through surveys of learners' goals and motivation, to create a rich picture of the patterns and pitfalls of taking an online course.

What to measure?

There is, however, no consensus in the learning analytics community on which learner activities and survey data are appropriate to measure, nor how these can be interpreted to improve teaching and raise performance. For example, a study of 118 biology students found that the number of discussion messages posted, assessments finished, and mail messages sent were useful in predicting student performance, but others such as the overall time spent online were not. This study and others using similar methods of analysis show that, in general, students who take the opportunity for discussion with their peers, are active in engaging with course materials, and keep up with the administrative details of the course, gain higher overall grades.

While these data may indicate connections between activity and performance, they do not explain *why* some types of learning are successful. Nor can they predict the performance of each student by studying general patterns of activity. A recent study of students on a mathematics course at Maastricht University logged over 100 variables (such as clicks, time spent, downloads, motivation, emotions, quizzes). It found that academic performance was only poorly predicted by these basic data. Instead, richer information on performance on various assessments during the module, learning strategies, and attitudes to learning allowed the researchers better to understand why and how students interacted in this environment over time.

It is tempting for course developers to track data that is relatively easy to capture, in order to gain a broad picture of performance. However, there is a need for researchers and practitioners to find 'actionable data' that can guide teachers in deciding when to offer assistance and can help course designers improve the content and structure of their courses. For example, an online course offers the opportunity for students to seek help and offer advice to their peers, but this needs to be supported by ways to judge when people are offering helpful and reliable advice. Analytics can indicate which social methods (such as rating the quality of advice or giving badges to helpful students) are most effective in helping students to find and give advice, and so guide the development of new tools and services. The Pittsburgh DataShop provides tools and datasets from existing online courses to help with identification of important learning activities and learning behaviours.



A value chain for large-scale data (Miller and Mork, 2013)

To make sense of the vast amounts of data that can be linked to understand learners' journeys, Miller and Mork propose a value chain for discovery, integration, and exploitation of large-scale data. This could help organisations to align their learning design with the outcomes from learning analytics in order to improve students' learning experience.

There are limits to the kinds of learning behaviour that institutions can analyse. As students learn at home or on the move with their own devices and tools, so their activities are increasingly beyond the reach of data loggers. Longitudinal research at a Dutch medical programme using problem-based learning showed that 80% of the students learned more from contacts outside their formal group than from their course colleagues. The informal social networks and personal tools of students have a substantial impact on their attitudes, actions and behaviour.

Ethical boundaries

A potential danger of learning analytics is mislabelling students according to incomplete or incorrect information, or inaccurate algorithms. How learners behave in classrooms or online depends upon a complex interaction of personal, emotional, social, and economic factors that are not directly observable from behaviour alone. In their extreme form, learning analytics may undermine or restrict an individual's choice of access to particular materials or resources. For example, when learning analytics are used to suggest courses and modules that increase a particular student's chance of successfully completing a qualification, there is a danger that students will select easier courses with a higher possibility of success rather than more appropriate, but challenging, courses. It is therefore important to involve students as active agents and collaborators. Student-oriented learning analytics, with data shown to the learners, could provide students and teachers with opportunities for self-reflection and the development of shared understanding.

Conclusions

Substantial progress has been made to use the power of learning analytics to inform and tune innovative learning designs. An important consideration for institutions wanting to implement learning analytics is their capacity to produce and act on reliable data. Organisational change takes substantial time, effort and financial resources. We expect an increased use of learning analytics by managers and teachers to improve the quality of their courses. This, in turn, will help the learning analytics community to understand more clearly which variables for learning are important, how to incorporate informal learning, and where the ethical boundaries of learning analytics lie.

"The informal social networks and personal tools of students have a substantial impact on their attitudes, actions and behaviour."

Resources

Study of 118 biology students into what learning activities to measure:

Macfadyen, L. P., & Dawson, S. (2010). Mining LMS data to develop an 'early warning system' for educators: A proof of concept. *Computers & Education*, 54(2), 588-599.

Pittsburgh DataShop provides both an online store for research data and a set of tools for analysis and reporting:

http://www.learnlab.org/technologies/datashop/

Study of 100+ learning analytics variables at Maastricht University relating to students on a mathematics course:

Tempelaar, D. T., Rienties, B., & Giesbers, B. (2014). In search for the most informative data for feedback generation: learning analytics in a data-rich context. *Computers in Human Behavior*.

Value chain for discovery, integration, and exploitation of large-scale data:

Miller, H. G., & Mork, P. (2013). From data to decisions: a value chain for big data. *IT Professional*, 15 (1), 57-59.

Flipped classroom

Blending learning inside and outside the classroom

Potential impact: high

Timescale: medium (2–5 years)

Flipped learning is an attempt to make best use of the learning benefits of online and face-to-face teaching. Direct teaching is taken out of the school or college classroom and put online so that students learn at home through instructional videos and presentations. The teacher may have created these or, more typically, they are produced by a company such as Khan Academy – a not-for-profit organisation that specialises in making short explanatory videos available for free access on the web. Then the classroom becomes a space for dynamic, interactive learning where the teacher guides students to apply concepts they have learned online and engage creatively with the subject matter through group work, discussion, and peer feedback.

Approaches

The flipped learning approach has two elements to consider: the direct instruction part at home and the interactive face-to-face element in the classroom. The home element does not have to consist of short videos, – textbooks, software or other resources could work as well – but video tends to be the dominant format.

The success of flipped learning depends on how the interactive classroom element is constructed. Some teachers have adopted peer mentoring, with students teaching each other, others have used group projects to explore the concepts learned at home In some versions, the face-to-face element is used for debate and discussion. The classroom environment is often set up explicitly to reflect and encourage this shift towards collaboration and group work.

The flipped approach is beginning to spread beyond classrooms, so that conferences and learning in the workplace can be flipped. In a flipped conference, attendees typically view selected videos, articles, and case studies online, then meet in workshops to discuss the pre-conference resources and share personal experiences.

Poster for the Flipcon14 flipped learning conference. Image courtesy of the Flipped Learning Network.

> “the classroom becomes a space for dynamic, interactive learning where the teacher guides students to apply concepts they have learned online”

Impact

Although the approach has been gaining currency, direct evidence of improvement in grades is limited to a few case studies. For example, a lecturer at University of Washington reduced the failure rate of his students from 17% to 4%, and increased the number of students attaining A grades from 14% to 24%. At the University of British Columbia, a controlled study found that the flipped students increased attendance by 20% and engagement by 40% and their scores were, on average, more than double those of students in a control group.

Surveys have indicated that teachers who flip are enthusiastic, with 96% saying they would recommend it, 71% reporting an increase in student grades and 85% an increase in student engagement and classroom participation.

Criticisms

Flipped learning shifts the workload of learning to the home, so that the bedroom or living room becomes a place of study and school encroaches on the social lives of students. Homework has long been a part of school and university education, but flipped learning demands a home environment where students are equipped with multimedia computers and must focus on watching videos and taking notes, rather than reading books or writing essays. The burden of learning shifts towards the student, but flipped learning pioneer Jon Bergmann emphasises the value of teachers in facilitating learning rather than delivering content, refuting the notion that in a flipped class the teacher becomes redundant.

Use of video as the prime means of direct instruction has resulted in an emphasis on the effectiveness of video production and delivery, with the teacher or school selecting videos rather than considering the broader range of direct teaching methods in a traditional classroom. As with any new method of teaching, there is currently a novelty effect from the new medium that may not persist as this approach becomes more routine.

Conclusions

Although there may be hype around the term flipped learning, it is a useful way to consider effective use of environments and tools. If a teacher is repeatedly explaining basic concepts that could be better covered via online instruction, it makes sense to flip and apply a more engaging style for the face-to-face element. Open education resources and MOOCs now provide a range of good quality and freely available online resources that suit different learners. With flipped learning, the classroom becomes the place to share, discuss and explore these materials, guided by a teacher.

Resources

University of Washington study, *Flipped Learning in Higher Education*:

http://www.flippedlearning.org/cms/lib07/VA01923112/Centricity/Domain/41/HigherEdWhitePaper%20FINAL.pdf

University of British Columbia study:

Deslauriers, L., Schelew, E. & Wieman, C. (2011). Improved Learning in a Large-Enrollment Physics Class. *Science*, 13 May 2011, 332 (6031), 862-864.

Flipped learning survey of 2,358 educators:

http://flippedlearning.org/survey

Survey of 109 teachers using, creating and sharing online resources in a flipped classroom:

http://www.flippedlearning.org/cms/lib07/VA01923112/Centricity/Domain/41/OERRH_FLN%20Infographic.pdf

What is flipped learning?

Flipped Learning Network (FLN). (2014) The Four Pillars of F-L-I-P™

http://www.flippedlearning.org/cms/lib07/VA01923112/Centricity/Domain/41/FLIP_handout_FNL_Web.pdf

Flipped learning:

Rees, J. (2014) *The flipped classroom is decadent and depraved*. Blog posting, 5 May 2007. Accessed online, 14 October, 2014, at

http://moreorlessbunk.wordpress.com/2014/05/05/the-flipped-classroom-is-decadent-and-depraved/

Bring your own devices

Learners use their personal tools to enhance learning in the classroom

Potential impact: **high**

Timescale: **medium (2–5 years)**

Many students now own smartphones, laptops, and tablet computers. They expect to bring these into the classroom, both to support their learning and for personal and social use. This creates challenges for educators, alongside opportunities for new forms of teaching and learning. Students come equipped not only with individual technologies that they maintain and improve, but also their personal learning environments and social networks. Teachers shift from being providers of knowledge and resources, to acting as directors of technology-enabled networked learners. This opens opportunities to connect learning inside and beyond the classroom.

> “This opens opportunities to connect learning inside and beyond the classroom.”

Personal ownership

Over the last decade, there has been an increasing level of personal ownership of computing technologies that can be used in the workplace or college and a desire by owners to use these, sometimes in preference to equipment provided by educational institutions. It has been recognised that the use of personal technologies will affect how organisations operate, and embracing this change with a bring-your-own-device (BYOD) policy can be more productive than banning users from bringing in their own devices. Early discussions in this area were focused on the impact of personal laptops, but attention is shifting to tablet computers and mobile phones which are more likely to be always with the owner and used for social and entertainment purposes as well as for work and study.

Research around BYOD initially focused on technical and usability challenges. There are security issues caused by letting unknown devices inside a secured network, with a risk of either malicious activity such as theft of data, or accidental damage such as passing viruses from a personal machine to others on the network. Then there is the need to provide access, making sure the personal devices can physically connect to the organisation’s network and are allowed to do so, and that there are enough WiFi points and charging sockets for all the additional devices. Finally, there is the challenge of ensuring the organisation’s resources can be accessed on the wide range of devices, so that web pages display correctly on different-sized screens, and interactive forms work on different platforms.

Standardisation ◄——————————————► Flexibility

1	2	3	4
Limit personally owned devices to specific brand/model	Limit personally owned devices to specific technical specifications	Limit personally owned devices to specific capabilities with regard to software, tools, apps, etc	No limitation on personally owned devices, provided they are Internet-ready

BYOD Models along the continuum from standardization to flexibility (adapted from Alberta Education, 2012)

There is a debate about what BYOD actually means. It can be broken down into a range of models, from the educational institution distributing its own centrally purchased and configured devices for students to use, through providing guidance and minimum specifications for learners' own devices, to supporting whatever devices students bring in.

Teacher control

More recent discussion about BYOD has focussed on its effects on education. Traditionally, the teacher has allocated and controlled technologies in the classroom, from computer labs to electronic whiteboards. BYOD could be considered as enriching and extending existing teaching methods. Teachers can create online polls where students respond immediately in a lesson via their web-enabled devices. Students can ask questions as they arise via text message, without disrupting the flow of a lecture or feeling embarrassed about drawing attention to themselves. The increasing number of sensors present on phones and tablets (such as accelerometers, thermometers and audio meters) can be used to support science experiments, providing accuracy as good as college equipment but without the expense of maintenance or training. Students can become more independent in their information seeking. Ubiquitous access to networked learning technologies changes the role of college libraries: rather than places to be visited for learning resources, they can extend their reach to students across the campus and in their homes, making scholarly content available for networked devices and offering new types of services to suitable mobile, autonomous learners.

> "Students can access their own devices to achieve goals set by their teachers and become more independent learners."

As with flipped learning, BYOD can shift the teacher's role towards guiding and managing. Students can access their own devices to achieve goals set by their teachers and become more independent learners. A teacher may set activities in the classroom to be continued at home or elsewhere and then shared back at college, confident that students have the technology to move between contexts, utilising travelling time and their home environment to access resources, communicate with other students and teachers and undertake work.

The functionality of personal devices allows these other environments to become places for data collection: cameras and microphones can be used to collect images, video and audio; location sensing can be used to tag places of interest. Mobile devices with built-in accelerometers, noise, light, humidity and temperature sensors, can be used as science toolkits to collect data and perform experiments.

Students' personal collections and social networks can become resources for learning. The use of the same device for storing both social and educational resources means a blurring of boundaries. Records of achievements in personal interests might provide evidence of learning for formal purposes, such as the creation and recording of a piece of music with friends; social networks might inform and offer practice for learning, such as conversing in a foreign language with a Facebook group of friends and receiving feedback from native speakers.

Challenges

BYOD can bring many challenges. Learners may be disadvantaged if they cannot afford the multimedia devices needed to participate fully, or if they have to monitor and restrict their data usage. Giving students uncontrolled access to the internet at all times may result in students browsing the web or messaging their friends when they should be concentrating on a classroom activity. Students may misuse the power of their devices, for example by filming teachers or students without their permission. In some countries, these issues of access and appropriate use have been highlighted in the press and taken up by teachers' organisations.

Conclusions

As a technology, mobile devices may threaten the carefully managed environment of the classroom. From the perspective of innovating pedagogy, BYOD is a means to introduce everyday social learning to the classroom. This requires careful management, since the teacher has to keep control of a room where learners can connect with each other and the outside world, continuing conversations and sending messages. The teacher and school together need to set clear guidelines for appropriate use, and also to accommodate those students who have their own devices and can afford to run them, but may not wish to do so, preferring to separate their personal and learner identities and use college equipment for carrying out educational activities.

Resources

Alberta Education (2012). *Bring Your Own Device: A Guide for Schools*. Edmonton, Canada: Alberta Education.

http://education.alberta.ca/media/6749210/byod%20guide%20revised%202012-09-05.pdf

Gidda, M. (2014). Students: bring your own technology to uni. *The Guardian*, 11 April 2014.

http://www.theguardian.com/education/2014/apr/11/students-bring-tech-device-uni

Stavert, B. (2013). *Bring Your Own Device (BYOD) in Schools: 2013 Literature Review*. Eversleigh, New South Wales: NSW Department of Education and Communities.

https://www.det.nsw.edu.au/policies/technology/computers/mobile-device/BYOD_2013_Literature_Review.pdf

Sweeney, J. (2012). *BYOD in Education: A Report for Australia and New Zealand – Nine Conversations for Successful BYOD Decision Making*. Intelligent Business Research Services Ltd.

http://1to1sustainmentdeecd.global2.vic.edu.au/files/2013/07/BYOD_DELL-2dtch9k.pdf

Learning to learn

Learning how to become an effective learner

Potential impact: medium

Timescale: ongoing

The focus of learning is usually on what we need to know, rather than on how to learn. This can lead to frustration because there is just too much to find out. On the other hand, the process of learning is itself a fundamental part of life that helps shape us as human beings and gives purpose to much of what we do. For a teacher, considering the process of learning to learn can help to schedule and balance learning opportunities so that they bring out the longer-lasting benefits associated with being a learner.

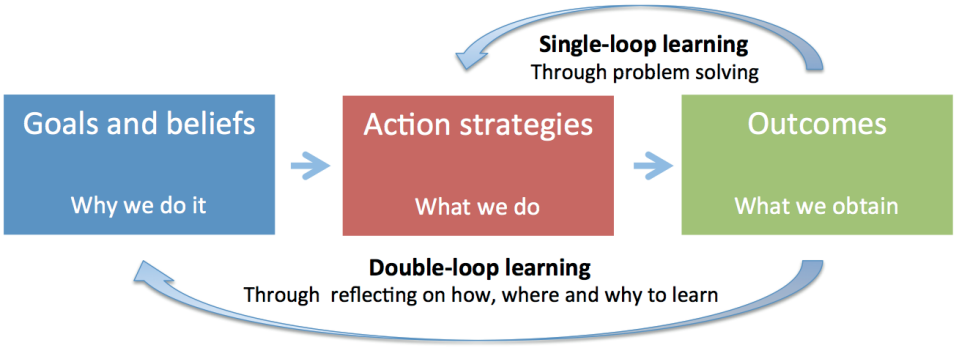
In learning to learn, success is not linked to the content a person acquires but to their development as a learner, so that when faced with situations in the future they have the personal capability to find new approaches or fresh information, and they are able to apply these in an effective manner. Educational content remains important, but there is a shift from a concern with delivery and assessment, towards the use of content in helping learners gain new skills. Whereas adult learning (or 'andragogy') is concerned with developing new skills, learning to learn (or 'heutagogy') also involves discovering how best to acquire those skills – in the classroom, workplace and at home – through a combination of study, discussion, investigation and practice. A teacher may provide resources, but the learner is in command of deciding how to organise them into a coherent course of study.

> "the ability to determine your own learning needs and to reflect continuously on the learning process"

Connected with learning to learn is the ability to determine your own learning needs and to reflect continuously on the learning process. This involves developing skills of open communication and teamwork, being flexible in approach and creative in new situations, and becoming confident in your ability to take appropriate and effective action in changing circumstances.

Mindful learning

This is all based on the assumption that learners want to determine their own learning and are able to do this. There is therefore an emphasis in learning to learn on enabling young learners to make sense of their world and helping them develop creative strategies for organising their studies. There are skills and techniques to becoming a learner that can be acquired and revisited over time, supported by 'learning to learn' courses on how to diagnose your learning needs, set goals, find valuable resources including other people to learn with, choose learning strategies, reflect on progress, develop creative skills, and evaluate learning outcomes.



Single- and double-loop learning (based on Argyris, 1976)

Another perspective on learning to learn is how to combine personal priorities with learning opportunities. In working life, the need to get through a seemingly impossible To-Do list can make for inefficiencies and too much switching of attention as we try to decide what needs to be done while more work piles in. There are many self-help books that suggest ways to prioritise the important tasks as well as the urgent and pressing but more mundane. These organisational techniques are also part of some approaches to learning to learn.

Another approach is to step back and ensure an overall mindful approach to life, by considering the impact of your learning on yourself and paying attention to personal actions. Mindfulness can be supported by meditation and understanding how much of what appears to be true is in the mind – whether something is upsetting to study, too difficult, or not worth the effort, is an internal judgement. Mindful learning encourages full attention on what is needed, balanced by the investment in time to gain that full attention.

Double-loop learning

An aspect of mindfulness is being able to reflect on yourself as a learner and how you have carried out a recent learning activity, in order to adjust your processes of learning. This approach contrasts with the normal process of 'single-loop' thinking that involves reacting to events, solving a problem in a familiar way and accepting information at face value. Double-loop thinking involves considering the problem at hand, looking for the greater system, so as to achieve personal development.

For a teacher, enabling double-loop learning puts the subject-based content into a larger framework where each student is encouraged to determine how, where and why they learn, and to negotiate a curriculum and learning strategies with themselves, their teacher and their peers. Open learning materials and MOOCs fit into this framework by providing resources for study that suit the needs and strategies of each learner.

Conclusions

Learning to learn makes sense in a world where nearly half of all job titles are now expected to change within 20 years and personal values cannot be linked to fixed measures of success. But the rethinking and techniques that are required for learning to learn are neither easy to acquire nor easy to teach in a classroom. Becoming a self-managed learner is not enough, as at least part of the problem in learning is too many options and unclear aims. The next steps include recognising that learning to learn is worth the investment in time, and looking for learning frameworks that bring together opportunities for learning around a mindful and reflective approach to life.

Resources

The idea of double-loop learning, based on a model of how feedback loops should help organisations work. Argyris, C. (1976). Single-loop and double-loop models in research on decision making. *Administrative Science*, 21(3), 363–375.

A review of andragogy and heutagogy in relation to lifelong learning:

Blaschke, L.M. (2012). Heutagogy and lifelong learning: a review of heutagogical practice and self-determined learning. *The International Review of Research in Open and Distance Learning*, 13(1), 56-71.

http://www.irrodl.org/index.php/irrodl/article/view/1076/2113

A chapter setting out the ideas of andragogy:

Knowles, Malcolm S (1970). What is andragogy ? In *The Modern Practice of Adult Education: From Pedagogy to Andragogy (2nd edition)*. Englewood Cliffs, NJ: Prentice Hall, pp. 40–59

A European research project that looked at using games to support financial decision making and how mindfulness can help learning and decision making:

Peffer, G., Fenton-O'Creevy, M., Adam, M., Astor, P., et al. (2012). *xDelia Final Report: Emotion-centred Financial Decision Making and Learning*. Open University, CIMNE, Milton Keynes UK.

http://oro.open.ac.uk/35099/

Dynamic assessment

Giving the learner personalized assessment to support learning

Potential impact: medium

Timescale: long (4+ years)

The basic premise of dynamic assessment is that it is important to assess students' potential to learn rather than measure what they have just done. Testing acts as a diagnostic tool that enables a teacher or the computer to offer guidance to the student during the assessment process. Thus, it differs from conventional testing in both assessing and guiding the progress of the student. The relationship between the assessor and student is not neutral because the whole purpose is to find suitable ways to promote student learning. A role of the assessor is to identify barriers to the student's success and then apply an appropriate strategy to overcome the difficulties. Assessment and intervention combine in the process of dynamic assessment.

As well as being a way to offer direct support to the learner, dynamic assessment can inform the teacher about topics and skills that many students are finding difficult and so help the process of re-designing and improving the teaching. It can also motivate learners to reflect on their learning journeys and decide on which skills they need to improve. It is particularly valuable for developing 21st-century skills of reasoning, problem-solving, decision making, leadership, creativity and literacy.

> "it is important to assess students' potential to learn rather than measure what they have just done"

Zone of proximal development

The dual function of assessing and improving a student's level of attainment is based on the notion of a zone of proximal development (ZPD). This is the difference between what a student can do unaided and what is possible with assistance. For example, a student who struggles to think of ways to measure the height of a building might be guided first to consider how the timer or the tilt sensor on a mobile phone could be used in solving the problem, and then how this could be done without the need for algebra (by sighting a 45-degree angle to the top of the building, at which point the distance from the building to the student is the same as the distance from the base to the top of the building).

Using a mobile phone tilt sensor to measure the height of a building

The combined measures of the student's actual development to date plus the zone of proximal development (what they could achieve with appropriate help), are more powerful indicators of attainment than a single score of current development, such as that given by an IQ test.

Methods

The methods of dynamic assessment are designed to allow the assessor (who may be a human teacher, or a computer-based tutoring program) to measure the effect of an intervention or lesson on the student's performance. Typically, this is done by setting a pre-test of the student's knowledge or skill, followed by a teaching intervention, and then a post-test to see how the knowledge or skill has changed. The 'pre-test, intervention, post-test' method resembles a traditional research design, but the aim is not to carry out a research study on a group of students, but to use this information to guide the learner and inform the teacher.

In the 'sandwich format' students receive coaching between the pre-test and the post-test. Alternatively, in the 'cake' format, students receive hints during the testing session. These two methods could be combined so that, in the example above, the student might be given hints to use a tilt sensor or to find an angle that would remove the need for algebra, then all the students could be taken out into the playground to measure the height of the school building, then they could be individually re-rested to see if they are able to apply their knowledge to a similar problem.

There is also an interactionist methodology that takes more account of the student's zone of proximal development. In this case, teacher and student work together to solve a problem, with an emphasis on the teacher providing continual appropriate guidance.

The differences between dynamic assessment and conventional or static assessment are that:

- the focus of dynamic assessment is on guiding future development, whereas static assessment measures past achievement;
- the assessor and student relationship is different, since the assessor intervenes during the process;
- with dynamic assessment there is feedback to the student during the assessment process.

Examples

An example of dynamic assessment at university level was the assignment of students to an undergraduate Spanish course by finding a good match between the level of development for each student and appropriate Spanish teaching. In this case, the assessor prompted the students to revise their answers if they had made mistakes. Some students were able to improve with prompting, while others were not. Those who did revise their answers correctly were placed in an advanced language course.

A second example comes from a school science lesson with children aged eight and nine years who were learning about magnetism. The teacher discussed the topic with the children and was sensitive to each child's ZPD, helping the class to move from everyday language, such as 'hold' and 'push', to the use of scientific terms such as 'attract' and 'repel'.

A third study was designed to support English as a Foreign Language with young adults who were considered to be 'at-risk immigrants' entering Israel. The students were given a reading and comprehension pre-test. Assessors then went through the test with the students, building strategies with them to address each test item and, more importantly, showing them how these strategies could be transferred from one example to another. A learning potential score was devised by the assessors and the students were then designated as high, medium or low performers. This dynamic assessment facilitated more accurate instructional recommendations that helped these students to improve their English language skills.

Providing dynamic assessment of each student and giving timely guidance is a demanding task for a classroom teacher, so attempts are being made to develop software to perform this process. For example, the OpenEssayist system gives immediate feedback to university students on their draft essays. It analyses the essay and produces a summary of the key sentences the student has used, enabling learners to decide whether these sentences are what they intended to emphasise in their assignment and then go back and refine the main argument of their essay. A more general

system of dynamic assessment is provided by the suite of Cognitive Tutors® from Carnegie Learning that provide individualized assistance to students as they work through problems in computer programming, algebra or geometry.

Conclusions

Dynamic assessment has been criticised on the grounds of its reliability. In order to construct a reliable test, the test items need to be stable, but the dynamic assessment procedure is deliberately associated with change, not stability. However, the main value of any assessment lies in the inferences that can be made from it about how well the student is progressing, and with dynamic assessment these inferences are sound, since they are tightly connected to administration of its test procedure. Although dynamic assessment puts new demands on teachers, test instruments have been constructed for use in the classroom. It should be considered as part of a range of assessment tools that can support individual students to reach their full learning potential.

Resources

Zone of Proximal Development:
Vygotsky, L. S. (1978). Interaction between learning and development. Chapter in *Mind and Society*. Cambridge, MA: Harvard University Press.

http://www.psy.cmu.edu/~siegler/vygotsky78.pdf

OpenEssayist is part of the SAFeSEA project involving The Open University and the University of Oxford:

http://www.open.ac.uk/researchprojects/safesea/

Cognitive Tutors® have been developed by the PACT Center at Carnegie Mellon University and are now managed by the spin-off company Carnegie Learning:

http://pact.cs.cmu.edu/

Book providing an overview of Dynamic Assessment, including the school Science example:

Haywood, H. & Lidz, C.S. (2006). *Dynamic Assessment in Practice: Clinical and Educational Applications*. Cambridge University Press.

http://assets.cambridge.org/97805216/14122/frontmatter/9780521614122_frontmatter.pdf

Event-based learning

Time-bounded learning events

Potential impact: medium

Timescale: medium (2–5 years)

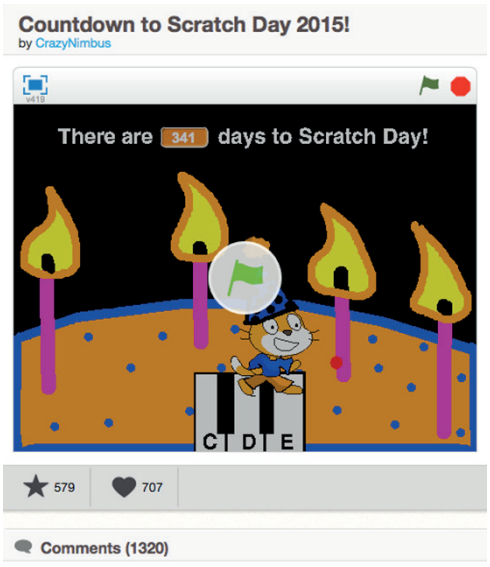
Events that shape our personal and national histories – births, weddings, funerals, religious holidays and festivals – are what we most remember later in life and record through photographs. In schools, key dates provide convenient hooks on which to hang lessons about culture, history and art. When we learn about the origins of our country or an annual festival, we know we are doing so at the same time as thousands of others and we benefit from the resources that are readily available at these times. There is also a sense of anticipation as we prepare to build on or challenge what we have learned during similar occasions in the past.

Technology provides opportunities to extend these benefits. Social network systems such as Facebook enable participation and collaboration, allowing us to share distributed expertise, disperse ideas and build understanding with friends and colleagues around the world. The possibilities opened up by the combination of event-based learning and social networking are being explored in a variety of subject areas, including science, computer science, history and literature.

Community events: Scratch Days, Maker Fairs and Raspberry Jams

Scratch is a free programming language, designed for children who are learning to program. The Scratch website brings together a user community that shares and builds on the stories, games and animations created by others around the world.

In 2008, the first annual Scratch conference was held with hundreds of the educators, researchers and developers involved in the project. But it was not aimed at the young people who make up the bulk of the Scratch community and it was only accessible to people with the time and money to travel to the East Coast of the USA. This prompted the creation of an annual Scratch Day, when Scratch users could gather together in their local communities. Since then, users have met up annually to collaborate on programming projects, share ideas and experience, and have fun together. In 2014, more than 250 Scratch Day events were run in 56 countries. The days are used to prompt further activity and interaction, with programs shared across the world in online galleries.



A Scratch Day project shared online by CrazyNimbus. Many of the 1320 comments refer to reuse of the software, or to understanding how this short program works

> “ the time-limited events inspire, support and showcase learning ”

Other events used to catalyse activity and interaction include the Raspberry Jam and Raspberry Jamboree events focused on the inexpensive Raspberry Pi microcomputer; and the Maker Faire events around the world that have a focus on do-it-yourself crafts and projects. All these are associated with enthusiastic and growing communities; the time-limited events inspire, support and showcase learning.

Knowledge-building events: bioblitzes

Event-based learning does not require engagement with an existing community. A bioblitz collects groups of people to carry out a biological survey of an area within a short period of time – usually a day or less. These events often have a festival atmosphere and bring scientists and naturalists together with members of the public. They provide opportunities for amateurs and enthusiasts to learn more about biology, ecology and the importance of nature in their area, while increasing scientific understanding of specific ecosystems.

Publicizing and sharing the results of a bioblitz online extends its reach beyond the local area. In addition, online tools can be shared with participants that may extend the learning experience over time. For example, the online site and community iSpot helps visitors share and identify observations of wildlife. This enables bioblitz participants to continue their investigations once the experts have gone home.

Media-led learning events

Television and theatrical events are increasingly being used as a focus for both entertainment and learning. The annual Springwatch and Autumnwatch BBC television programmes combine live and recorded footage of seasonal wildlife activity with opportunities to engage by accessing additional resources, attending events or taking part in citizen science research. For example, the spring 2014 series encouraged viewers to map bumblebee distribution, provide data to help target hedgehog conservation actions, take part in phenology (the study of seasonal phenomena), and participate in research on the breeding behaviour of gannets. The use of technology meant that observations made worldwide could be viewed online via webcams, submitted using smartphone apps, and shared using social media.

Stargazing Live, another annual event on BBC television, focuses public interest on astronomy and planetary science. Again, there are opportunities to extend the experience by accessing online resources, attending face-to-face events or participating in citizen science. In 2012, online classification work by viewers led to the discovery of a new planet revolving round a distant star; their work the following year identified dozens of previously unknown galaxies. Zooniverse, which runs these online projects, registered over a million classifications per hour when the programme was running in 2013, resulting in the classification of more than 6.5 million images (with each image classified multiple times to increase reliability).

There are also media-led learning events in the arts and humanities. The Royal Shakespeare Company played out its digital retelling of *A Midsummer Night’s Dream* in real time over midsummer weekend 2013. The project appeared on 25 million Twitter feeds and opened discussion of Shakespeare and his contemporary relevance to a worldwide audience. Earlier in the same month, the Channel4 television company ran a one-day event on 6 June, linking television programmes about the World War 2 D-Day landings to a retelling of the event through social media. In both cases, the events were strongly time-bounded, encouraging discussion and reflection across a wide group for a short period of time.

Conclusions

Technology-enhanced event-based learning offers opportunities for participation, collaboration and distributed expertise. These events not only have the potential to engage millions of people in memorable learning experiences, but can also make significant additions to the body of knowledge available to us as a society.

Resources

Scratch Day annual event run worldwide in association with the Scratch programming language:

http://day.scratch.mit.edu

Raspberry Jam – A global network of groups and events associated with the Raspberry Pi computer:

http://raspberryjam.org.uk/what-is-raspberryjam

iSpot – a free site where participants can share and identify wildlife observations with other community members:

http://www.ispotnature.org

Autumnwatch – BBC website with links to resources and activities:

http://www.bbc.co.uk/programmes/b0079t1p

Zooniverse and Stargazing Live:

http://blog.zooniverse.org/2014/01/09/stargazing-live-the-results-are-in

Midsummer Night's Dreaming – a digital theatre event by the Royal Shakespeare Company:

http://www.rsc.org.uk/explore/projects/midsummer-nights-dreaming/

D-Day as it happens – television and social media coverage of some of the events of 6 June 1944:

http://dday7.channel4.com

Learning through storytelling

Creating narratives of memories and events

Potential impact: medium

Timescale: long (4+ years)

Learning through storytelling – by sagas, parables and fables – has a long history. The rise of a more objective, scientific approach to learning and teaching has often sidelined these narratives in favour of a curriculum that emphasises mastery of facts and figures. However, as the wealth of information that is available online continues to grow, there is an increasing need for storylines that can help learners to find their way through resources.

On a personal level, we use narrative to describe to ourselves and to other people who we are, where we have been and where we are going. This provides a fundamental way of understanding and expressing our experiences of events that unfold over time. Stories can be used not only to make sense of past events but also to predict and plan future actions.

Here we look in more detail at four approaches to learning through storytelling: narrative pedagogy, narrative-centred environments, practomime and MOOCs.

Narrative pedagogy

Narrative pedagogy was developed within the field of nursing education and emerged from a long-term analysis of teachers and students within that discipline. The approach is set alongside content knowledge and focuses on interpreting and thinking critically about ideas and situations. Students and teachers work together to share and interpret their experiences. As well as sharing stories with each other, they may be encouraged to create reflective journals in which they reflect on their actions, analyse patient situations and evaluate outcomes.

Narrative pedagogy is a community practice that allows nursing students and their teachers to consider what is possible and what is problematic within their teaching. This approach provides learners with opportunities to hear and consider different viewpoints. Within these different narratives, knowledge is contested and elements of uncertainty are explored. Nothing in the subject area is taken as certain: everything is open and problematic.

This approach supports a context-sensitive approach to learning, a consideration of different viewpoints in a given situation and opportunities to empathise with others. As stories are shared, nurses are prompted to examine their values and their attitudes. They are also made aware of the importance of continually questioning and thinking things through, rather than reaching for a set answer.

Narrative-centred learning environments

Narrative pedagogy takes place within a real-world environment. A narrative-centred learning environment, by contrast, provides a ‘story world’ in which guided exploratory learning can take place. These environments may be based within virtual worlds (such as Second Life), augmented reality or game settings. In each case, they situate learners within unfolding stories that require them to ask scientific questions, design experiments, make predictions, generate and test hypotheses.

> “they situate learners within unfolding stories that require them to ask scientific questions, design experiments, make predictions, generate and test hypotheses”

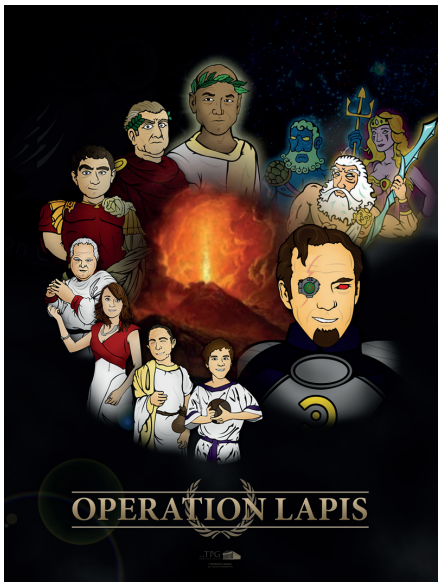
The aim here is to provide engaging and effective narratives that motivate students in a variety of ways. Tasks set at the right level for learners provide *challenge*. Quests stimulate learners' *curiosity* by requiring them to explore intriguing environments and interact with engaging characters. These environments put the students in *control*, not only of their route through the landscape, but also of their route towards a solution. The *fantasy* elements of the scenario contribute to vivid imaginative sequences. Together, these motivational aspects combine to provide a narrative backbone for guided student enquiry.

Practomime

A similar approach, emerging from the field of classical studies, is practomime. This involves 'playing pretend in a context where everyone agrees that playing pretend is what you do'. By blending elements of role-playing games and alternate-reality games, learners are prompted and guided to produce creative solutions to problems.

In practomime, the emphasis is less on the creation of a story world *for* learners and more on the creation of a storyline *with* learners. For example, *Operation Lapis*, a two-year course for beginners in Latin, can be played out in the classroom or online. Within this course, the story is built through a shared narrative. Learners search for the Lapis – a symbol of the power struggle between the forces of populism and traditional authority in Classical Rome. They gather clues to its location by engaging in significant events in ancient history and strive to understand its influence in the modern world. The story framework is already in place, but how it plays out depends upon the engagement of the learners. Through reading and writing Latin, and contributing to the narrative, they can reach the solution and find out how their story ends.

A successful practomime brings together problem solving, student inquiry and the social construction of knowledge in a continuous and engaging process. This means the approach is transferable, and can be applied to the study of science as readily as to the study of classical languages and history.



Poster for Operation Lapis, showing some of the leading characters in the story

MOOCs

Ideally, story environments and story frameworks should not need to be created from first principles in every classroom. Narrative structures like Operation Lapis that are developed in one environment can be reused and reinterpreted elsewhere, just as storybooks can be used in different ways with different classes. There is now increasing demand for pedagogies that can be used at scale, and some massive open online courses (MOOCs) are exploring how a storyline can be used to build engagement and to provoke discussion.

For example, the University of Strathclyde constructed an 'Introduction to Forensic Science' as a MOOC. This course on the FutureLearn platform played out through a CSI-style murder mystery, with learners actively engaged in the twists and turns of the plot line. There were opportunities to compare witness statements, examine the crime scene, decide who should be fingerprinted, and consider blood pattern analysis, footwear marks and the use of firearms. In the final week of the MOOC there were over 1300 contributions to the discussion about who had committed the crime, with a final moment of tension as the murderer was revealed on the last night of the course. A current challenge for MOOC creators is to engage learners over time, so the use of a storytelling approach offers one way forward.

Conclusions

Storytelling offers a way of engaging learners over time, structuring learning and encouraging students to develop their understanding. Although narrative is traditionally associated with Arts-based subjects, the examples explored here show that it can be used across the curriculum and also in practice-based settings.

Resources

Narrative pedagogy:
Ironside, P. M. (2003). New pedagogies for teaching thinking: the lived experiences of students and teachers enacting narrative pedagogy. *Journal of Nursing Education*, 42, 509-516.

Benefits of narrative-centred learning environments and the Crystal Island guided exploratory environment:

Mott, B., McQuiggan, S., Lee, S., Lee, SY, & Lester, J. (2006). Narrative-centered environments for guided discovery learning. In *Proceedings of the AAMAS Workshop on Agent-Based Systems for Human Learning*, Hakodate, Japan.

http://www.intellimedia.ncsu.edu/wp-content/uploads/crystal-island-abshl-06.pdf

Practomime:

Ballestrini, K., Travis, R. & Slota, S. 2010.
The Pericles Group: Theory behind Practice – The Case for Practomimetic Learning.

http://www.practomime.com/about/theory-behind-practice.php

Operation Lapis: a two-year epic adventure and introduction to the Latin language

http://www.practomime.com/lapis/lapis.php

FutureLearn principles, including a focus on telling stories:

https://www.futurelearn.com/about/our-principles

Overview of psychological theories of learning and narrative:

Hazel, P. (2008). Toward a narrative pedagogy for interactive learning environments.
Interactive Learning Environments, 16, 199-213.

StoryMap: explore a subject by mapping it:

http://storymap.knightlab.com

Threshold concepts

Troublesome concepts and tricky topics for learning

Potential impact: medium

Timescale: medium (2–5 years)

The idea of threshold concepts can itself be difficult to understand. How to identify them and distinguish them from other learning topics has provoked debate between academics. There is general agreement that threshold concepts are those parts of a curriculum that students struggle to understand and that they have one or more of these characteristics:

- *transformative*: they shift a learner's perceptions of a subject
- *irreversible*: once learned, they are hard to unlearn
- *integrative*: they expose the inter-relatedness of some things
- *bounded*: they border with other threshold concepts to define a disciplinary area
- *troublesome*: they appear difficult and unintuitive

> "a good starting point for teachers is to explore which curriculum topics seem strange and counter-intuitive"

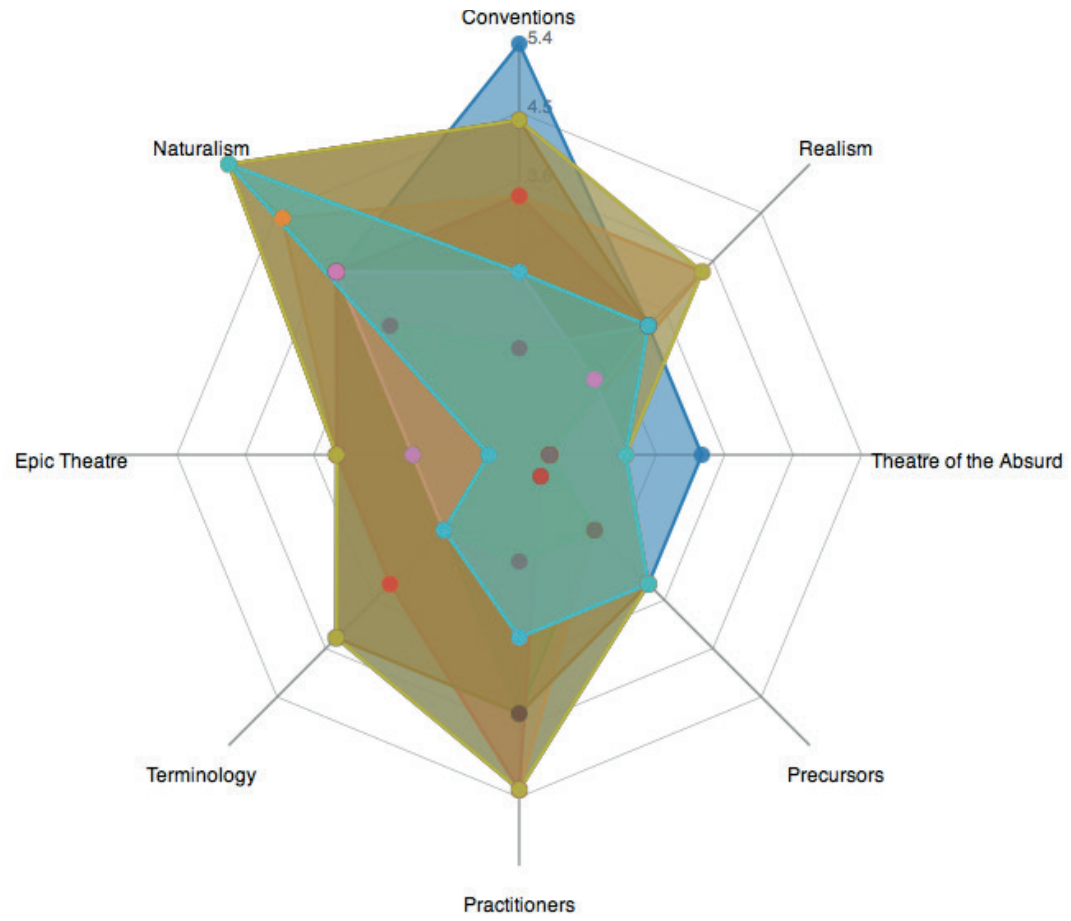
Troublesome knowledge

It is unclear how many of these five characteristics are required to define a concept as a threshold concept. A simple approach is to say that threshold concepts are core topics in education without which students cannot progress in the subject. The characteristic of 'troublesome knowledge' is central. Especially within science and technology, a good starting point for teachers is to explore which curriculum topics seem strange and counter-intuitive. For example, in computing the concept of 'recursion' causes problems for learners because it relates to one computing structure being embedded inside another, like a set of dynamic Russian dolls. So using Russian dolls as an analogy might be a way to start teaching the concept. As always with analogies in teaching, there is a need to balance a compelling image against its power to explain.

Although engineering and the sciences have been the main focus of projects to identify and map threshold concepts, they have been identified in other disciplines, from technology to economics, drama, and accountancy. A recent shift has been towards applying threshold concepts through the design of curricula and lesson plans, to guide teaching practice. For example, the figure shows the results of a quiz given by a teacher of drama to test the students' knowledge of concepts such as 'realism', 'epic theatre' and 'theatre of the absurd'. This forms part of the Juxtalearn project, where the students progress to making short videos that present in imaginative ways their understanding of the concepts.

Threshold concepts guiding teaching and learning

In practice, education is designed to transform learners so they gain a deep knowledge of the concepts needed to understand and apply a



Results of a quiz created by teachers of drama students to show gaps in their understanding of eight threshold concepts. Each plot shows the extent of a student's misunderstanding of the concepts.

curriculum topic such as electromagnetism, and can fit these topics together appropriately and accurately. Threshold concepts can provide a starting point for this transformation. Effective design of a curriculum around key concepts can provide a structure for teaching, promote dialogue among students, help in introducing complex topics, and prompt inquiry into the nature of student and teacher understanding. They may act as a means for teachers to reflect on important points in learning from the students' perspective, indicating areas of misunderstanding and barriers to deeper learning of a subject.

Threshold concepts can also guide assessment practices. By breaking a concept into related elements, a teacher can guide and assess knowledge of each part, then fit them together into a composite whole. Just as with a jigsaw puzzle, there is also value in showing the 'big picture' of a threshold concept – why it is important and how it can be applied in practice – before putting together the component parts.

These formative assessments and quizzes not only review students' deep learning of threshold concepts but also show where they are encountering barriers to understanding. The true value of threshold concepts is that they provide an approach to teaching across different disciplines that is based on fostering deep understanding of difficult concepts rather than measuring outcomes.

Conclusions

Threshold concepts are hard to define and so have provoked debate about their use as an educational theory. There is a growing movement to exploit them in designing curricula and in helping teachers with their lesson planning. By sharing and discussing barriers to understanding, teachers can adopt a more student-centred approach as an alternative or supplement to outcomes-based teaching.

Resources

The use of threshold concepts for teaching and learning in the JuxtaLearn project:

www.juxtalearn.net

Threshold concepts and transformation / transformational learning – a useful short summary and related references:

http://www.ee.ucl.ac.uk/~mflanaga/popupTransformation.html

Edited book on threshold concepts with an online copy of the Preface, Foreword and first two chapters:

Meyer, J.H.F., Land, R. & Baillie C. (Eds.) (2010). *Threshold Concepts and Transformational Learning*. Rotterdam: Sense Publishers.

https://www.sensepublishers.com/catalogs/bookseries/educational-futures-rethinking-theory-and-practice/threshold-concepts-and-transformational-learning/

Short introductory article:

Cousin, G. (2006). An Introduction to threshold concepts. *Planet, 17*.

http://www.sddu.leeds.ac.uk/uploaded/learning-teaching-docs/teachtalk/5-12-2008/cousin_threshold_concepts.pdf

Bricolage

Creative tinkering with resources

Potential impact: high

Timescale: long (4+ years)

The term 'bricolage' is French for 'tinkering', or working creatively with whatever tools and resources are available. Originally used in relation to practical activities, such as carpentry, it has since been applied in many fields, from music created by everyday objects like spoons, to cultural identities such as punk that are constructed from elements of other cultures.

Improvisation around materials

There are two uses of bricolage with relevance to pedagogy. The first refers to the ways in which people learn by improvising around materials. Children learn how to relate to others and to tell stories by playing games with toys and props such as chairs and sheets. Students of art and drama learn the skills of improvisation with found materials and their own bodies. To combine these in productive ways to produce a deliberate effect is the creativity of bricolage – it is what distinguishes playing with sand from building sandcastles, hitting objects from creating stomp music, scribbling from doodling. Through bricolage both the learner and the materials are transformed, so that two chairs and a sheet become a house in which children can play at being parents.

It follows that children can be encouraged to learn through imaginative play by providing them with a rich environment of objects that they can combine and modify. What is fascinating is that young children are able to engage in long periods of learning through bricolage, building castles or creating pretend homes, making up stories as they play, without the need for an adult teacher.

"Bricolage develops sensitivity to the forms, properties and uses of materials that are important for professions ranging from cooking to chemistry, architecture to engineering."

Rather than seeing this pretend play as a training for adult life, to be replaced by school education as they mature, perhaps we should be exploring how young children's bricolage can contribute towards a new theory and practice of creative adult education. Bricolage develops sensitivity to the forms, properties and uses of materials that are important for professions ranging from cooking to chemistry, architecture to engineering.

Practices of educational innovation

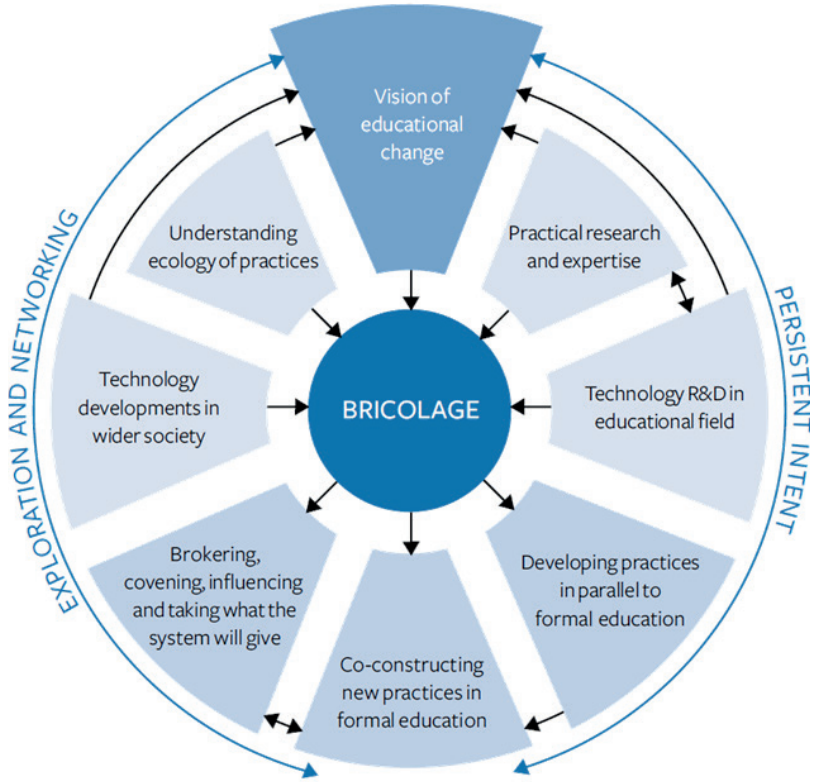
The second use of the term in education relates to engaging in innovation by creative exploration of the practices and technologies needed to achieve an educational goal. In the classroom, a teacher creates a lesson out of the current educational materials, classroom practices, and skills of the pupils. At a larger scale, researchers and entrepreneurs develop innovations in education from resources that are available locally. For example, the Yoza project has supported young people in South Africa to read works of fiction by distributing them to mobile phones. The project

team considers the main innovations to include not only the use of phones for delivery of the novels, but also the availability of really engaging local stories, with readers able to comment as they read and to see other people's comments.

Trying things out

Innovation in education has similarities to innovation many other areas – such product design, pharmaceuticals, mathematics, and entrepreneurship. It is a process of well-informed 'trying things out to see how they work'. Tim Berners Lee, developer of the worldwide web, described how he developed the web from many sources, including the educational theories of Seymour Papert and the Hypercard software that was available on Apple computers at the time. The project began as a way to enable learning among scientists by information sharing. Berners Lee first wrote a simple computer program called Enquire to keep track of people and programs across different types of computer system and different networks. The practical process of developing the Enquire code led him to a larger vision of a system to support the decentralised growth of ideas across the world. He describes this process as 'the swirling together of influences, ideas, and realizations from many sides, until, by the wondrous offices of the human mind, a new concept jelled'. It was a process of bricolage, not the linear solving of one well-defined problem after another.

Big, expansive innovations such as the worldwide web, mobile learning, or MOOCs not only arose from a process of bricolage, they are themselves sites of bricolage as people use them to explore new methods of teaching and learning. The illustration here of the process of innovation in learning with technology shows how a vision of educational change held by one or more people needs to be accompanied by an exploration of theories, practices and technologies. These form the materials for a sustained bricolage that could last many years as the new methods are researched, tested at small scale in classrooms or workplaces, and expanded. Sometimes promising developments are abandoned, only to be resurrected for a new generation of technology, educational theory and practice. The best innovations become sites for playful exploration, by inventors and entrepreneurs as well as teachers and learners.



The role of bricolage in the innovation process for technology-enhanced learning (from Scanlon et al., 2014)

Testing constraints and learning from failure

At a more abstract level, bricolage is a continual testing of constraints and the structures within which imaginative play occurs. Too much constraint means that creativity is stifled; too little constraint and the activity becomes disorganised and formless. The other side of bricolage is evidence. In order to make progress, as a person or as an organisation, we need to base new practices on evidence of success and on learning from productive failure. Each failure emerges from a process of testing of what does and does not work in practice, and so becomes a resource for further creative exploration.

Conclusions

Bricolage is a fairly simple term to understand – it refers to playing in a creative way with things that are ready to hand. It has power to describe how children play creatively with everyday objects such as sheets or stones, making fantasy worlds and telling stories. It can also be used at a different scale to support a more abstract process of innovation through playing with a combination of ideas and tools until new concepts start to form. Rather than seeing these as separate forms of creative play by children and by adults, we might look for ways to teach children how to improvise like adults as well as exploring how the bricolage of young children can contribute towards a theory and practice of adult innovation.

Resources

Introduction of the term bricolage in relation to creative play:
Lévi-Strauss, Claude (1962). *La pensée sauvage*. Paris. Translated into English as *The Savage Mind* (Chicago, 1966).

HyperCard was based on the concept of a virtual stack of cards, each holding a piece of information, connected by links that users could follow to browse the information. This 'hypermedia' system was an inspiration for Tim Berners Lee in developing the mechanisms of the world wide web:

Berners-Lee, T., Fischetti, M. and Dertouzos, M. L. (2000). *Weaving the Web: The Original Design and Ultimate Destiny of the World Wide Web by Its Inventor*. Harper Information.

http://en.wikipedia.org/wiki/HyperCard

Educational theory and practice of learning through creative play:

Papert, S. (1980). *Mindstorms: Children, Computers, and Powerful Ideas*. Basic Books.

Yoza cellphone stories:

http://www.yoza.mobi/

Role of bricolage in the innovation process for technology-enhanced learning:

Scanlon, E., Sharples, M., Fenton-O'Creevy, M., Fleck, J., et al. (2014). *Beyond Prototypes: Enabling Innovation in Technology-Enhanced Learning*. London: Technology Enhanced Learning Research Programme.

http://beyondprototypes.com/

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Exploring new forms of teaching, learning and assessment, to guide educators and policy makers

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