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The Open University
50 YEARS

Innovating Pedagogy 2019

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

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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 seventh report proposes ten innovations that are already in currency but have not yet had a profound influence on education. To produce the report, a group of academics at the Institute of Educational Technology in The Open University collaborated with researchers from Norway's Centre for the Science of Learning & Technology (SLATE). We 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. Lastly, we drew on published and unpublished writings to compile the ten sketches of new pedagogies that might transform education. These are summarised below in approximate order of immediacy and timescale to widespread implementation.

1 **Playful learning:** There are many advantages to play in learning, both for children and adults. It is not simply an activity to help young children develop. It evokes creativity, imagination, and happiness. It also has life-long benefits. Playful learning has a focus on the process more than the outcome and allows for exploration of different issues from a variety of perspectives. There are many different ways to support playful learning. These include play-based approaches to teaching, designing digital games for learning, and developing playful values through participation in spaces that allow experimentation and positive failure. Play provides an important contrast to an increasing focus on memorisation, testing, and performance in education, all of which reduce opportunities for active exploration.

2 **Learning with robots:** Conversations that facilitate and enable learning are an essential part of education. Skilled teachers engage in frequent conversations with their learners. These interactions take time but intelligent software assistants and robots can help. These machines set new expectations for what can be achieved. For example, they can help a learner understand something by providing a partner for conversation who is always available. They can assist teachers by responding quickly to frequent queries or by helping them with assessment. This can free teachers to redirect their energy towards essentially human tasks, such as exercising judgement and providing emotional support. Robots are also becoming capable of learning through interaction and conversation with a human tutor. Once they understand humans sufficiently well, this approach could be used for skill-based assessments.

3 **Decolonising learning:** A curriculum provides a way of identifying the knowledge we value. It structures the ways in which we are taught to think and talk about the world. As education has become increasingly global, communities have challenged the widespread assumption that the most valuable knowledge and the most valuable ways of teaching and learning come from a single European tradition. Decolonising learning prompts us to consider everything we study from new perspectives. It draws attention to how often the only world view presented to learners is male, white, and European.

This isn't simply about removing some content from the curriculum and replacing it with new content – it's about considering multiple perspectives and making space to think carefully about what we value. Decolonising learning helps us to recognise, understand, and challenge the ways in which our world is shaped by colonialism. It also prompts us to examine our professional practices. It is an approach that includes indigenous knowledge and ways of learning, enabling students to explore themselves and their values and to define success on their own terms.

4 **Drone-based learning:** Drones are small devices that can be controlled remotely and made to carry out various tasks, either while in the air or once they have landed. Typically, they are used to take photographs or make videos. Learners can use them to look inside inaccessible places or to see a landscape from different angles. Using drones, students can collect data in places that would otherwise be difficult or dangerous to access. The use of drones helps learners to develop new skills, including planning routes and interpreting visual clues in the landscape. This enriches exploration of many physical spaces. Drone-based learning also stimulates valuable discussion around how emerging technologies can be used responsibly in learning spaces beyond the classroom.

5 **Learning through wonder:** A wondrous event, such as seeing a brilliant rainbow or a majestic mountain waterfall, creates an experience that provokes interest and curiosity. By questioning and investigating encounters in the everyday world, a child's desire to understand leads to learning. A nature walk can reveal patterns, such as spirals, fractals, waves, bubbles, and cracks that are at once beautiful and open to mathematical modelling. Visual illusions and magic tricks with familiar objects can provoke questions of causality, action at a distance, and free will. Such wondrous encounters motivate learners to see a phenomenon from many different perspectives. Teachers can include wonder in learning activities through magic shows, object lessons, nature tables, cabinets of curiosities, and outdoor quests, as well as through literature that evokes a sense of wonder

6 **Action learning:** Action learning is a team-based approach to professional development that addresses real and immediate problems. The approach was developed for workplace learning and is now being used more widely. Its aims are to improve existing skills and to solve problems that are significant to those taking part. Learners work in small groups with a trained facilitator. The groups contain a diverse set of people with different interests and experiences. Each learner introduces a problem or issue of concern. By meeting regularly and sharing different perspectives, group members find and apply solutions. In order to do this, they ask questions, share experiences, and reflect on their actions.

7 **Virtual studios:** Virtual studios are a topic of great current interest. While they have existed as a concept for some time, understanding of how learning takes place in traditional and virtual studios has matured, and there is a growing confidence associated with the use and understanding of alternative studios. Virtual studios are not simply an online version of physical studios. They have their own educational value and offer new possibilities. The studio is changing, allowing different forms to emerge in education. For example, a globally distributed design, specification, and fabrication studio is no longer an impossibility – it is a probable future for design practice as well as education. Commercial examples have already been established. It is now important that educators reflect on how to make best use of this emerging technology.

8 **Place-based learning:** Where learners are at a given time influences what they experience, their feelings, and their ways of thinking. These opportunities are limited if study always takes place in similar settings such as classrooms, lecture halls, or libraries. Place-based learning considers location to be a trigger for learning and an active part of how people learn. It is an approach that involves looking for learning opportunities within a local community and using the natural environment to inspire learners. It can support learning about a wide range of subjects, including Culture and History, Geography and Science. Mobile technologies are opening up new opportunities for place-based learning. They offer a sophisticated set of tools that can be used to support study outside the classroom. They also provide opportunities for adding virtual information to physical settings.

9 **Making thinking visible:** Learning becomes more effective when students can visualise their thinking. This can include setting goals, writing down the steps when solving a problem, and making annotations. Teachers can benefit from seeing students' goals, concepts, and progress. Making thinking visible fits with a view of learning as a constructive activity. Students create knowledge by interacting with tools and resources. As they do so, they leave traces of their thinking in the form of written marks and interactions with digital media such as videos. Technology-enhanced assessment prompts students to show their working as they solve problems and receive automated feedback. Some systems also allow students to pose questions and discuss their progress with teachers and peers during a learning activity. These visible records of students' personal and social learning can become resources for reflection. Teachers can see how each student is progressing towards mastery of a topic and can identify where students are blocked or have misunderstood a topic.

10 **Roots of empathy:** Roots of Empathy is a classroom programme that is designed to teach children empathy. It prepares children aged 5 to 13 to interact with others healthily and constructively. It also prepares them to cope with different relationships in their lives. This programme is based on the principle that when children understand how they feel and how other people feel, they find it easier to cope in social situations. In order to help them to do this, Roots of Empathy develops their emotional understanding. Evaluations of the approach show that it decreases children´s aggressive behaviour, improves social behaviour, and, due to its emphasis on the actions and feelings of babies, increases the knowledge children have about infant development.

Introduction

This is the seventh 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.

This report is the result of collaboration between researchers from the Institute of Educational Technology at The Open University, UK, and Norway's Centre for the Science of Learning & Technology (SLATE). We have shared ideas, proposed innovations, read research papers and blogs, and commented on each other's draft contributions. We worked together to compile this report by listing new educational terms, theories, and practices, then reducing these to ones that have the potential to provoke major shifts in educational practice. This 2019 report introduces ten pedagogies that either already influence educational practice or offer opportunities for the future. By 'innovative pedagogies', we mean novel or changing theories and practices of teaching, learning, and assessment for the modern, technology-enabled world.

In keeping with the themes of innovation and looking forward, *Innovating Pedagogy* reports are now published at the start of each year. This seventh report, *Innovating Pedagogy 2019*, was published in January 2019, at the start of The Open University's 50th year. It follows the sixth report, *Innovating Pedagogy 2017*, which was published in December 2017.

Educational futures

During the past year, new approaches to education have often grabbed the headlines. A university in London trialled the use of hologram lecturers who could appear to talk to students in many rooms at the same time. A school in China announced that it was using facial recognition software to monitor student attention in class. Facebook designed an online learning programme, which prompted students in New York to walk out of a classroom where it was being used. Amazon founder, Jeff Bezos, announced his intention to create a string of schools where the child would be the customer. In an interview in *Wired* magazine, artificial intelligence (AI) expert Sebastian Thrun said:

"With AI, we could turn people into instant experts... You don't have to spend 10,000 hours learning something. Just imagine you could become a world-class doctor in one day."

Although all these approaches seem new, they are rooted in limited understandings of education. Although they are presented as exciting, they have a depressing ring to them. Each one presents learning as something to be consumed, as a set of facts and skills that must be transferred from experts to learners. Learning is not presented as an enjoyable or stimulating activity. The role of the teacher is overlooked, or presented as something that will in future be simulated by a machine. The role of the learner is reduced to that of a customer or a consumer.

Online learning specialist Stephen Downes takes a different view. In his roadmap for teaching and learning in the digital age, he argues that, in the education system of the future,

"the core of learning is found not in what is defined in the curriculum, but in how teachers help students discover new possibilities from familiar things, and then from new things."

This is the view that we have taken while compiling this report. Technology can help us to do new things, rooted in our understanding of how teaching and learning take place. Learning can be playful, wonderful, a way of understanding and making sense of the world. Pedagogies change and develop in

response to changes in society. They open up new possibilities rather than reproducing what happened in the past. Seen in this light, Decolonising Learning opens up the most exciting, and the most unsettling, possibilities. This is a pedagogy that could produce radical changes in education, leading to learning that not only supports and develops communities but is also strongly rooted within them.

Some of the pedagogies in this report have a long history. Playful Learning, Learning through Wonder, and Place-based Learning are not new. However, they are pedagogies that have proved to be powerful and engaging over long periods of time, and they are now being developed further. Each one of them provides a means of helping students discover new possibilities from familiar things. Each of them can build on the possibilities offered by new technologies, particularly the possibilities for exploring, for communicating and for collaborating.

Other pedagogies in this report, particularly Learning with Robots and Drone-based Learning, are strongly linked to new technologies. However, the technologies alone are not sufficient to spark real changes to learning and teaching. More important are the opportunities that these technologies open up, the new perspectives provided and recorded by drones, and the suggestion that robots can free teachers to spend more of their time on teaching and less of their time on repetitive administrative tasks.

A final set of pedagogies provides ways of addressing challenges. In the case of Action Learning, this is overt. Learners bring the problems they are facing and work together to solve them. Roots of Empathy offers a structured way of tackling bullying and cruelty within society, and takes the radical approach of using a baby as a teacher. Virtual Studios not only solve some of the problems associated with more traditional design studios, they also provide new opportunities for developing skills, sharing creativity, and collaborating across continents. Finally, Making Thinking Visible moves the focus back to education and proposes a way of making teaching more relevant and appropriate for individual learners.

By looking into the future and trying to predict what will happen, we also shape that future. We hope these ten pedagogies will play a part in shaping the future of teaching and learning, and in opening up possibilities for learners and teachers around the world.

Resources

Brooklyn students hold walkout in protest of Facebook-designed online program, *New York Post*, 10 November 2018:
https://nyp.st/2BQoOVj

Chinese school uses facial recognition to monitor student attention in class, *The Telegraph, 17 May 2018:*
http://bit.ly/2AOhg3H

'Hologram' lecturers to teach students at Imperial College London, BBC News, 1 November 2018*:*
https://www.bbc.co.uk/news/technology-46060381

Quantum leaps you can expect in teaching and learning in the digital age – a roadmap, Stephen Downes, Contact North, 5 February 2018:
http://bit.ly/2RyNozD

Sebastian Thrun on AI, Flying Cars, and Sam Altman, *Wired, October 2018:*
http://bit.ly/2Uf5KqP

Playful learning

Motivating and engaging learners

Potential impact: High
Timescale: Medium

Playful learning has traditionally been considered a means to help children in their development. However, play has no age limitations – it is a beneficial activity for both children and adults. An example of how play has been used with adults is the use of LEGO® at a university to build models of nutrition and help students to model what they are thinking. Learning and play can go hand in hand as a means to motivate and engage learners. A few schools across the world have adopted this idea and created spaces where learners engage in their own quests, trying to solve problems that they find interesting. Learners are shown how to develop critical thinking, problem solving, analytical, and communication skills. The challenge ahead is to find out which play-based teaching and learning approaches work best, and for whom, and align these with existing teaching practices both inside and outside schools.

Playfulness in learning can take many forms, including:

- pretend play,
- mobile play,
- digital games,
- developing playful values.

> “ ideal spaces for learning – joyful and engaging”

Pretend play

Pretending that a pen is a magic stick, acting the role of a super hero, or role-playing different situations have many potential learning outcomes. They help learners become aware of different perspectives, support them in their development of language and social skills, and encourage them to learn about others and their physical environment. They also provide opportunities for both children and adults to express and explore emotions, including fears and desires.

Play occurs naturally and is initiated by children throughout their development. It can also be more structured and guided by adults. Guided play is an approach to teaching and learning during which free play is combined with guidance and support from a teacher. This can help children achieve specific learning objectives. The focus of this approach is the learner rather than the teacher. It can take two forms:

- teachers design a learning environment in such a way that children have the freedom to explore and discover new things,
- teachers watch the activities children are naturally doing, make comments and encourage questions, supporting active exploration.

Mobile play

Playful learning experiences can also be supported by mobile devices. More and more mobile applications target young children and their learning. Most of these present learning content together with game elements. For example, they offer badges or points for finding the correct answer, or they combine racing with a learning activity.

When children use specific applications, Literacy, Maths and Science skills can improve, and they can become better at solving problems. Yet most of these applications are not well-designed or appropriate for the age of

the children. Applications that support learning are typically interactive and flexible. More benefits, such as language development, are gained when children use applications along with teachers, parents, or other adults. Well-designed mobile applications provide opportunities for exploration and discovery, support learners when they face difficulties, make learning visible, and guide adults as to how they should use an application with children.

Digital games

Digital games are ideal spaces for learning – joyful and engaging. They present incentives that are built into the structure of the game and that motivate learners. They provide opportunities for social play and teamwork, adaptable design features such as customising the level of difficulty, feedback that responds to game actions, leader boards, and trophies. They also let learners try out new things, take risks, and learn to fail in a safe learning environment.

Digital games have been used to teach all age groups, from young children to mature adults. Research shows that games can motivate learners and help develop skills such as collaboration, problem solving, and creativity. There are also benefits when learners are asked to make their own games, and when they learn to code and use technology in order to do this. Games help learners to develop their identity, as well as supporting communication and collaboration with others.

The use of games in teaching remains limited. This may be due to a lack of understanding of how gamers learn from playing games. Other reasons include the high cost of some games and equipment, as well as the difficulty of finding the space to incorporate games in the curriculum. 'Game analytics' could provide a way forward. These datasets are automatically created when learners play a game. They can provide information about how learners play the game and how they interact with game features. This reveals which parts of a game individuals find difficult to complete, which parts are most popular, and which are never used.

Such insights can be used by teachers to understand what learners are doing in the game, help learners who struggle, or provide additional activities for those who are progressing fast. These datasets can also be analysed to relate learners' performance to specific in-game actions. For example, analysis may show that learners don't understand a game goal. This information can be used to improve the design of the game and to change the ways in which the game is used and supported by teachers.

Developing playful values

Playful learning is not only about toys and games, or using gaming elements to enhance learning. It is also about changes in how learners think about learning and the development of playful values. These include being open to new experiences, being curious, taking risks, and learning from failure. To do this, it is important to create opportunities for learners to take part in play spaces, either physical or imaginary, where actions do not have the same impact that they do in the everyday world. These spaces may have their own rules. They are safe, can be explored, and support productive failure. To design such spaces for adult learners, what is needed is an environment that:

- is easily accessible, supports progression, and is flexible,
- supports active physical engagement and collaboration with others,
- is democratic, open, accepts failure, and is intrinsically motivating.

An example of the use of playful learning with adults is the Playful Learning conference. This annual event includes treasure hunts, secret storytelling, escape rooms, sandpits, and video games. Delegates are encouraged to make use of these activities, step out of their comfort zone, and take risks. Learning from failure is seen as a way of helping the conference improve in the future.

Innovative approaches can pave the way to wider change. One example is a 'low-tech, high play' school in San Francisco with no exams or formal curriculum. Teachers are regarded

as collaborators and learning is structured around projects devised by students. The school is located in a warehouse, and a lot of learning takes place outdoors or during field trips. There are also out-of-school examples that make use of playful learning. For example, 'Playful Boston' in the city of Boston aims to make transit stops more playful through a public competition and playful interactions at the stops. This project promotes interactions in order to increase trust and empathy. It also helps people think outside the box and develop creative solutions to problems.

Challenges

There are concerns that an emphasis on memorising and testing in education leaves no space for active exploration or playful learning. At the same time, playful learning doesn't fit well in many current education systems. Teachers and policy makers may feel it's difficult or too challenging to incorporate play into teaching. It can also be more difficult to evidence the benefits of play than those of structured learning. If education is to make the most of what playful learning has to offer, it will be necessary to modify how teaching is delivered and how learners are expected to learn.

Conclusions

Play should remain a central component of teaching and learning throughout life. More needs to be done to make playful approaches to learning common in all forms of education. The first Professor of Play has been recently appointed by the LEGO Foundation to investigate which types of play-based teaching work best and for whom. More experimentation with play in schools and in adult education is needed to test approaches with learners of different ages as well as find out how various forms of play can blend with existing teaching practices both inside and outside schools. The role of teachers is also crucial. They need to be aware of the various forms of play and the benefits of these forms for learning. With this information, they can actively seek to add these approaches to their teaching. More evidence is still needed as to how best to guide or support learners when engaged in playful activities. The challenge lies in finding the right balance between learners' agency, freedom to play and explore, and the guidance teachers need to offer for better learning outcomes.

A seismic shake table created using LEGO is used to simulate earthquakes and explore civil engineering and materials through play.

Resources

Lego professor: Cambridge University hires 'professor of play':
https://www.bbc.co.uk/news/uk-england-cambridgeshire-40031687

LEGO shake table, supporting understanding of material properties:
http://www.legoengineering.com/shake-table/

Playful Learning conference:
http://conference.playthinklearn.net/blog/

The Need for Pretend Play in Child Development. Blog post by Scot Barry Kaufman, Jerome L. Singer and Dorothy G. Singer, 11 November 2013:
http://bit.ly/2DYDYti

Experts warn play time is 'disappearing' as emphasis is placed on performance and tests. Rhianna Mitchell, *The West Australian*, 27 June 2018:
http://bit.ly/2FTIVGh

Herodotou, C. (2017). Young children and tablets: a systematic review of effects on learning and development. *Journal of Computer Assisted Learnin*g, 34(1) 1–9.
http://bit.ly/2AKQGso

Qian, M., & Clark, K. R. (2016). Game-based learning and 21st century skills: a review of recent research. *Computers in Human Behavior*, 63, 50–58. Highlights and abstract openly available at:
https://doi.org/10.1016/j.chb.2016.05.023

Skolnick Weisberg, D., Hirsh-Pasek, K., Michnick Golinkoff, R., Kittredge, A.K. and Klahr, D. (2016). *Guided Play: Principles and Practices*:
http://bit.ly/2QtM9V7

Whitton, N. (2018). Playful learning: tools, techniques, and tactics. *Research in Learning Technology*, 26, May:
https://journal.alt.ac.uk/index.php/rlt/article/view/2035

Learning with robots

Helping teachers free their time for teaching

Potential impact: High
Timescale: Medium

Introduction

Working with robots is no longer the stuff of science fiction. The first industrial robot was designed by George Devol in 1954. More recent progress in artificial intelligence techniques has produced robots that can respond to changes in their environment instead of just repeating the same task over and over again on the factory floor.

Using robots for educational purposes is not new. The widely recognised Logo Turtles were described by Seymour Papert in 1980. The thinking behind the development of these was based on constructionism. This theory of learning states that people construct their own understanding of the world. They do this through making objects that are tangible and shareable. They become active creators of knowledge who explore, question, and assess what they have learnt. Schoolchildren use Logo Turtles to solve problems. Doing this helps them to understand basic mathematical concepts.

Creating robots that perform well at specific tasks can be an exciting and collaborative learning activity. The RoboCup and RoboCup Junior competitions are now well established. Participants work in teams to produce robots that specialise in playing football or exploring a maze. RoboCup competitions also include events in which robots take part in an artistic or theatrical performance. These events recognise the growing potential for communication and expression that is possible with these technologies.

New practices

Robots have a long history in education, but the breadth of potential uses is now increasing rapidly. Artificial intelligence (AI) has been integrated into a variety of robots, creating an exciting space for learning together. For example, CHiP the Robot Dog has been developed to be a pet. These robot dogs can share their thoughts, such as 'I would like to go for a walk', via an app. They develop their behaviour over time, respond based on how their owners interact with them, and can be trained.

Advances in design and hardware support natural forms of interaction or dialogue with robots, using speech, gestures, and emotional expressions. The SoftBank NAO robots can speak and understand 20 languages, using cameras to recognise people and objects. SoftBank states that learners perceive the robots as friendly and non-judgmental, which gives them confidence when answering questions. Robots designed as social communicators provide opportunities for language learning. The robot can act as a tutor, available at any time the learner wants to chat.

> "we have robots that can respond to changes in their environment"

Robots are still a starting point for learning programming skills, but this can now be achieved in increasingly natural ways. For example, children can develop the understanding of a Photon robot by increasing its skills so it can complete challenges. The intention is that children learn by teaching the robot.

These latest developments extend possibilities for humans and machines to collaborate. In the field of medicine, robots can take on routine tasks, freeing humans to spend time with patients. The same is true in education. Robots can take on routine tasks, freeing teachers to spend more time with learners. It's now beginning to be possible, in some cases, for robots to take on the time-consuming job of skills assessment. Rather than simply demonstrating a task, learners can demonstrate their understanding by teaching the necessary skills to a robot.

This is possible due to new breakthroughs in Programming by Discussion. Robots can now learn not only from trial and error, but also from conversation with a human teacher. This mimics the way human teachers behave with pupils where pupils understand how to go about solving a problem after being given verbal feedback on each of their attempts. This way of working has been well documented by Jerome Bruner and has been termed 'scaffolding'.

Challenges

Advanced robotics equipment can be very expensive and can also require support to set up and maintain. This may mean that it isn't possible to use particular technologies in many educational contexts. There are, however, many lower cost robots entering the mainstream market, and also many kit-based approaches aimed at supporting creativity by providing the building blocks for a range of robotics projects.

Many people have an inherent distrust of advanced technologies, and the combination of robotics and AI certainly can provoke strong reactions. The 'uncanny valley', in which certain levels of human-like appearance in a robot can trigger negative responses in people, has long been recognised and debated. This could limit the use of robots in education, but it is a problem that needs to be overcome in order to benefit from robots' potential for promoting understanding. Learning with robots offers us opportunities to develop our judgement and ability to interact. It also offers a means to consider big questions related to the responsible use of artificial intelligence.

Working and learning together at the RoboCup

Resources

InsideCoach football collects and reports data on force, trajectory, spin, number of passes, and number of touches:
https://www.indiegogo.com/projects/world-s-smartest-football-soccer-ball#/

Learning about Life with Robots. In Japan, children work with robots to improve creative thinking. Video resource:
video **http://bit.ly/2BqPFFU**

Photon robot official website:
https://photonrobot.com/

RoboCup Junior:
http://junior.robocup.org

Robot dog CHIP:
http://robotdogchip.com/how-does-chip-the-robot-dog-work/

Short biography of Seymour Papert, with links to some of his writing:
http://www.papert.org/

SoftBank Robotics, producers of the NAO robot:
https://www.softbankrobotics.com/

Catlin, D. and Blamires, M. (2012). *The Principles of Educational Robotic Applications (ERA): a framework for understanding and developing educational robots and their activities*.
http://legacy.naace.co.uk/1948

Hutson, M. (2015). Why we need to learn to trust robots. *Boston Globe*, 25 January 2015.
http://bit.ly/2KSbeDN

Lay, S. (2015) Uncanny valley: why we find human-like robots and dolls so creepy, *The Conversation*, 10 November 2015.
http://bit.ly/2SnF8Cg

Mubin, O., Stevens, C.J., Shahid, S., Al Mahmud, A. and Dong, J-J. (2013). A review of the applicability of robots in education, *Technology for Education and Learning*, 1(1), 1-7.
http://bit.ly/2KRhlIm

Papert, S. (1980). *Mindstorms: Children, Computers, and Powerful Ideas*, Basic Books. Short introduction openly available at:
http://bit.ly/2SpMGV4

Decolonising learning

Changing perspectives and opening up opportunities

Potential impact: Medium
Timescale: Medium

When thinking about colonialism, it's useful to start by thinking about some of the things that can happen when one group of people tells another group what to do. Imagine a situation in which people from a different neighbourhood came to your house and told you how to live your life. They might not think about, or know about, the issues faced by people in your area. Their instructions on how to live might be counterproductive when addressing those issues. Settler colonialism is a large-scale version of this situation. It's the process of ruling people within the borders of their land.

> "tools for colonised peoples to shape their future"

Opposing settler colonialism by decolonisation is an unsettling activity because decolonisation is a process, not a metaphor. If people come to your neighbourhood to tell you what to do, one solution is to stop them exerting control over you, claiming the power to make your own decisions. This is unsettling because so many aspects of the situation change for everyone involved. The same applies at a larger scale. Decolonisation requires systematic unsettling change. This may include measures such as dismantling colonial structures while empowering indigenous cultures with nation-building activities. Part of this process involves acknowledging the ways in which digital presence can contribute to colonisation.

Digital colonialism

Imagine a situation in which people from a different neighbourhood make a website to provide your community with a place to communicate with local politicians about current issues.

Their neighbourhood is interested in building a new school.

As the authors of the website, they add a poll asking which part of their neighbourhood would be the best location for the new school.

If they don't include an option to say you want the school built in your neighbourhood, your choices are limited by their priorities.

By participating in the poll, you help to direct resources to their community.

There is more than one way in which one group of people can exert influence on another group. Digital colonialism occurs when indigenous populations use resources developed by the colonial population. This can happen with online learning, and is a danger when millions of learners from countries around the world join massive open online courses (MOOCs) run on platforms developed in just a small number of countries.

In contrast, digital decolonisation considers how to support colonised people with technology in order to:

- connect them with a shared history,
- support a critical perspective on their present,
- provide tools for them to shape their futures.

To enable the use of this critical perspective and these tools, it's important that digital decolonisation transfers decisions about how to use technology to the people.

If the power to make decisions isn't transferred, colonialism can continue, no matter how well intentioned the decision makers might be. The website creators from a different neighbourhood (see box) might try to gain your support for a new school by considering your views and developing proposals that take your community's educational values into account. However, if they don't understand that you'd prefer to have the new school in your neighbourhood, their work will remain focused on a new resource that benefits them. The ability of one group to understand and anticipate the needs of the other group relates to what some refer to as critical pedagogies.

Critical pedagogies provide frameworks for the academic success of indigenous students. For example, culturally relevant pedagogy seeks to provide a way for students to maintain their cultural integrity (their needs) while succeeding academically (educational needs). Similarly, culturally sustaining pedagogies seek to support students in sustaining the cultural competence of their communities (their needs) while also offering access to the colonial cultural competence (educational needs).

To understand the distinction between using critical pedagogies with mainstream materials as compared with building educational material from the starting point of indigenous cultures, the next section compares different approaches to game-based learning as well as a flexible online course.

Examples of digital de/colonisation

The commercial video game *Civilization* can be used in educational contexts to normalise or to challenge colonialism. The game's theme is colonialism – it encourages players to 'expand your empire across the map, advance your culture'. Players engage in settler colonialism as they conquer and rule neighbouring civilisations. If the game is presented as a representation of history, it normalises colonial behaviour in America, because Native American cultures appear homogenous and their rich diversity is obscured. On the other hand, the game also provides opportunities for critical pedagogy that encourages students to critique colonisation and how Native Americans are represented.

Critical pedagogy can be used to reframe games. One way of doing this is to begin with the perspective of indigenous people rather than the colonisers' perspective. Elizabeth Lapensée earned a doctorate and went on to build capacity within indigenous communities to author games and comics that represent their cultural heritage. This resulted in the creation of a variety of games, including *Thunderbird Strike*. In *Thunderbird Strike*, a bird from indigenous cultures fights oil pipelines. The game is an example of digital decolonisation that connects the cultural heritage of indigenous people with important current issues relating to the oil industry ignoring their land rights. The game encourages players to oppose the oil industry. If people make that move, from game play to political action, the game will become an example of digital decolonisation transitioning into settler decolonisation.

A different approach is to adopt a pedagogy that can support a variety of approaches to digital decolonisation. In higher education in the US and the UK, the course *Digital Storytelling* helps students use authoring tools to tell digital stories. The course is led by students. They can take a narrative such as settler colonialism and tell that story through a critical lens, they can tell the story of indigenous people taking action on current issues, or they can explore critiques of colonial nations.

Conclusions

Colonisation is not a metaphor but a process that shapes reality for generations. Digital colonisation is an aspect of this, and digital decolonisation can be used within education to support settler decolonisation. These processes take place at all levels of education.

Higher education helps students to prepare for jobs, as well as offering its own career ladder. Recruiting diverse students and providing them with equal access to jobs is, at best, a partial solution and may perpetuate

Image from the game *Thunderbird Strike*

colonisation. What is needed is to give equal access to success, bearing in mind that success for a student may be at odds with success within colonial society. Success for indigenous students will be associated with work on cultural preservation, revitalisation, and nation building. Higher education has the opportunity to align content and help build local communities. This is work that requires support for change both within universities and within the wider communities they support.

Historically, schools have played an active role in colonisation. As a result, they frequently fall short of serving the educational needs of indigenous populations. We are in a period of transition away from the use of schools to suppress indigenous culture and towards approaches to education that can serve the needs of all students. As education tackles global issues and engages people worldwide with new initiatives such as MOOCs, the ideas of open learning provide sparks of opportunity for new approaches that serve the needs of local communities.

The transition of education from local to global can and should change the nature of learning. Rather than using educational technology to amplify oppressive efforts, it can act as a catalyst that precipitates a change in the aims of education. By reimagining education as an activity that serves the needs of local communities, including indigenous populations, the impact of learning can be expanded, making it more inclusive and more valuable to us all.

Resources

Digital Storytelling:
http://ds106.us/about/

Elizabeth LaPensée:
http://www.elizabethlapensee.com/

Sen David Osmek: MN taxpayers should not be funding Angry Birds for eco-terrorists. (2017).
http://bit.ly/2retD4O

Barlow, A. (2014). Another colonialist tool? In S. D. Krause & C. Lowe (Eds.), *Invasion of the MOOCs: The Promise and Perils of Massive Open Online Courses* (pp. 73-85). Anderson, South Carolina: Parlor Press.
http://www.parlorpress.com/pdf/invasion_of_the_moocs.pdf

de Waard, I., Gallagher, M. S., Zekezny-Green, R., Czerniewicz, L., Downes, S., Kukulska-Hulme, A., and Willems, J. (2014). Challenges for conceptualising EU MOOC for vulnerable learner groups. *European MOOC Stakeholder Summit 2014*, 33–42.
http://bit.ly/2Rz9t0Z

Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal*, 32(3), 465–491.
http://bit.ly/2RBpNyl

Levine, A. (2013). ds106: Not a course, not like any MOOC. *Educause Review*, (January), 54–55.
http://www.educause.edu/ero/article/ds106-not-course-not-any-mooc

Loban, R. (2016). Indigenous Depictions in Strategy Games: An Argument for Flavour.
http://bit.ly/2EaSDIN

Paris, D. (2012). Culturally sustaining pedagogy: a needed change in stance, terminology, and practice. *Educational Researcher*, 41(3), 93–97.
http://bit.ly/2DVJAEB

Squire, K. (2008). Video game-based learning: an emerging paradigm for instruction, *Performance Improvement Quarterly*, 21(2), 7–36.
http://bit.ly/2Q9KjJn

Tuck, E., and Yang, K. W. (2012). Decolonization is not a metaphor. *Decolonization: Indigeneity, Education, and Society*, 1(1), 1–40.
http://bit.ly/2PIlh3W

Wolfe, P. (2006). Settler colonialism and the elimination of the native. *Journal of Genocide Research*, 8(4), 387–409.
http://bit.ly/2EbXyTt

Drone-based learning

Enabling and enriching exploration of physical spaces

Potential impact: Medium
Timescale: Medium

Drones are small vehicles that are controlled remotely: usually aircraft, but also waterborne craft. They often have on-board sensors that can gather data, with many carrying cameras. Small, affordable drones have become widely available and can be used in many countries without a licence, enabling recreational and educational activities. They are being used in education as a way to enable or enrich exploration of various physical spaces. They support fieldwork and enquiries, by enhancing the capability of students to explore physical environments, enabling data collection from novel perspectives. As well as providing data for research, the use of drones supports learning and reflection related to research methods and data analysis. The operation of the drone itself can be used to explore various subjects, including mastery of flight systems. Drone-based learning extends what can be achieved in fieldwork but can lead to additional costs.

Collecting visual data

Small drones can be launched from the palm of a hand or from the ground. When in the air, they can be controlled using pointing gestures or a remote control. Many drones carry cameras that enable distant viewing as well as video and image capture. A drone with a camera can be made to fly and hover above areas of terrain and above objects, including buildings and trees. It can be controlled manually or it can carry out a pre-programmed mission.

Drones are becoming such a pervasive technology that many students will benefit from early introduction to them before going on to interact with them regularly either at work or in everyday life. Drones have proved to be very useful to workers in a variety of areas, including land surveyors, farmers, construction companies, news reporters, film makers, police officers, and emergency responders. In all these areas, drones equipped with cameras are used for everyday tasks and research.

Students training in these subject areas need to understand how drones are used in work settings. In the construction industry, for example, photographs can be taken by a drone in order to inspect the ongoing construction of a building. Coaches of sports teams have used the overhead views provided by drones as part of training. In Ecology, drones can monitor areas of land and water in order to detect changes in animals or plants. Cultural heritage sites, including nature reserves and areas containing ruins, are now using drone-based exploration and informal learning to attract new audiences and to make the visitor experience more attractive. Aerial photography using drones has revealed the imprints of ruins of archaeological interest that are not visible from the ground or that are uncovered at particular times due to extreme weather conditions.

Communities have also used drones to capture images of their local area from different angles, enabling them to collect evidence of environmental changes such as deforestation, or to monitor illegal trade without confronting criminals in the process. In the aftermath of natural disasters such as hurricanes and earthquakes, drones have been used to assess damage, locate victims, and deliver aid.

> “Drone-based learning extends what can be achieved in fieldwork”

Benefits of this approach

Drones can be used to support educational fieldwork and enquiries by enhancing the capability of students to explore physical environments, enabling data collection from novel perspectives, and in spaces that would otherwise be difficult or dangerous to access. The use of drones provides learning opportunities and supports reflection in the areas of research methods and data analysis, including route planning and interpretation of visual clues in the landscape.

The variety of types of drone and the precision with which some of them can be controlled, means that they can support activities within a classroom, school gymnasium, or other indoor environment. These activities can add a new dimension of engagement to learning Mathematics, including activities such as predicting flight times, or landing drones in particular places identified through mathematical problem solving. Use of drones helps to make some mathematical concepts more concrete for students.

The operation of the drone itself can also be the subject of learning. This includes mastery of flight systems, and discussion of important issues including ethics, privacy, team roles, legal regulations, and safety procedures. Drones can be used to develop orientation skills, motor skills, and digital literacy skills. They can also be used to develop programming skills when students write flight-control software.

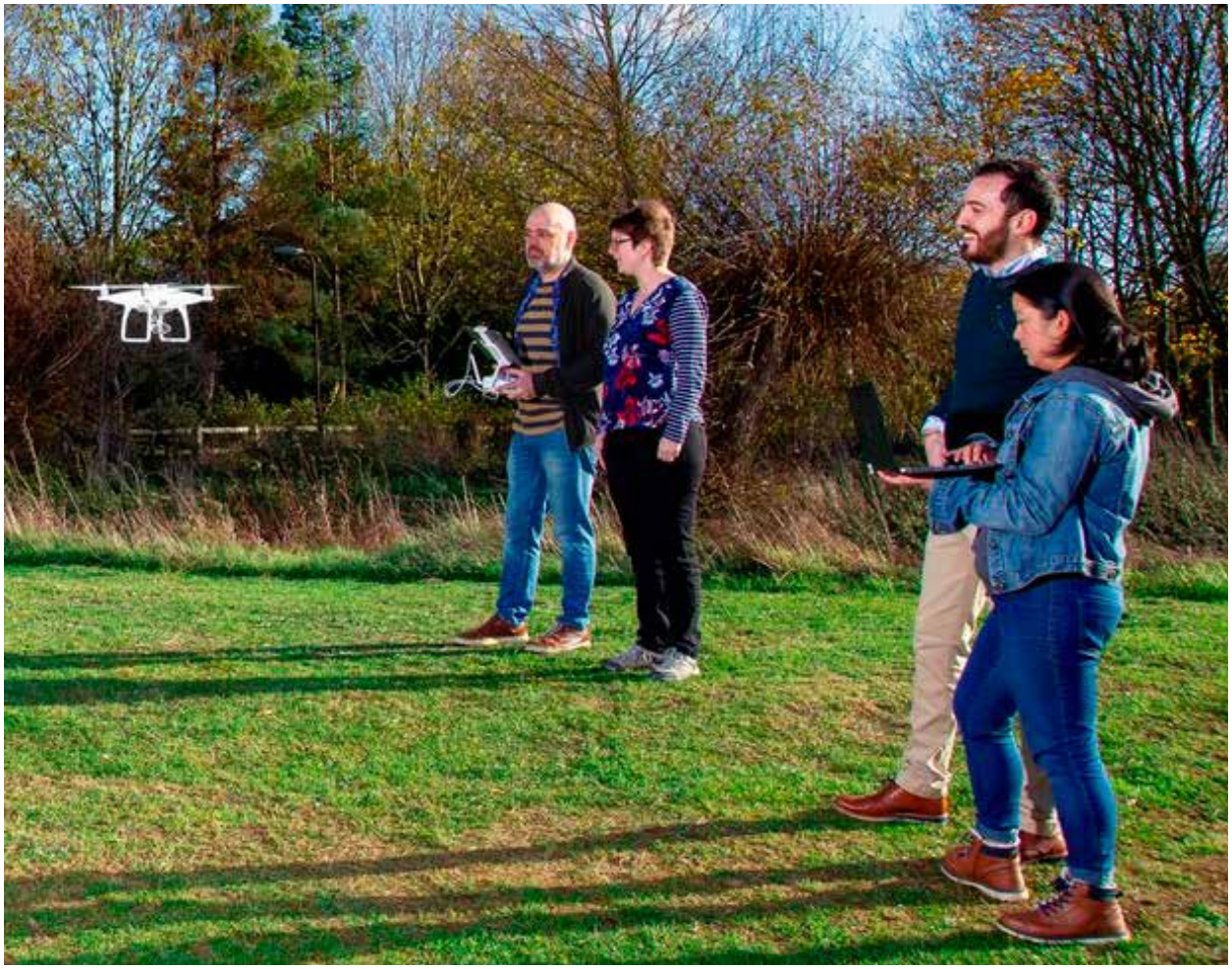
Issues with this approach

Drone-based learning extends what can be achieved in fieldwork but implies an additional cost for equipment, training, deployment, and maintenance. There are practical issues that mean students should receive training before taking charge of a flight. Drones may cause damage or get stuck in trees or other inaccessible places. Their noise and flying activity can be a nuisance. Wildlife may react in unpredictable ways. The licensing and legality of drone flying activities varies around the world, and is still evolving as governments adapt to this new technology. Indoor activities are less prone to these issues and provide an environment suited to the use of smaller, lower cost drones.

The excitement may primarily come from seeing the drone fly or from taking control of that flight. However, the breadth of uses of drones as pedagogical tools means it's likely to be the data gathered by the drone (such as video footage of a location) that matters. For example, a fieldwork task could make use of data collected by an educator in a controlled manner, or could require students to make decisions about data collection in one session and then analyse the collected data in further activities.

Conclusions

Drones enable both recreational and educational activities. They're new tools, which offer a different approach for fieldwork as well as an effective way to engage students in learning. Drones can feed learners' curiosity to see things that are hidden, can help make abstract concepts more concrete, and have a role to play in making outdoor learning more attractive.



Resources

Apply drones in education to real-world problems. MindSpark Learning:
http://bit.ly/2U9lxX8

Dawn of the eco-drones? Blog post by Andrea Berardi, 7 May 2015.
http://bit.ly/2AKAZ4k

Division B Drone Project: lesson plans:
https://www.divisionbdroneproject.com/types-of-plans

How teachers have used drones to teach Mathematics: With drones, students tackle complex topics. Alan Joch, *EdTech Focus on K-12*. 27 March 2018.
http://bit.ly/2UcVtMa

How to fly a drone: a beginner's guide to multirotor systems and flight proficiency. UAV Coach:
https://uavcoach.com/how-to-fly-a-quadcopter-guide/

The PowerDolphin underwater drone is every bit as ridiculous as it sounds. Blog post by Luke Dormehl, 9 January 2018.
http://bit.ly/2FY4kOA

Halkon, P. (2018) Seen from the air, the dry summer reveals an ancient harvest of archaeological finds, *The Conversation*, 17 August 2018.
http://bit.ly/2Ec2Dev

Short article about ecologists using drones to monitor wildlife populations and the state of vegetation: Hodgson, J., Terauds, A. and Pin Koh, L. (2018) 'Epic Duck Challenge' shows drones can outdo people at surveying wildlife, *The Conversation*, 13 February 2018.
http://bit.ly/2zHFwoB

'Problems to solve' section in this article addresses issues of reliability and privacy:
Kelaher, B., Colefax, A., Creese, B., Butcher, P. and Peddemors, V. (2017) How drones can help fight the war on shark attacks, *The Conversation*, 12 February 2017.
http://bit.ly/2rkDhCI

Learning through wonder

Sparking curiosity, investigation, and discovery

Potential impact: Medium
Timescale: Medium

Seeking wonder

Wonder invites learning. The everyday phrase, 'I wonder how that works?', can be the start of a quest to understand. Philosophers such as Aristotle and Plato saw wonder as a spur for learning, when we confront our familiar conceptions and explore strange new ideas. Since antiquity, teachers have created curious mechanical toys, displayed wondrous objects for their pupils, and organised tours to see the wonders of the world. Wonder Rooms and Cabinets of Curiosities were forerunners of museums in Renaissance Europe. In more modern times, teachers take students on nature walks to find wondrous objects such as spider webs, and set up experiments to show the wonders of science. The innovative practice here is a curriculum design that builds upon and extends the heritage of wonder, encompassing virtual trips to wondrous places, digital cabinets of curiosities, and student-led object lessons.

Wonder can be deliberately sought and designed to support learning. The poet Wordsworth saw wonder in everyday sightings, such as a field of daffodils or a sky of clouds, seen through the eyes of an imaginative child. Lingering on the familiar can provoke a 'joy of being' that inspires creativity.

Wonder is multi-faceted. It can be awe-inspiring in a flame or a plasma globe; or associated with curiosity, in the shape of an ostrich feather or the motion of a gyroscope. A classroom nature table can be a focus for exploration and classification; it can form connections between nature, Science, and Mathematics. Wonder is associated with kindness and with positive experiences that lead to observation and an urge to find out more.

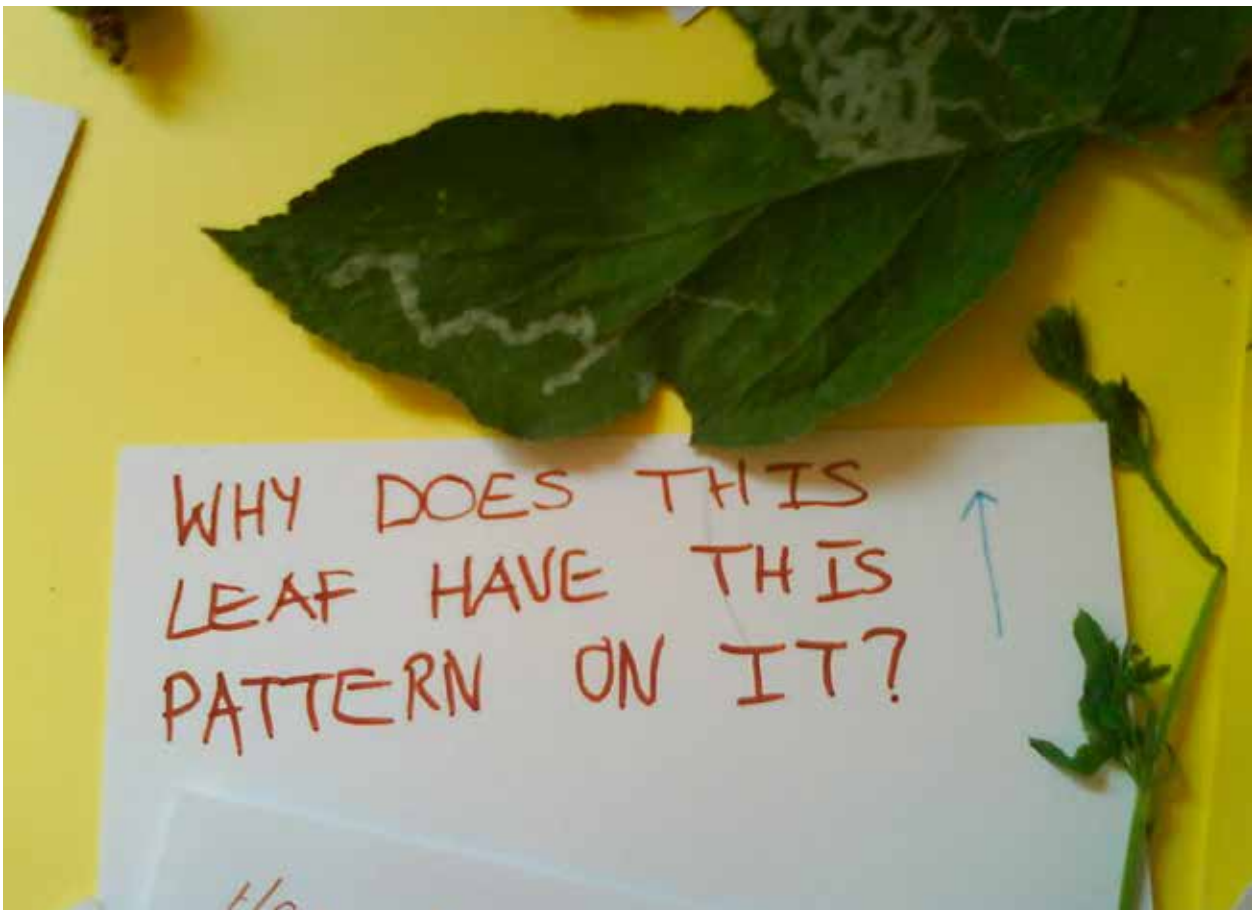
Anticipation, encounter, investigation, discovery, propagation

A pedagogy of wonder has some similarities to guided discovery learning, where a teacher helps students solve a problem or understand a principle through a process of hands-on exploration. But it differs in how the quest begins: by showing an object or event that sparks curiosity, presenting the familiar in a new way, setting up a puzzle, or conjuring with science and nature.

Much of this section is based on a doctoral thesis and subsequent explorations by Matthew McFall on designing wonder in and beyond school settings. He builds on previous work to describe wonder as a series of phases.

- **Anticipation**: a sense that something is going to happen and a desire to know more.
- **Encounter**: the moment of experiencing the wondrous.
- **Investigation**: pursuit of the wondrous, to understand it better or to continue the experience.
- **Discovery**: coming to understand, or realise how much more there is to know.
- **Propagation**: continued working with this wonder, to share and celebrate.

> "wondrous encounters motivate learners to see a phenomenon from many different perspectives"



Nature inspires a classroom curiosity display

Each phase can be designed for learners. A sense of anticipation can be seeded with riddles, questions, mysterious conversations, or posters. There could be an event that takes students out of their classroom into a strange place, either by physically moving to another place, or by evoking the strangeness through storytelling.

The encounter with wonder should be inspiring, not frightening. It can be deliberately constructed, as with a table or case displaying peculiar objects: a fossil, a sea urchin skeleton, a seed pod, a sparkling stone, a kaleidoscope, a tooth, a marble, the workings of a clock, or anything else that that inspires curiosity. It can be a journey to a new place, such as a walk to find spider webs or seeds. It can be a puzzle or magic trick. It can be an 'object lesson': time devoted to considering the phenomena that make up the object, and looking to see, understand, and communicate the remarkable qualities of the exhibit.

Each design for wonder and learning should be constructive. It should allow learners to share their ideas of wonder and to find or create their own wondrous objects. The encounter should prompt questioning and a search for meaning that spreads beyond the encounter. How does it work? Why does it have that shape? What makes it so beautiful? What happens next? Each of these questions can start a journey to understand more about the encounter.

The phase of discovery can continue throughout a lifetime through a profession or hobby such as Geology, Botany, or Engineering. Memorable exposures to the wondrous are key. A school offers many opportunities to display and share – such as curated classroom cabinets and 'wonder walls'.

Principles for wonder lessons

McFall offers some general guiding principles and provocations for pursuits rooted in wonder:

1. How we are introduced to things makes a difference. Consider how the encounter with wonder is designed and allowed for. Build anticipation and spark investigations from the beginning.

2. The rules governing interaction influence the outcomes. If each child can touch the curious object, play with the puzzle, and try to re-create the strange event then the learning will be more engaged than watching a display by the teacher.
3. We are drawn to things that are concealed or are the means of concealment. A gold envelope lends authority and prestige.
4. Objects afford different interactions; some of these may allow exploration and insight. Seek connections.
5. Consider all the senses when planning an interaction.
6. Try to satisfy. A promise should be met, though not necessarily in the way that a participant expects. Be mindful of frustration. Sometimes questions are more potent than explanations.
7. Be kind.

Practices of learning through wonder

Some educational philosophies, schools, and technologies emphasise the wondrous nature of learning. The educational philosopher Rudolph Steiner saw children's early years as a period to stimulate their imagination though wonder at the beauty of nature, the elegance of numbers, the design of artworks, and the telling of a suspenseful story. He saw his Waldorf School as a place to foster a spirit of wonder that combines thinking, feeling, and doing.

Matthew McFall set up his first Wonder Room in a school in Nottingham, UK, containing objects to provoke wonder, curiosity, and investigation. These ranged from an African voodoo lily that once a year gives off the smell of rotting meat to attract flies, to a mechanical typewriter from before World War Two. He reports high engagement from pupils, staff, and community; multiple arising wonder-based projects; and the sheer enjoyment of co-creating a culture of wonder.

McFall has also developed a sequence of eight sessions that form a pedagogy and curriculum of wonder and wondering. He presents the sessions as modules or 'boxes', each with a colour scheme, to be opened one at a time into a learning activity.

1. **Black Box** is a launch event that stimulates anticipation and piques curiosity. Depending on the teacher and the setting, it might be a table draped with a black cloth that is removed with a flourish to reveal a curious object; or it could be a magic or science show; or a physical box that is opened to reveal a clue or a puzzle. The students share their ideas of wonder and learn more about their roles as 'wonder workers'.
2. **Red Box** is a series of 'object lessons'. The students look for objects of wonder outside the classroom and bring them in for a show-and-tell session. The exhibits might range from the seemingly mundane (a leaf, a stone, a paper clip, a coin) to the exotic (a porcupine quill, a statuette). The students consider and discuss what makes them wondrous.
3. **Orange Box** is a scavenger hunt within the school grounds. The students, with support from staff, go in teams to look for the weird and the wonderful. They are encouraged to question the things they see around them and collect specimens such as pebbles, seeds, or flowers.
4. **Yellow Box** is a nature table gallery. The students examine items they have found and discuss how they can be described and displayed for others to see. They might use a magnifying glass to look at the objects more closely, organise the items into groups, and add labels to identify or question.

Wonder Room

5. **Green Box** is a cabinet-of-curiosities event. The students create interactive exhibits to share and explain. These could be items they collected on the scavenger hunt, displays inspired by wondrous events they have witnessed (such as a lightning storm), objects brought from home (a fossil collection), or stunt (juggling), feat (conjuring trick), challenge (mathematical magic) or survey. For example, a student could take apart an old mobile phone, with all the components displayed, or could plant seeds at different times to show stages of growth. A curiosity need not be a physical object. It could be a question such as 'What are thunder and lightning?', or 'Why do shells form spirals?'
6. **Blue Box** is a quest to explore and understand that takes the pupils on a visit to an historical site, a zoological museum, a woodland. Students and staff collect and consider their wonders in this new setting.
7. **Indigo Box** is an opportunity for students to create displays of their exhibits and conceptions of wonder to a larger audience. They could design classroom museums or a 'wonder show' for other students to visit. The emphasis is on bringing previous Boxes together. They can seek feedback, learn from the experiences, and create something even more ambitious.
8. **White Box** is the ambitious whole-school celebration of wonder with a larger invited number of participants, including other year groups, schools, and families. It could be similar to a school science fair, but around the theme of curiosity and wonder, focused on the results of the students' quests. It is a grand finale, but with an understanding that wondering never ceases.

Wonderopolis® is a computer platform created by the US National Center for Families Learning. It offers a Wonder of the Day, in the form of an intriguing or curious question supported by text and images. Students can submit their own wonder questions to a Wonder Bank. They can also vote for favourite questions to be promoted as the Wonder of the Day. The platform provides resources for learners to explore wonders in more detail and discuss these online.

Conclusions

Wonder has a rich heritage. It differs from awe, amazement, and astonishment in opening multiple pathways to learning. A pedagogy of wonder encourages the design of opportunities for anticipation, encounter, investigation, discovery, and propagation. At one extreme, this may consist of a teacher dragging reluctant students on nature walks to find the wonder in a puddle or a raindrop. At the other extreme, it becomes a diffuse empathy associated with wondering how others are feeling. Done well, learning through wonder can fit into a curriculum of Science or Arts, yet provoke new ways of seeing and understanding, where familiar objects become prompts for inquiry and imagination as the wonderer continues to learn.

Resources

The book *Wonder* by R.J. Palacio (also made into a film) has been the basis for school projects on wonder and kindness:
https://wonderthebook.com/for-teachers

John Spencer has developed Wonder Day and Wonder Week projects for schools, based on design thinking and inquiry learning:
http://www.spencerauthor.com/wonder-week/

Wonder in Steiner education:
http://bit.ly/2UhWjHs

Wonderopolis is an educational software platform to provoke learning through curiosity and wonder:
https://wonderopolis.org/

Wonder and passion-based learning:
http://bit.ly/2KXMrhT

Article in *The Guardian* newspaper about the Wonder Room created by Matthew McFall in a school in Nottingham, UK:
http://bit.ly/2PfzobT

Book on the centrality of wonder in education:
Egan, K., Cant, A. I., and Judson, G. (Eds.). (2013). *Wonder-full Education: The Centrality of Wonder in Teaching and Learning across the Curriculum*. Routledge.
Parts of the book are available online:
http://bit.ly/2KPu6U3

PhD thesis and a pocket Cabinet of Curiosities from Matthew McFall:
McFall, M. (2014). *Using Heritages and Practices of Wonder To Design a Primary-School-Based Intervention*. Unpublished PhD thesis, University of Nottingham.
http://bit.ly/2QY1sp9

McFall, M. (2013) *The Little Book of Awe and Wonder: A Cabinet of Curiosities*. Independent Thinking Press.

Action learning

Finding solutions to apply in daily life

Potential impact: Medium
Timescale: Ongoing

Action learning combines learning-by-doing with reflective learning and collaborative learning. Learning-by-doing says that there can be no learning without action and no action without learning. In an action-learning scenario, participants work on finding solutions to problems that they have to deal with in their lives. The goal is to find actionable solutions that can be applied in the real world. This is a pedagogy that has become increasingly relevant in the face of a rapidly changing world that requires lifelong learning in order to deal with new sets of challenges.

Reflection forms part of any action-learning session. Finding a solution to a problem is guided by questions that encourage learners to reflect on their own and others' experiences. It's not about the art of giving correct answers, but the art of asking questions that stimulate deep thinking. An action-learning session helps learners treat everyday experiences as opportunities to learn and grow.

> "The foundations of action learning are collaboration and lifelong learning"

Another important part of action learning is collaboration. Action-learning sessions take place in groups. Group participants have enough knowledge of the problem area to be able to help each other. At the same time, they are diverse enough to offer various approaches to the problem. Peer knowledge is promoted over expert knowledge. This can empower learners to solve complex issues together and help them to develop problem-solving skills.

Action-learning session

An action-learning session has four main components: a coach, a group, a problem, and questions. The coach helps learners stay focused on the problem through asking questions that reframe the problem or facilitate reflection.

The group is made up of five to eight learners. They might meet once, or multiple times; it depends on how many sessions they need in order to achieve their learning objectives. When there is more than one session, learners have the chance to reflect on the consequences of actions taken between the sessions. A group works either on a single problem that's discussed by all learners, or each learner presents their own problem and the group works on multiple problems. Problems should be urgent and should come from learners' own lives. It's important that action can be taken based on the solutions that are worked out in a session.

An atmosphere of trust within a group is also needed, so that learners listen to each other with an open mind and aren't afraid to ask questions. Questions should encourage reflection, help to understand and analyse the problem, as well as find a solution. Debates aren't encouraged. They might hinder deep reflection on personal beliefs, ideas, and assumptions and, instead, focus the conversation on trying to win an argument.

Stages of an action-learning session

An action-learning session begins with understanding and reframing the problem. By asking questions, learners try to understand the real nature of the problem rather than its symptoms. This stage ends when learners agree on what the problem really is. They then formulate a goal that's both strategic and actionable. In the next stage, they develop a specific action plan that they can carry out. Learners should develop and test many

strategies and take into consideration both the resources that are needed and the potential consequences of a strategy. At the end of a session, learners decide what specific action will be taken after the session, and reflect on their choice.

Examples of action-learning projects

Action learning was developed by Reg Revans with the aim of helping managers and businesses, on the basis that leadership and business problem-solving cannot be learnt from books. The approach provides not only a workplace learning opportunity, but also part of the curriculum in many business schools. For example, at the Robert H. Smith School of Business at the University of Maryland, students participate in several action-learning scenarios during their studies. They build a new business from scratch, examine a company and try to improve some of its business practices, or lead a change within the organisation.

The approach is also used for teacher professional development. The Whole School Action Learning Project started as a leadership programme for teachers to improve student outcomes at a Whalan Public School in Australia. It evolved into a 12-week action-learning project that involved the whole school staff with the goal of developing teachers' knowledge and skills related to writing. This led to changes in school practice and better learning outcomes for students. However, the school found that setting up and developing action learning takes time, as learners need to develop a common language and understanding.

A similar project ran at the Campbelltown Performing Arts High School. Teachers participated in more than 25 action-learning projects on topics such as peer assessment, self-assessment, and project-based learning. The programme improved teachers' professional practice, cultivated a culture of innovation and evidence-based practice, and increased collaboration among teachers.

Communication technologies make it possible to engage in online action learning. Sessions can be held using popular communication platforms, such as Skype or Google Hangouts, or other conferencing tools. Discussion forums can make it possible to hold action-learning sessions when there's no need for all learners to be present at the same time. This method of action learning was implemented in a six-week leadership course at the Northeastern University, with students working on a real-life problem while supporting other students through the use of text messages.

Conclusions

Action learning has proved to be effective in the business world as well as in the educational sector. In the face of 21st-century challenges, implementation of action learning has expanded significantly in recent years. It develops collaborative skills, which are increasingly important in the digital age, as well as a recognition that lifelong learning is a skill necessary for professional development in a rapidly changing world. Action learning not only has a positive effect at administrative levels, but it can also have a positive impact on learning at the classroom level.

Components of action learning

Resources

Action Learning – *Learning Series* by NGO Learning Centre, video resource: **http://bit.ly/2AMYQQZ**

All About Action Learning, Carter McNamara: **http://bit.ly/2Q8Jz7r**

International Foundation for Action Learning: **http://ifal.org.uk**

Optimizing the Power of Action Learning. Soundview Executive Book Summaries. **http://bit.ly/2QuC22l**

Action-learning projects at Robert H. Smith School of Business at the University of Maryland, USA: **http://bit.ly/2PfC4pX**

World Institute for Action Learning demo session, video resource: **http://bit.ly/2PijPQT**

Abramovich, S., Burns, J., Campbell, S., and Grinshpan, A. Z. (2016). STEM education: action learning in primary, secondary, and post-secondary mathematics. *IMVI Open Mathematical Education Notes,* 6(2), 65-106. **http://bit.ly/2DZbHm8**

Cother, R. and Cother, G. (2017). Delivering Australian vocational qualifications through action learning. *Action Learning: Research and Practice*, 14(3), 269-274. **http://bit.ly/2QzfjCb**

Curtin, J. (2016). Action learning in virtual higher education: applying leadership theory. *Action Learning: Research and Practice*, 13(2), 151-159. **http://bit.ly/2KQFkHJ**

Flanagan, P., Polios, H., Smith, L., and Talde, A. (2017). School-wide application of action learning: teacher-driven learning for improved student engagement and learning outcomes. In *Excellence in Professional Practice Conference 2017: Case Studies of Practice*, 63-69. **http://bit.ly/2BQdJ6H**

Waddill, D.D. (2006). Action e-Learning: an exploratory case study of action learning applied online. *Human Resource Development International*, 9(2), 157-171. **http://bit.ly/2QF71ZH**

Virtual studios

Hubs of activity where learners develop creative processes together

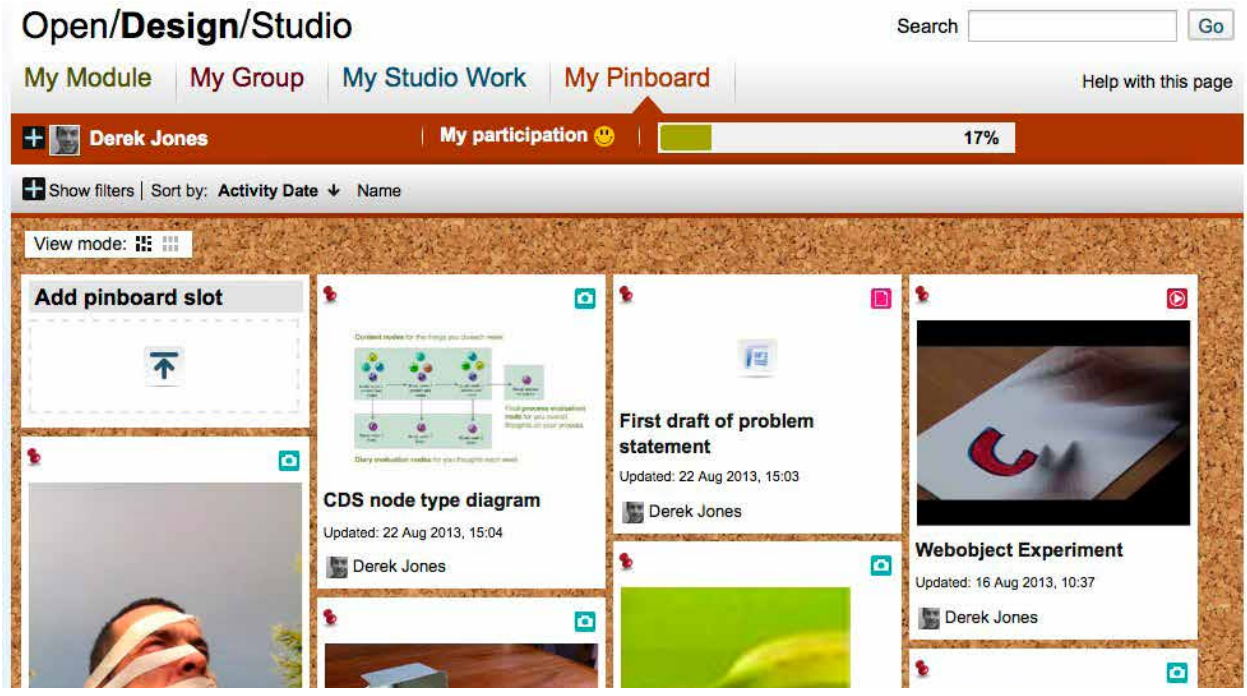
Potential impact: Medium
Timescale: Ongoing

The studio is the primary learning environment for many creative disciplines, including Design and Architecture. Learning in this environment involves social interaction and collaboration. The studio is typically a hub of activity, with half-formed ideas and concepts articulated as sketches, models, and artefacts. Learning is experiential and constructive. The focus is on developing creative processes. Linear ways of thinking are challenged, and uncertainty is embraced through practice. The role of the tutor is not to teach but to observe, comment, and critique. Students learn through doing within a community of practice of peers and tutors. In virtual studios, these experiences of active and social learning are extended to online education. This can give learners increased access to a range of solutions to design problems. It also extends opportunities for working together with other learners and professionals around the world.

Bringing studio pedagogies online

Digital technologies have changed creative industries by introducing new tools for creation, dissemination, and commercialisation. These changes are also evident in the classroom. There is a greater demand for flexibility to accommodate the challenges students face in maintaining a life-work-study balance. Students expect to graduate with a portfolio of skills that will equip them for the modern workplace. These include computer-aided design (CAD) for creation and simulation, and building information modelling (BIM) for data management and collaborative project work. This means that studios compete with computer labs for space. Time previously spent developing traditional skills of sketching and making is now spent on developing literacy with digital tools.

In response to these pressures, virtual studios provide a digital complement to the physical



Example of a student's view of a virtual studio on an undergraduate design course

studio. They make use of sharing experiences available on social media platforms, but are focused on learning activities linked to artefacts, including images, models, and videos. Virtual studios are all about online exchange of ideas, rapid feedback from tutors and peers, checks on progress against learning outcomes, and collaboration. They provide tools for recording, reflecting, and archiving. The aim is to support learning through inquiry and dialogue. Virtual studios enable students and tutors to work together even if they are in different places and working at different times. They're well suited to a range of learning approaches where face-to-face collaborative work is limited, such as distance learning.

> "students can discover and develop networks of learning and support"

Benefits and challenges

A major benefit of virtual studios is scale. Opportunities for comparison and social learning increase in a larger studio. Virtual studio communities can consist of hundreds, sometimes thousands, of students. Access to so many different responses to the same learning task is powerful; it allows a greater range of comparison, progress checking and exposure to other students' ideas. For example, at The Open University, novice undergraduate designers learn in the OpenDesignStudio through social comparison with hundreds of other students. In an early activity, students are asked to design a T-shirt, and are guided by seeing the work of their peers. Once online social interactions have begun within the virtual studio, students can discover and develop networks of learning and support.

The success of a virtual studio depends on learning design, the digital interface, and making good use of the data collected. The purpose and value of the virtual studio in the learning journey should be clear to students and part of their broader educational experience. Different learning contexts and students' developing maturity as learners can change their engagement with studio learning. Students will make comparisons with the interface design of commercial software tools, regarding ease of use, social protocols, and interface functionalities. Learners and tutors may be constrained by tools that are poorly designed. For example, an 'I need help' button will trigger a very different response to one labelled 'Feedback request'. Monitoring of student activity can lead to adjustments to the environment and learning design. However, not everything that is valuable to know may be captured from the virtual studio. Sometimes a lack of, or unexpected, activity may also be useful in understanding the learning process.

Looking to the future

A virtual studio can extend beyond traditional university boundaries, giving access to opportunities not possible in a physically restricted environment. These can be facilities and technologies, experts and users, or live projects. For example, a studio can be the hub for community-led design projects or can extend to include links with makers and industry partners. The boundaries of a contemporary studio are constantly evolving. At the University of Mary Washington, USA, 'DS106 Digital Storytelling' is an open online course built around a virtual studio using digital tools to develop skills of storytelling, through practice and interactions in the online space. It has evolved from an undergraduate module for computer science to a course open to the public and has run without a tutor for the last five years.

While the concept of a studio comes from the arts and from design, virtual studios can be used more widely. This is a learning approach that applies in areas where active teaching methods are used, such as teacher training and Medicine. It also applies in areas where learning in context is important, such as Modern Languages and Science. Virtual studios provide a rare opportunity for some learners to experience studio-based pedagogies and provide others with an addition to]face-to-face teaching.

Sample of responses to a T-shirt design task, showing the scale and variety produced

Resources

DS106: a virtual studio for digital storytelling that has been running and evolving since 2013: **https://ds106.us/**

Broadfoot, O. and Bennet, R. (2003). Design Studios: online? Comparing traditional face-to-face design studio education with modern internet-based Design Studios, in *Apple University Consortium*. **http://bit.ly/2DXan3k**

Jowers, I., Gaved, M., Dallison, D., Elliott-Cirigottis, G., Rochead, A. and Craig, M. (2017). A case study in online formal/informal learning: was it collaborative or cooperative learning? *Design and Technology Education: an International Journal*, 22(1). **http://oro.open.ac.uk/48128/**

Kovach, J.V., Miley, M., and Ramos, M.A. (2012). Using online studio groups to improve writing competency: a pilot study in a quality improvement methods course. *Decision Sciences Journal of Innovative Education*, 10, 363-387. Abstract openly available at: **http://bit.ly/2RvOpZ1**

Lloyd, P. and Jones, D. (2013). Everyday creativity in design process. *Art, Design and Communication in Higher Education*, 12(2). 247–263. **http://bit.ly/2DXaDPQ**

Vowles, H., Low, J., and Doron, H.R. (2012) Investigating architecture studio culture in the UK: a progress report, *Journal for Education in the Built Environment*, 7:2, 26-49. **http://bit.ly/2BPuVZZ**

Place-based learning

Location as a trigger for learning

Potential impact: Medium
Timescale: Ongoing

What is place-based learning?

Place-based learning makes use of learning opportunities within a local community. It could involve a project that answers questions such as:

- How were the mountains nearby formed?
- What are the important social issues in the community?
- How does the transportation system work?
- What was life like for people who lived here in the past?

Such projects can involve members of the community as well as teachers and students. The role of the teacher is to be a broker between students and the local community. Place-based learning provides opportunities to spark curiosity in students. It helps students connect the abstract concepts in their textbooks with practical issues and challenges in their own community. It also builds a strong sense of identity. Any place is rich in learning opportunities. Place-based learning takes learners outside the classroom and can also make place or location a part of online learning.

Place-based learning isn't new, but mobile technologies have opened up new possibilities in this area. There are increasing numbers of tools and technologies that support working as a group without needing to be together in one place and at one time. Sharing images and joint approaches to setting up tasks make local collaboration easier. Websites such as the Do-it trust help to locate volunteers and support community activities. In addition, a range of technologies are now enabling rich and inclusive learning opportunities associated with place.

Physical location and learning

One approach is to identify locations as a way to get out of the classroom. Activities such as taking part in field studies or work in developing new facilities for a nature site can engage learners with activities that are meaningful for them. The natural environment can inspire learners and may provide opportunities for learners to join local projects as volunteers

David Sobel identified the benefits that learners gain from working with a town on a conservation project and from going outside to look at the flowers that appear in textbooks. He referred to this range of experiences as place-based education, an approach that

> immerses students in local heritage, cultures, landscapes, opportunities and experiences, using these as a foundation for the study of language arts, mathematics, social studies, science and other subjects across the curriculum. It emphasizes learning through participation in service projects for the local school and/or community.
> **https://promiseofplace.org/**

Virtual location and learning

Place can be a fixed point where there is access to virtual information. Location-aware devices such as mobile phones can be used to trigger events. These devices can also connect messages that are sent by people from a specific location. Such tools can be used to find new locations, store and visualise data, find more information, and connect learning in the classroom with learning in the community or outside the school. A learner can prepare for an activity while in a classroom or lecture hall, then carry out work in another location, before reflecting on it in the classroom. In this way, learners can make connections between school, home and the community, prompting them to think of learning as more personal and relevant to their own interests.

Various projects have examined place-based learning associated with field trips or museum visits. In the Enabling Remote Access project, Davies and colleagues studied the ways in which mobile learning impacted on field work when teaching Geology at universities. The Personal Inquiry project, with the help of the nQuire software developed for use in the project, investigated the features of urban heat islands – areas that are significantly warner than neighbouring areas due to human activity. Young teenagers collected and analysed data across different settings – including the classroom, their homes, and various field sites.

> “connect learning that happens in the classroom with learning in the community”

The MASELTOV project is an example of the use of mobile devices to develop technology-rich and inclusive learning opportunities for migrants. The project investigated ways of using smartphones to motivate and support learning of language and cultural knowledge. An app was used to identify where users were and to offer learning resources that related to that place. Learning activities were available for many locations, including banks, train stations, shops, and health centres.

The SALSA project investigated language learning via smartphones in an urban environment, as part of a Smart City initiative. The aim was to improve the spoken English skills of adults in the city. Learners received learning prompts while out and about. Bluetooth beacons sent prompts to an app and triggered relevant content when a learner’s smartphone was within range. For example, while waiting at a bus stop, a learner might be near a SALSA beacon. This would trigger a phone notification via the app. Notifications drew attention to available language activities, which included content relevant to the location. An activity associated with a bus stop would outline the activities and language needed to purchase a ticket from a bus driver.

Conclusions

Place-based learning can be used in a wide range of subject areas, including Culture and History, Geography and Science. Mobile devices are opening up new opportunities and are increasingly used to support place-based learning and provide new learning opportunities related to locations. They can be used to add virtual information to physical settings and also offer a sophisticated set of tools that can be used to support study outside the classroom.

Resources

Do-It: volunteering opportunities:
https://do-it.org/

Learners making science, *Innovating Pedagogy Report 2017*:
https://iet.open.ac.uk/file/innovating-pedagogy-2017.pdf

MASELTOV: Mobile Assistance for Social Inclusion and Empowerment of Immigrants with Persuasive Learning Technologies and Social Network Services:
www.maseltov.eu/

SALSA: Smart cities and language learning:
www.open.ac.uk/blogs/salsa/

What is place-based education? Promise of Place:
https://promiseofplace.org

Davies, S., Collins, T., Gaved, M., Bartlett, J., Valentine, C., and McCann, L. (2010). Enabling remote activity: using mobile technology for remote participation in geoscience fieldwork.
http://bit.ly/2KRDma5

Gaved, M., Peasgood, A. and Kukulska-Hulme, A. (2018). Learning when out and about. In: Luckin, R. (ed). *Enhancing Learning and Teaching with Technology: What the Research Says*. London: UCL Institute of Education Press, 76–80.
http://bit.ly/2BPGd0z

Nova, N., Girardin, F., Dillenbourg, P. (2005). 'Location is not enough!' An empirical study of location-awareness in mobile collaboration. *Wireless and mobile technologies in education, 2005. IEEE International Workshop*, 28–30 November.
http://bit.ly/2BPH4yf

Scanlon, E. (2014). Mobile learning: location, collaboration and scaffolding inquiry. In: Ally, M. and Tsinakos, A. eds. *Increasing Access through Mobile Learning. Perspectives on Open and Distance Learning*. Vancouver: Commonwealth of Learning, 85–98.
http://bit.ly/2BQRg9q

Sobel, D. (2004). Place-based Education: Connecting Classroom and Community:
http://bit.ly/2rkyiCn

Making thinking visible

Opening windows into student learning

Potential impact: Medium
Timescale: Ongoing

Making student thinking visible can support a student's learning process by making studying more effective and teaching more targeted. Activities that raise student and teacher awareness of the learning intentions of a course, the student's subject understanding, and how to improve are all important. The core of such activities is making student assumptions and ideas visible for both teachers and students. This information can be used by teachers to adapt their teaching and provide feedback, and by students to make more informed decisions about their study.

Digital tools offer a wide range of opportunities for students to construct and express their understanding, alone or in collaboration with others. The ways in which digital tools can be used to support the process of making student thinking visible depends on several factors. These include: what the tools can do, how they are understood and used, and how activities align with the learning intentions of the course as a whole. Digital tools offer more opportunities than a traditional classroom when it comes to storing and processing information, creating spaces for communication and cooperation, enabling students to construct and express ideas in new ways, and providing opportunities for fast feedback.

Visualising student thinking

Both subject-specific and non-subject-specific tools can be used to make student thinking visible. Various tools allow students, together or alone, to demonstrate their understanding of phenomena and ideas by visualising them in different ways. For instance, software enables students to create models, videos, or texts that bring together audio, images, and video. Augmented reality can be used to create virtual objects as holograms, or artefacts can be created in virtual reality. The use of a variety of media can open new windows into student thinking.

To gain insights into students' learning processes and create purposeful feedback, it's important that digital activities provide rich information that can be considered and discussed. Students can be offered opportunities to express their understanding at different points and evaluate each other's work. Diversity in student responses can be achieved by giving them open tasks, allowing them to choose their own tools and ways of presenting their ideas.

Open tasks require the use of authentic questions in teaching. These will have a wider variety of acceptable answers than is the case with most test questions. Teachers therefore need to be open to unexpected responses. Letting students choose how to express themselves can provide different perspectives on a topic. This enables them to develop their understanding by presenting and evaluating different types of work.

Co-creation of ideas and communication

Digital tools offer new opportunities regarding collaboration and communication, when it comes to creating tasks and giving feedback. Many teachers have found that written feedback doesn't necessarily lead to students doing better. Many students express dissatisfaction with the feedback they receive. One problem with written feedback is that it's often a one-way communication in which teachers use language that isn't available to students. Digital tools can be used to create more dialogue, both inside and outside the classroom.

Digital media such as Twitter, YouTube, Facebook, blogs, wikis, Google Docs, Etherpad, and Padlet invite interaction and collaboration in ways that weren't possible in

the past. These media can be used to support collaboration when creating and sharing digital products. They also offer a way of providing feedback during the process of creation, which makes it easier for students to ask follow-up questions. They may also discuss, or even challenge, the teacher's feedback along the way. Some social media make it possible to receive feedback from a larger audience, with varied expertise, outside the teaching environment.

Some tools can be used to make student thinking visible during lectures. Response systems can be used to collect student answers or to enable students to ask questions. Teachers can follow up on the student responses at the time, contrasting and discussing the content of the lecture with the ideas of the students. This makes it possible for teachers to adapt their teaching to the learning needs of students. It also helps students to relate their assumptions to the ways in which ideas are discussed within a discipline.

Just-in-time teaching

Digital tools can be used to make student thinking visible before classes take place, so that the learning activities can be adapted to meet their learning needs. Just-in-time teaching gives students questions or assignments before a class for them to solve and discuss using digital tools. Teachers then use student answers when preparing the class. This approach has five phases.

1. Making students understand the purpose of the approach.
2. Creating purposeful questions or tasks.
3. Setting a deadline for responses.
4. Analysing responses.
5. Presenting responses to the students and adapting learning activities to take these responses into account.

It's vital that students understand the purpose of the approach so that they know what's required of them and how their contributions can shape the teaching they receive. This can lead to students feeling greater ownership of issues that are discussed and worked on in class.

Different tasks invoke different responses and require different ways of visualising student thinking. The questions posed can be multiple-choice, short-text response or tasks that allow the students to express themselves using illustrations, images, sound, or video. The tasks don't need to be restricted to questions that the students need to answer. Students can be asked to pose their own questions to the teacher and each other in a shared online room.. This means that students are less restricted by their teacher's questions and perspectives, and can voice the questions with which they're struggling. It can also be useful for students to become aware of the questions and ideas of their peers.

After the deadline, teachers can use digital tools to collect student answers. These responses can be used to plan lessons. They can also be presented to the students and used as an integrated part of the learning activities.

The assignments and the way in which they're used is not only about making student thinking visible for the teacher. This approach makes students more aware of their own thinking and prompts them to reflect on their learning process. They have opportunities to shed light on their misunderstandings. Students become aware of what they can do and what they understand, and can identify topics that are important to work on further.

> "Students become aware of what they can do and what they understand"

Why make student thinking visible?

Different devices and media support different ways of creating and expressing ideas. Digital tools create new spaces for communication and enable ideas to be expressed in a variety of ways. This can lead to improvements in teaching and studying. It also connects study with instruction so that what happens in a class can support student learning activities outside the classroom, and vice versa. Different experiences with creating and expressing ideas, assessing their own work and the work of peers, and discussing the subject matter can help students monitor and regulate their learning processes more purposefully. If teachers use student thinking to design their lessons, it's more likely that the content of a class will answer student questions and extend their understanding. Instead of basing study and instruction on assumptions about student understanding, digital tools can be used to provide teachers and students with a more accurate picture of the students' learning needs.

Although technology changes the possibilities for making student thinking visible, the pedagogical principles don't change. It's essential to align the use of digital tools with the intentions and activities of a course as a whole. Learning to write an essay and learning to build a car engine, for example, are likely to require different tools and methods for making thinking visible. If used purposefully, however, digital tools can help make both instruction and studying more flexible, integrated, and responsive to students' learning needs.

Online tools extend the possibilities for sorting, grouping and preserving the thinking of different participants

Resources

Academic Writing Analytics (AWA) from the UTS Connected Intelligence Centre:
https://utscic.edu.au/tools/awa/

Cmap – concept-mapping tool:
https://cmap.ihmc.us/

Etherpad: online tool that supports collaborative editing:
http://etherpad.org/

Flinga – collaborative platform with integrated pedagogical activities:
https://flinga.fi/

Goformative – assessing student understanding:
https://goformative.com/

Padlet – collaborative boards for sharing resources online:
https://padlet.com/

Prism – tool for collaborative interpretation of texts:
http://prism.scholarslab.org/

Verso – tool to promote collaboration, critical thinking, feedback, and metacognition:
https://versolearning.com/how-it-works/

17 Formative Digital Assessment Tools To Help You Know Your Students. Blog post by Lee Watanabe-Crockett, 7 September 2018
https://globaldigitalcitizen.org/17-formative-digital-assessment-tools

Five EdTech Tools To Make Thinking Visible. Blog post by Dennis Pierce, 12 August 2016
http://bit.ly/2FWtE7D

Roots of empathy

Social and emotional learning

Potential impact: Medium
Timescale: Ongoing

Roots of Empathy is an award-winning classroom programme designed to teach children empathy so they can interact with others healthily and constructively. The programme prepares children for coping with different relationships in their lives. Empathy is defined as 'the ability to identify with another person's feelings. The ability to see and feel things as others see and feel them is central to competent parenting and successful social relationships in all stages of life.' Empathy and its development are seen as essential to healthy and social behaviour.

When children understand how they feel and how other people feel, this makes it easier for them to cope in social situations. The Roots of Empathy programme aims to:

- develop children's emotional understanding
- decrease children's aggressive behaviour
- encourage children's social behaviour
- increase the knowledge children have about infant development.

Roots of Empathy in schools and classrooms

There has been a lot of research into the factors that are involved in the development of children's emotional competence. This research is carried out to find out more about how to promote children's positive development. School is an important arena for these studies since almost every developing child attends school.

Roots of Empathy is designed for school children between the ages of 5 and 13. During the school year, the class has a visit every three weeks from a baby and parent who live locally. The children sit around the parent, baby, and instructor, observing the baby's development and emotions, and how the parent and baby interact. A Roots of Empathy instructor guides the pupils, helping them to reflect on the baby's development and to put the baby's feelings into words. The baby functions as a 'teacher' and lever for the instructor to help the pupils identify and reflect on their own feelings and the feelings of others. The instructor spends time with the class before and after the family visits to prepare and reinforce teachings, using a specific lesson plan.

In every Roots of Empathy lesson, there are opportunities for a variety of discussions. The purpose of these is to explore and experience different activities that will help the children to learn about empathy. This involves learning not only to identify emotions but also to develop emotional sensitivity. For instance, in one discussion, children are encouraged to identify the emotions of babies and then to describe and explain these identified emotions. In this way, they develop a language about emotions.

The children also engage in other activities. In one of the lessons in the programme, they're offered an opportunity to create a class recording of nursery songs that they sing to 'their' baby. Once the school year is near its end, they can make a wishing tree for their baby. Here they write the wishes that they have for the baby's future and lifetime. This activity promotes altruism and offers the children a perspective that has a focus on values. They're encouraged to think about the whole lifetime of their baby and to reflect on how they want that life to turn out, and what kind of future they want their baby to have. In this exercise, the children are prompted to adopt a wide perspective and to imagine different scenarios.

Intentions and evidence

Unlike programmes that address bullying by targeting the victim or bully, Roots of Empathy works with the whole class. The programme teaches skills that enable all the pupils to gain insight into how others feel and to develop a sense of social responsibility for each other. They're also empowered to challenge cruelty, whether this is in the form of bullying or meanness.

> "The emotional awareness promoted is designed to create more caring classrooms and schools"

The intentions of the programme are to foster empathy and emotional literacy, reduce bullying, aggression and violence, and promote prosocial behaviour. The programme also aims to increase pupils' knowledge of human development, learning, and infant safety, and to prepare the pupils to be responsible citizens and parents. The emotional awareness promoted is designed to create more caring classrooms and schools. Children who are competent in understanding the feelings of others are less likely to be cruel to each other.

A study of the programme showed a clear positive impact on empathy – children who had participated in the programme showed increased empathy, stronger anger management, reduced aggression, and a greater understanding of how to recognise emotions. There was a positive impact on how teachers rated the children's prosocial behaviour. The children who participated in the Roots of Empathy programme also demonstrated a greater understanding of infant development than a control group who had not participated in the programme.

The Roots of Empathy curriculum

Empathy is at the core of the Roots of Empathy curriculum because it's seen to have a key role in promoting prosocial behaviour. The curriculum is aligned with a framework that has three components:

- ability to recognise and name how other people are feeling,
- ability to understand another person's perspective,
- emotional responsiveness – the ability to experience emotions.

This framework provides a foundation for the lessons and also provides a way of structuring evaluation of the programme's outcomes.

The curriculum is adapted to the development and interests of the children, and is divided into nine themes. Each of these themes is supported by a pre-family visit, a family visit, and a post-family visit – 27 visits in all. Each of the nine themes is further broken down into four age ranges: Kindergarten, Primary, Junior, and Senior.

The Roots of Empathy curriculum addresses the affective side of education, which is concerned with feelings and emotions. The activities are also linked to other subjects. For example, pupils use Mathematics when they calculate and chart the baby's weight and measurements, Literature is related to feelings and perspective taking, and Art is used to represent inner feelings that are hard to express in words.

Conclusions

The Roots of Empathy programme was founded in Canada by Mary Gordon. It has been trialled in many different schools and classrooms. The programme has been well received and is now available in many countries worldwide. Research on the programme consistently shows a reduction in aggression and an increase in helping, inclusive, and caring behaviour. Some studies have found that the decrease in aggression lasts for at least three years. Research has also shown an increased perception of the classroom as a caring environment among the Roots of Empathy pupils when compared to control groups, as well as an increased understanding of infants and parenting.

Resources

Babies Fighting Bullying, video resource:
https://cnn.it/2KTvchv

The Babies Teaching Kindness in Class, video resource:
http://bit.ly/2StJLe6

Empathy is the Only Way to Stop the Cycle of Bullying and Abuse, HundrED:
http://bit.ly/2APNBqO

Pre-school Learning Alliance, Roots of Empathy in the UK:
https://www.pre-school.org.uk/roots-empathy-uk

Official website of the Roots of Empathy organisation:
https://rootsofempathy.org/

Roots of Empathy, information for schools:
http://bit.ly/2KTvULL

Roots of Empathy, video resource:
http://bit.ly/2Qg4aqr

Broidy, L.M., Tremblay, R.E., Brame, B., Fergusson, D., Horwood, J.L., Laird, R., Moffitt, T.E., Nagin, D.S., Bates, J.E., Dodge, K.A., Loeber, R., Lynam, D.R., Pettit, G.S., and Vitaro, F. (2003) Developmental trajectories of childhood disruptive behaviors and adolescent delinquency: a six-site, cross-national study. *Developmental Psychology*, 39 (2), 222-245.
http://bit.ly/2APP6VT

Cain, G. and Carnellor, Y. (2008). 'Roots of Empathy': a research study on its impact on teachers in Western Australia. *Journal of Student Wellbeing*, October, Vol 2(1), 52-73.
http://bit.ly/2EcWr6i

Gordon, M. (2012). *Roots of Empathy: Changing the World, Child by Child. Thomas Allen, Canada.* The first chapter is openly available from:
http://bit.ly/2E0tglV

Schonert-Reichl, K.A., Smith, V., Zaidman-Zait, A., and Hertzman, C. (2012). Promoting children's prosocial behaviors in school: impact of the 'Roots of Empathy' program on the social and emotional competence of school-aged children. *School Mental Healt*h, 4(1), 1-21.
http://bit.ly/2APgsvw

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