

The challenge-driven university: how real-life problems can fuel learning

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Summary

Higher education globally is booming with 150 million students worldwide, projected to rise to over 260 million by 2025. 2.5 million are internationally mobile, a figure expected to rise to seven million by 2020 and expenditure is already some \$1.8 trillion, and growing at roughly 8 per cent each year.

Despite a vast increase in scale over the course of a generation the basic model of university education has not changed much since the second world war, and continue to centre around three or four year courses, lectures in lecture halls, reading lists, exams, dissertations and PhDs. Although universities are packed full of technologies, the many online tools for learning, from open universities and MOOCs to tools for adapting learning, remain on the margins of the system rather than at the centre.

This paper focuses on one important strand of change: the rise of what we call 'challenge-driven' university models. These models develop students by putting them up against difficult problems and challenges for which there are no established answers. Instead students to draw on many disciplines to solve them; they have to work in teams; and they have to collaborate with organisations outside higher education.

These models aren't a replacement for the classic core of university education - mastering a discipline. But they provide an important complement to this core, and they may be better suited to preparing young people for the needs of the world. They also re-emphasise one of the founding principles of some ancient universities: a focus on questions rather than answers as the key to deep learning.

The first part of the paper, by Geoff Mulgan and Oscar Townsley, describes why they are rising in importance; how they work; and describes many examples around the world.

The second part, by Adam Price, puts this model into a broader historical perspective of innovation in university models.

Part One - The rise of the challenge-driven university

Background: the pressures for change in higher education

As higher education has grown, numerous pressures for change have become more apparent. They include the rise of competitors - research institutions of all kinds and think-tanks creating knowledge, as well as ready sources of knowledge online. They include the pressures of globalisation and competition for more mobile students and faculty. Employers increasingly demand more than just subject knowledge from their graduates, and in their opinion, universities are not delivering. The latest research shows that only [one in three](#) firms believe academic institutions are adequately preparing students for roles in their organisations. A [report](#) this year by the Association of American Colleges and Universities demonstrated that employers do not think that the higher education system is providing students with the fundamental skills required for success in the workplace: applied knowledge, critical thinking and communication.

Students and parents are behaving more like 'customers' of education than ever before and demanding value for money. With the high cost of a university education (especially in the US) and the [lack of graduate jobs](#) since the financial crisis, students and parents are questioning whether the utility of a degree justifies its price. The widespread availability of educational resources online has fed the perception that universities should be providing much more than lecture-based content delivery.

In an [open letter](#) to Higher Education Funding Council for England (HEFCE) and Universities UK, over 150 leading professors recently argued that, "higher education is not simply about producing students with degrees but more fundamentally about promoting a range of skills and qualities within students... these include independent critical thinking, self-organisation, community service, knowledge of national and international processes and developments etc."

Yet growth has been largely unaffected by these problems and debates. That is why some fear that universities will be largely complacent, rather than developing new responses that address these challenges head-on.

Policy?

The policy responses from government have tended to fall into three main categories, which are at best partial answers to the underlying pressures:

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- In many countries the main drive has been to create and grow universities closely modelled on the examples in the US and Europe: the highest ambition is to rise up the various league tables which reflect peer opinion.
- A second response has been to change the funding arrangements for universities, with various formulae to cover the costs of much greater student numbers, usually involving more payments and more debt.
- A third response has been to attempt performance management of existing university activities. The UK government has attempted to do this for research through REF and for teaching through a 'Teaching Excellence Framework' to incentivise universities to deliver a higher standard of teaching.

There has been much less interest in innovation. Indeed no country has explicitly prioritised innovation in university models. This was a priority in some previous periods (e.g. the 1960s when the UK government created the [Open University](#), and figures like Clark Kerr transformed US universities). But most of the radical innovations in recent years have come from outside the system, as in the case of many recent MOOCs such as [Udacity](#), [Coursera](#) and [iTunes U](#).

There have been plenty of attempts to define a 'new model' of education for the 21st century. [The Entrepreneurial University](#) (Etzkowitz, 2004), [The Civic University](#) (Goddard, 2009) and [The Innovative University](#) (Christensen, 2011) are examples. But although each proposed a plausible route to the future, each also confirmed that the best answers may lie in a more pluralistic university system rather than the adoption of one new model. And none has succeeded in showing how higher education as a whole could institutionalise innovation with more systematic experimentation, assessment and then adoption of superior new methods. This lack of a [system for innovation in higher education may be just as important as the weaknesses of individual innovations](#).

The challenge-based approach

One response to these pressures is a new kind of learning, or to be more precise, the rediscovery of some very old models. These treat traditional pedagogy and mastery of disciplines as a foundation and then add to this:

- Work organised through projects.
- Work organised in teams.
- Projects that primarily address unsolved problems, whether in science or society, i.e. the creation of new knowledge rather than learning of existing knowledge.

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- Involvement of external partners and clients in the projects, whether businesses or public bodies.

The insight is that learning may happen much faster, and more intensively, through engagement with real-world problems, and through embedding learning in relationships. Practice and theory feed each other; there is a clearer line of sight between what is learned and how it can be used; and peer pressure encourages greater commitment.

At a more fundamental level these approaches focus on questions first, rather than answers. They look for important, challenging questions, and then pull together the relevant knowledge and disciplines needed to answer them. In this respect they echo much older traditions of learning, going back to Socrates and beyond.

There are many precedents for forms of learning that focus on real-life problems in this way. Many medical schools, for example, have been using a 'problem based' approach to learning for some time. The approach was pioneered by [McMaster University Medical School](#) in the late 1960s where in response to changing demands on the profession, the curriculum was changed so that students learned collaboratively, working on real-life cases in small groups. This new self-directed group model has since been called 'The McMaster Model' and is now used in medical schools around the world from [New Mexico](#) to [Taiwan](#). Elements of the model have been used in engineering and military colleges, too.

There are also parallel developments in other areas of education. For example [studio schools](#) in the UK, and examples like [High Tech High](#) in the US, use project-based learning, centred on real-life problems, as the core curriculum for students.

[Aalto](#) in Finland is a fairly recently created university that has deliberately put methods of this kind centre stage. Pioneers are also working on new models of university that could take this approach further - such as MIT's Christine Ortiz who proposes a university with no classrooms or lectures.

Models of this kind are arguably more interesting than the first generations of MOOCs, which simply broadcast or amplify very traditional models of teaching. They largely ignored evidence about learning - which has shown, again and again, that learning is more likely when pedagogy is combined with peer influence; when online or video learning combines with face-to-face; and when there is a close link to practice.

In what follows, we briefly summarise some interesting examples around the world that provide prompts for a more developed stream of challenge-based

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education, either in existing universities or in new ones. These are not a comprehensive solution and should leave plenty of space for other methods, from pure discovery and research to excellent teaching of established knowledge. But they should form an important part of any serious strategy for the future.

US

[Stanford School of Engineering's](#) P⁵BL model was designed to address two observed shortcomings in engineering graduates: a lack of cross-disciplinary communication, coordination and negotiation skills, and a narrow perspective of the job itself. Students on Stanford's AEC courses collaborate with students from other disciplines and in other continents on half-year construction projects, accountable to an industry leader. They are encouraged to use technology such as screen sharing and interactive whiteboards to aid in their collaboration.

[Olin College of Engineering](#) has quickly gained a reputation for being one of the most innovative institutions in the US since it opened in 1997. Through its partnerships with Babson and Wellesley colleges (The Olin Triangle), the college mandates that students combine science and engineering education with business and entrepreneurship, arts, humanities and social sciences. This gives students a holistic education and a broader outlook on the relationship between engineering and other disciplines.

Olin's philosophy is that learning should be taken out of the world of academic theory and practised in context. Tasks are designed to model real-life constraints such as finance and personnel, so that students learn the skills which are required to cope in a professional environment. All students complete a year long capstone project that gives them the opportunity to implement what has been learned in the real world. The culture that has developed amongst the Olin staff promotes continual tinkering and improvement of their teaching; their pioneering [SEER summer program](#)

engages undergraduates with education research, so that the students can improve the overall education that Olin provides.

There is also an increasing trend of real-world, project-based work in the social sciences. Last year, the [Ash Center for Democratic Governance and Innovation](#) at the Harvard Kennedy school founded the 'Urban Innovation Field Lab', a project aiming to improve social conditions in cities in Massachusetts. Using 'problem-driven innovation', students meet with stakeholders and officials from different municipal sectors and departments generate strategies to assist their local areas. The Lab doubles as a research centre and a teaching environment,

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generating cutting edge research as well as giving students credits which count towards the completion of their degrees.

Canada

In Canada, the [University of Waterloo](#) uses a model of co-operative education, where students' time is split between study and assessed work experience. Its success has led it to spread to over 100 colleges and universities although the University of Waterloo's programme remains the largest. Students apply the knowledge they have learned in the classroom on paid work placements, where they also have the opportunity to secure job offers and gain valuable experience. As it is credited students are required to engage in productive work rather than purely observational, and are assessed by their employers and on their own written reports. Currently over 60 per cent of the University's 30,000 undergraduate students take part in the programme, along with over 6,000 employers.

Europe

Scandinavian countries have been pioneers in higher education, with many institutions founded on the principles of continuous innovation, collaboration and interdisciplinarity. [Aalto University](#) in Finland was created out of a merger between Technology, Economics and Art Universities in Helsinki and now runs four interdisciplinary 'factories' - Design, Health, Media and Service, where teams of academics and students work with companies and communities to develop new products that respond to demand from the real economy.

The [Norwegian University of Science and Technology](#) in Trondheim has a similar approach. As part of their courses, students are required to join a 'village' (i.e. area of interest) of around 30 members which address questions such as 'Biofuels - a solution or a problem?', 'Sustainable, affordable housing for all', and 'Portable technology and well-being'. Each village is run by a professor who divides students into smaller groups to work on problems in their topic area.

At [Maastricht University](#) (the second youngest university in the Netherlands), all teaching uses a problem-based learning model, and this has become one of the main attractions of the university. Twelve to fifteen students discuss problems in group sessions, with one student appointed to lead the discussion. The students are given complex problems from everyday professional practice which they brainstorm and research both together and separately. This process is repeated every week until the problems are completed. Partially due to its innovative approach to teaching, Maastricht University was ranked sixth in the QS 2014 top 50 universities under 50 years old.

[Imperial College London](#) and the [Royal College of Art](#) (RCA) are two particularly innovative higher education institutions. For the last ten years, Imperial has been running the [Energy Futures Lab](#) - a cross-discipline, issue-based department aimed at tackling global energy challenges. It was established to bring together disparate fields of study that are relevant to energy including engineering, environmental sciences, computer science, business, policy and mathematics. The lab's research is based around around five themes - clean fossil fuels, energy infrastructure, low carbon transport, policy and innovation, and sustainable power and offers. The Lab has hosted a number of groundbreaking research projects, researchers are currently refining the design of fuel cells that use algae to efficiently and sustainably create energy (via the production of hydrogen). The Imperial Energy Futures Lab also offers an MSc in Sustainable Energy Futures which is accredited by the Energy Institute, the leading chartered professional membership body for the energy industry.

Imperial and the Royal College of Art also run a [Double Masters in Innovation Design Engineering](#) (IDE) which is well known for producing some of the best talent in the field. It's a creative product development course which includes experimentation, design, engineering and enterprise, making use of multidisciplinary teams in the process. Unsurprisingly, the IDE course has been a catalyst for a number of innovative startups.

The IDE course has been successful in part because of its strong external relationships. Projects have been undertaken with companies such as Ford, Coca Cola, Airbus, BBC, Unilever and many others. Their flagship international module 'GoGlobal' takes students abroad for three week cross cultural, collaborative projects with academics and industry partners. Past projects have included: sports innovation with University of Technology, Sydney; social city software with KAIST, South Korea; exploring rural-urban migration issues with Tsinghua University, Beijing; the future of food at Tsukuba University, Japan; and the growth of the creative industries in Ghana.

The [University of Lincoln](#) has challenge-driven education at the core of its teaching. Its 'Student as Producer' pedagogical approach promotes learning by doing and emphasises the role of students as knowledge creators together with academics. The model has four key themes. Discovery: students learning through their own research and enquiry; collaboration: creating knowledge together with their peers and academics; engagement: becoming more involved in their discipline and production; creating knowledge rather than consuming education. The approach was recognised by the UK's Quality Assurance Agency (QAA) in the university's institutional review in 2012. The QAA commented that



the high levels of student engagement were directly attributable to the 'Student as Producer' concept.

The University of Lincoln also recently launched the [Lincoln School of Engineering](#) in collaboration with Siemens Industrial Turbomachinery. The school offers degrees that are tailored to the changing demands of the engineering industry, focusing on specialisms such as control systems and power and energy. Siemens Industrial Turbomachinery also provides scholarships and paid work placements to the most talented students. One of the most interesting features of the collaboration is that academics and Siemens employees are co-located, meaning students benefit from real-world practical experience as well as theoretical education.

This is by no means an exhaustive list and there are many other notable institutions that are experimenting with their approach to teaching. These include the Indian School of Design and Innovation in Mumbai, Western Governors University, Arizona State University, The University of Exeter, The University of Warwick, The University of Melbourne, Nanyang Technological University and the Pohang University of Science and Technology.

Modules or Competitions

Increasingly, universities are using external competitions to give their students a broader range of experiences. [iGEM](#), for example, is an annual competition run by the [BioBricks](#) foundation where university students design new products using synthetic biology. The students compete for prestigious awards and their efforts are rewarded with credits towards university qualifications. Teams are interdisciplinary - participants have a broad range of backgrounds including biology, computer science, art and design, physics, marketing, law, mathematics and social sciences.

The competition is structured into three parts. The beginning of the year is spent brainstorming ideas in order to get faculty approval and funding, the middle is spent working on projects in the lab and at regional meetup events, and the final part of the course is a presentation of work and competition for prizes at a 'Giant Jamboree'. An interesting feature of the iGEM competition is that the projects are then uploaded into the [iGEM Registry of Standard Biological Parts](#), a library of genetic building blocks that academics and industry can use to create more complex synthetic biology devices and systems.

The [ArtScience Prize](#) is a competition where students combine both art and science to create innovations inspired by an annual theme. Previous themes have included neuro informatics, futures of water, and machine life and products

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created have ranged from a football that generates energy to microbial fuel cells made from dirt. Originating in Boston but now spanning 22 countries, the prize uses an experience based learning model which teaches critical thinking and problem solving skills to the competitors.

Over the course of the year, students brainstorm, refine and build their concepts, with help and guidance from ArtScience staff. Through working together, they learn social skills, project development, creativity and artistic process building cutting edge projects with their teammates. During the course, students have the opportunity to win Idea Translation Fellowships - funding to develop their ideas further over the summer. Every year the best contestants are selected to attend the Annual Innovation Workshop at Le Laboratoire either in Paris or in Cambridge, Massachusetts, where the groups present their work to the public and press. The ArtScience Prize collaborates with universities around the world and has been integrated into the curriculum as part of Harvard's optional engineering module; 'How to Create Things and Have Them Matter'

New contenders

[Hyper Island](#) (which was funded by Nesta) is a digital media school from Sweden that now offers a Master's programme in the UK. Its radical approach has no teachers, no grades and no exams and the initial results are promising. The course uses experiential, vocational and interdisciplinary approaches with groups of students working on briefs set by industry. Each project has a broad theme such as problem solving, strategic innovation or running a creative business and the work is interspersed with talks, workshops and discussions with industry professionals.

Hyper Island's close collaboration with members of the digital media industry is one of its most notable features; industry members help to design the curriculum, select students, create task briefs, and facilitate education. In terms of curriculum design, industry members shape the course in response to the skills and qualities that they think are missing in the sector. Partners of the course include Google, McCann-Erickson, Channel 4, MTV, Saatchi & Saatchi, TBWA, Sony Games, Unilever and BBH as well as a range of smaller creative agencies. The results have been encouraging. Of the first UK cohort of 16 graduates, six months after leaving, seven were in full-time paid employment in the industry, two were doing paid internships, three had set up their own ventures and another three were doing freelance work in the industry.

Another innovative approach is [Year Here](#); a postgraduate course in social innovation based in London. Founded in 2013, the course was designed as a platform for graduates and young professionals to build solutions to difficult

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social problems in their own local area. Year Here is unconventional as it has no lecture halls, no teachers and no fee. Instead, Fellows are immersed in the daily experience of the problems they are trying to solve, and mentored by industry, on the subjects of entrepreneurship and social innovation. The course maintains its zero-fee structure because its Fellows create value for external institutions, who cover the costs of the year here programme.

In two years, Year Here's Fellows have volunteered 40,000 hours to frontline services, such as homeless shelters, community centres and Pupil Referral Units and have launched seven social ventures, including [Settle](#), which supports vulnerable young people who are moving into their first home, [Rootless Garden](#), running nature-inspired activities to reduce the isolation of older people, and [Birdsong](#), an online marketplace selling fashion products made by vulnerable women

There are more prospective developments. In 2018, [New Model in Technology and Engineering](#) (NMITE) will launch a new British university aiming to meet the needs of the advanced manufacturing, defense, agri-engineering, sustainable and smart living sectors. The curriculum is being designed in collaboration with industry and academic partners (including Olin College of Engineering) and will use interdisciplinary and problem-based approaches to deliver curriculum content. All students will be required to study humanities, design and social science topics along with their core content and will be given mandatory 6-12 month work placements during their studies. The curriculum design includes rewards for innovative teachers and will incentivise staff to create 'safe to fail' environments.

Finally, The South University of Science and Technology of China is noteworthy. Located in Shenzhen, one of China's most successful Special Economic Zones, its launch was marked by a widely publicised fight with the Chinese Department of Education over their rejection of the gaokao rote-learning education system. In protest, the university admitted its first cohort of 45 students 'illegally' before it had been granted official approval from the ministry. This willingness to take risks in the name of educational innovation highlights the extent of the desire for change amongst students and teachers across the globe.

Different methods, but are there common themes?

Although these many examples of challenge or problem-based learning in higher education are diverse, there are common themes.

- Learning as an inherently social activity

Educators are increasingly treating learning as a social activity. Group learning is preferred as it gives opportunities to develop lifelong learning skills such as teamwork and communication, and also exposes students to other cultures, heritages and biases. Group or student-centred learning implies a fundamental reconception of the roles of teacher and student; rather than the professor being the source of all knowledge, delivering lectures to the class, he is expected to facilitate group discussions, providing knowledge and insight where necessary, but guiding students through their own journey of self-discovery. The students are expected to teach and learn from each other as well as to teach and learn from the teacher. This approach increases the collective intelligence of the group and fosters values of independence, problem-solving and continuous learning.

- Learning is often best achieved by solving real-world problems

Students learn best when they are working on problems that stimulate them, and they are also best motivated when they can see the purpose of their work. Learning by solving real-world problems is also crucial preparation for life in the outside world. One of the key benefits of teaching in this way is that it teaches how to break down a complex problem into its constituent parts, a skill that will be of increasing use to graduates over the course of their careers.

Solving real-world problems also helps higher education institutions achieve their 'third mission' of community impact. Of course, solving relevant problems requires strong connections with society, so as elegantly described by Etzkowitz (1993) in his [Triple Helix](#) model, Universities should actively pursue partnerships with governments and companies. The Earth Institute at Columbia University is one standout example of this. It works with companies including British Telecom, Du-Pont, General Electric, GlaxoSmithKline, Monsanto and many others to research ways to address global problems such as climate change, poverty and disease. Aalborg University is another. As part of the Sino Danish centre for education and research and the European Consortium of innovative universities, it received external funding of over €100 million in 2013 and worked on over 1000 research and consultancy projects with external partners.

A recent development in this area is the University of Waterloo's 'Problem Lab'. The lab brings together students and researchers along with companies such as Thomson Reuters, to help identify and define problems for students to work on. Along with inspiring students to come up with solutions, these efforts also go towards the creation of a Problem Archive', a resource which can be accessed by the University of Waterloo community.

- Interdisciplinarity

The virtues of interdisciplinarity are widely understood, yet for a number of reasons there is still a large gap between the ideal and the reality in most universities. One is that, as an array of research shows, interdisciplinary projects actually require [more investment in strategic management and funding](#) than traditional projects - in order to broker collaborations, increase engagement with users and disseminate outcomes. There also remains the problem that scholars are incentivised to publish in well-established journals, established fields which requires them to work in orthodox disciplines to progress their careers. This being said, universities are now gearing up for an increasingly interdisciplinary future, especially in the UK, where the Government has signalled a major overhaul of the higher education and research funding system.

University College London for example, offers a Bachelors of Arts and Sciences, which allows students to create bespoke degrees, incorporating both arts and sciences subjects along with a foreign language. The course structure allows the choice of both a major and minor pathway from four subject clusters: cultures, societies, health and environment and science and engineering. Further afield, [The Centre for Research and Interdisciplinarity](#) (CRI) Paris, offers only one subject - 'integrated life sciences'; at undergraduate, Master's and PhD levels. The course combines knowledge from biology, physics, chemistry, mathematics and computer science into holistic science qualifications.

- An innovative approach to assessments

Universities around the world are experimenting with assessments. When thinking about assessments, it is logical to begin with the question of 1) what do we want students to learn?', and 2) how are we going to assess them?' If we start with the assumption that we want students to learn formal disciplinary knowledge along with a range of lifelong learning skills such as communication, problem solving, teamwork etc., then a range of assessment options open up that are much broader than the standard exams and essays.

Stanford University's P⁵BL model for example uses a Cross Disciplinary Knowledge Framework, where students are graded based partially on how well they understand the subjects of their teammates from other fields (Architecture, Engineering, Construction). They are also graded on other factors such as the teamwork process, team presentation of the product and process and product quality in terms of system integration thinking. McMaster Medical school has a different approach and deliberately avoids assigning grades at the end of each group unit in order to discourage 'learning for the test' and to support a collaborative learning environment.

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- From building blocks to thematic blocks

In a traditional 'building blocks' structure, basic knowledge is taught first, with later modules building on key concepts. Whilst this intuitively makes sense, it can leave students unmotivated as interesting topics are often saved for last. Thematic learning is a different approach to course structure that teaches a number of concepts under a single theme. For example, a climate change block in a Biology course might bring together the fields of Ecology, Synthetic Biology, Biochemistry, Ecophysiology amongst others to help gain a holistic understanding of the subject. Along with being engaging for students, this type of learning challenges them to develop skills such as critical thinking, problem solving and metacognition.

- Openness

With the growth of the internet and the spread of MOOCS, universities have been forced to reinvent themselves; moving from a collegiate, exclusive model of education, to an open, transparent one. Although many institutions feel threatened by the prospect of openness brought on by the digital revolution, in reality, it is an opportunity for universities to reinvent themselves as sites for problem-solving and innovation.

While courses are increasingly open in transmission, most are still not open to contribution. The [Phonar](#) (Photography and Narrative) module on Coventry University's undergraduate Photography programme is an example of a course that is designed to be both. It is an open class which means that anybody across the world is able to access and take part in it. All the lectures are broadcast live from [Coventry University](#) in a 'Google Hangout' and course members (in person and online) are encouraged to discuss each other's work and give feedback.

Openness in the Higher Education can also be seen in the rise of open teaching resources. [TESGlobal](#) for example has an online network of seven million teachers, sharing resources and ideas order to improve students' experiences and the collective intelligence of the teaching community. The company has a number of platforms that allow teachers to create and share lessons, buy and sell resources and share ideas. The company has won a number of awards including 2013 Digital Innovation of the Year and Digital Product of the Year.

- Technology

The use of technology can facilitate new modes of knowledge production. Whilst it is important not to fall into the trap of using more technology for the sake of it, a focus on new uses of technology not only allows students to become familiar with real-world tools but can also lead to the development and creation of new

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ones. Technology is a prerequisite for teaching methods such as flipped learning, where content is delivered online and face-to-face time is used for discussion of ideas. It also facilitates international collaboration. Stanford School of Engineering's AEC course for example, uses a variety of technologies from interactive whiteboards to instant messaging and screen sharing to help students collaborate and coordinate their work. Another interesting example is The Estonian Information Technology College which encourages students to experiment with collaborative tools such as [Pingpad](#) and [Fleep](#). Students are also graded on how well they use the collaborative tools, based on their own evidence and documentation.

- Social Innovation

Social impact is a strong and growing theme in Higher Education. Solving social problems - either global or local, teaches problem solving and teamwork, whilst also instilling values of citizenship and community in students. One interesting organisation in this area is [Ashoka U](#). Ashoka U's [Changemaker Campus](#) designation accredits universities which embed the values of social innovation within their institution. There are over 30 Accredited Institutions including Arizona State University, Boston College, Cornell University, Johns Hopkins University, Tecnologico de Monterrey in Mexico and the University of Northampton in the UK.

The [University of Northampton](#) was the first UK higher education institution to gain Changemaker status. It offers a Changemaker Certificate is given to students who work on social ventures during their degree. It also runs the Social Venture Builder programme which gives students the chance to achieve a Masters in Social Innovation whilst growing their own social venture. The programme is unique in the UK as it does not charge a fee up front and accredits work-based learning.

Innovation Infrastructure

Fundamental changes in higher education need dedicated support if they are to be successful. New infrastructure is needed to foster a collaborative culture and break down political and budgetary silos. It can be difficult for leaders themselves to find time to focus on academic innovation, so innovation units (which combine instructional design, technology, faculty development and data analytics units) are a good solution to the problem. As MJ Bishop and Anne Keehn note in their recent [report](#): there has been a dramatic increase in these units in the US over recent years, with Stanford, the University of Maryland, Purdue, UT-Austin, the University of Georgia and the University of Connecticut all launching their own versions.

For these units to work they need clear purpose and boundaries, effective governance, a healthy budget and open and clear communication. They also need the political independence to allow them to experiment with radical ideas so they can truly make a difference. Tackling culture of course is key and those hiring for educational innovation units should seek to work with established influencers and changemakers within the university structure and to assist in this.

Multi-institutional initiatives can be a good way to research and experiment of new models within teaching and learning. The [Institute for Transformational Learning](#)'s Competency-Based Learning initiative and BCcampus' [Open Textbook Project](#) for example use a 'Shared Services Network' model for collaboration, where each institution is assigned a specialised role for the project. This allows for greater efficiencies, however, it can cause communication and coordination problems. In Thomas Carey's recent blog post, he [argues](#) that for many initiatives, a superior approach is that of the 'Open Innovation Network'. An Open Innovation Network goes a step further than a shared services network as it has a shared co-ordinating hub that plays a convening and catalysing role amongst its member institutions. This shared investment allows member institutions to spread their political and economic risk capital and undertake larger and more effective initiatives.

Overcoming difficulties, managing risks

A big challenge in this area is how to innovate whilst maintaining a good standard of education for students. This is one of the main reasons many universities have been so conservative about curriculum change - the costs of failure on their reputation and their students' education is large. There is a general tradeoff between experimentation and improvement on the one hand and predictability and conservatism on the other, so for this reason radical curriculum change should be undertaken with the utmost prudence. In the examples discussed above, faculties have invested significant time and resources researching and learning from others before them. Even McMaster Medical School, the originator of Problem Based Learning, drew on years of experience and learning from related studies when designing their PBL curriculum.

Whilst radical curriculum changes are inevitably costly to undertake, smaller changes such as incorporating challenge based modules can be a good intermediate choice, providing valuable skills and experience to students and giving faculties the opportunity to innovate their curricula in an isolated fashion. Challenge-driven modules can be optional, allowing ambitious students the opportunity to learn in new and interesting ways. Of course there is always a

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risk that students choosing innovative modules could do worse than those who were not given the option. Tsinghua University's approach of only allowing the top 3 per cent of students to take part in these modules is one way to solve this. However, it is quite possible that those achieving lower grades would also benefit from innovative teaching methods. Encouraging students to participate in external competitions such as BioBricks or the ArtScience prize as electives has the benefit of shifting the responsibility for designing challenge-based modules onto expert providers with specific reputations, however this often requires extra funding for students to take part.

Beyond Capstone: a global network for SDGs?

We should take the lessons we've learned from innovation happening around the world and strive for more. Examples like Stanford's P5BL have shown the promise of technology-assisted international collaboration, and the ongoing success of interdisciplinary bodies like the Imperial Energy Futures Lab and [Aalto's Factories](#) demonstrates the benefits of an issue-based approach for solving global problems.

The recent announcement of the UN's [Sustainable Development Goals](#) could provide the spur for taking these ideas to a much larger scale. Ending poverty, providing clean energy and ensuring health and wellbeing for the world's inhabitants requires a concerted effort by creative minds across the world. Giving students a way to work on these issues, whilst also earning credits for their studies would help solve the world's problems whilst also producing graduates that are better prepared both for the workplace and to be future citizens of the world.

A Global Online Campus could link up the kinds of programme described in the previous sections - connecting project and challenged based learning in existing universities. The Campus would be organised around each of the UN's 17 Sustainable Development Goals and 167 targets.

Projects would focus around the local dimension of problems such as gender equity or access to sanitation. Students would work in teams, and with partners - companies, NGOs and municipalities, over reasonably long periods (more like six to nine months rather than the one to three weeks for many current projects in universities). An online platform would provide access to data, research, and groups of other students globally working on parallel issues. The students would be rewarded with credits as in existing courses.

Assessment of student contribution could be achieved by using open data like that provided by [Open Seventeen](#) along with other measures. This global



campus can also serve as a platform to connect change-makers with ideas that need to be implemented, giving students the chance to inspire real-world projects.

Models of this kind can be adapted for many ages - including 16-18 year olds still in school and graduate students. In each case careful design is needed to ensure sufficient time to absorb knowledge.

What should or could universities be?

Universities are very privileged places, and they are also providers of privilege. The education they provide creates a public benefit but also of course a huge private benefit for students.

Challenge-driven models are good for students as individuals - sharpening up their skills of analysis, problem solving and collaboration. But they also have an ethos of service - putting the brainpower of the brightest students to work on the problems most in need of solution.

This is perhaps the key issue - reimagining the social contract between those given the most opportunity to develop their knowledge and their minds, and the rest of the population.

Part Two - The challenge-driven university in historical perspective

There have been many attempts to break the mould of the monastic university, some of them quite dramatic.

In September 1793 the leaders of Revolutionary France closed every university and college in the country, arguing them to be bastions of medievalism. A year later they were reopened as laboratories of learning based on Enlightenment principles.

Nowhere was this more evident than in medicine. Three hospital-based "schools of health" were opened in Paris, Montpellier and Strasbourg in 1794 with the aim of reforming medicine along scientific lines, to be based on experiment and observation. The chemist Antoine Fourcroy announced to France's new law-making body, the Convention, how medicine would now be taught: "Reading little, seeing a lot and doing a lot will be the foundation of the new teaching... Practising the art, observing at the bedside, all that was missing, will now be the principal part of instruction."

Though the first university hospital proper was opened at the University of Leiden in the Netherlands just a few years earlier in 1798, the Paris School in particular, - the home of the stethoscope, the autopsy and modern biology itself - was to be the model for a new synthesis of practice-based learning and experimentalism that spread across the world. As Daniel Drake, the founder of the first University Hospital in the US, in Cincinnati, was to say in 1820: "The laboratory is not more necessary for the study of chemistry or a garden for the study of botany, than a hospital for the practical study of medicine or surgery."

But the move towards a more practical and professional higher education system was also a shift away from the universal and inter-disciplinary ideal that was the very root of the classical notion of the university. Anxiety over the social and cultural consequences of increasing intellectual and occupational specialisation in the 20th century spawned a number of attempts to blend technical knowledge with a multi-disciplinary curriculum. This was often accompanied by a more expansive environment of free-flowing and self-directed enquiry than either the French *Écoles Normales* or the traditional Anglo-Saxon university could afford.

Some of these were fairly short-lived. The University of Wisconsin's Experimental College - a two-year programme with no schedule, no compulsory lessons nor semester grades, but a common syllabus of liberal arts and real-world study in a collegiate community set apart from the town - flourished briefly between 1927 and 1932. But in the very year it closed Frank and Olgivanna Lloyd Wright - inspired by the educational philosophy that had come

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to be known as the Wisconsin Idea, the notion that the State of Wisconsin should be the classroom and that university research and learning should focus on solving problems for citizens - accepted their first apprentices for the Taliesin School, a revolutionary new school of architecture with a radically universal curriculum focused on Learning By Doing - set on the banks of the river in Spring Green, Wisconsin, where it retains its "Summer Campus" to this day alongside the more famous Taliesin West in Arizona, having recently fought off a threat to its accreditation from America's Higher Learning Commission.

An equally successful experiment was born amid the austerity and idealism of post-war Britain. It was the brainchild of A.D. Lindsay, the then Master of Balliol College, Oxford, who bemoaned the fact that graduates were losing the common background, terminology, and values which had previously been almost universal in university education. Mutual understanding was declining as specialisation increased.

Lindsay's central thesis was that "... (the) man who only knows more and more about less and less is becoming a public danger", believing that steps needed to be taken to balance essential specialist and expert knowledge with a broader outlook and more general understanding. "If we are going to try and keep a democratic country and maintain understanding of one another", he argued, "we have to send out people from our universities who can do the technical stuff and who at the same time have an understanding of political and social problems and of the values that lie behind them".

It's from this idea that the Keele Experiment, the first Higher Education institution to be established after the Second World War in the United Kingdom, gaining degree-awarding powers in 1949, was born. Its radical educational principles were quite influential. Nearly every UK university now presents dual-honours degrees, a Keele innovation, although now quite in the esoteric combinations originally offered at Keele. The attempt to create a campus community was adopted by the later wave of new universities e.g. Sussex, often using Keele's original template, in an effort to replicate Keele's integration of educational and social life.

The most radical innovation though - the four-year degree predicated on a Foundation Year of universal study was discontinued in the 1990s because of a combination of political pressure, cost and growing unpopularity among applicants. The Keele Experiment made a dent in the prevailing orthodoxy, and inspired other more radical ideas like Cedric Price's Thinkbelt - a university on rails - and Michael Young's hugely influential Open University. But in the end it too had to accommodate to a system highly resistant to change.



A similar fate befell the the *Centre Universitaire Expérimental de Vincennes* - the Experimental University - established in the outskirts of Paris in 1969, in response to the May student protests the year previously. Its specific goals were to open the university to the world, breaking down the hierarchy between professors and students and transforming traditionally elitist access to university.

Though its faculty was a roll-call of the French and international intelligentsia - Foucault, Ranciere, Balibar, Deleuze, Bensaïd, Negri and many others - its relaxed attitude to traditional educational structure (one of its lecturers, Judith Miller, the Maoist daughter of Jacques Lacan, once famously handed out a degree credit to someone she met on a bus) meant the experiment was wound up by 1971 when it became the much more prosaic University of Paris 8.

Graduate schools have proven more fertile environments for the growth of problem-based learning. The Deans of Harvard Law School revised the curriculum at the end of the 19th century to be based on interactive discussion of real world examples. The approach was soon adopted at Columbia and became the norm for Law Schools throughout the world. In 1908 the first Dean of Harvard Business School adopted this approach for management education and the 'Case Method' - his original term was the 'Problem Method' - has since become standard for business schools everywhere.

In 1969 the new McMaster University School of Medicine built on medical education's history as a pioneer by inventing 'problem-based learning' (PBL) soon taken up by medical schools elsewhere. Characteristically, it was the Scandinavians that embraced this innovation wholesale, being the first to found an entire university on PBL, at Aalborg in Denmark in 1974.

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