Creativity and Innovation in Higher Education

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PREFACE

To stay competitive in the rapidly changing and globalized world, higher education communities across the globe have put extensive efforts to equip students with the 21st century skills, especially creativity and innovation. They devote to developing and implementing new curriculum, in alignment with the changing educational objectives, and to preparing students with the ideal graduate competency. Since 2012, City University of Hong Kong has been adopting the Discovery-enriched curriculum (DEC), which provides students with the chance to make an original discovery during their stay with the University. With concerted efforts of the University community in implementing the new curriculum, the University received the 2017 Team Award for Teaching Excellence from the University Grants Committee (UGC) of Hong Kong in 2017.

As such, City University of Hong Kong was keen to share the success story through the organization of the Discovery-enriched Curriculum (DEC) Symposium in 2018 and The International Conference on Higher Education - Curriculum for Discovery and Innovation (ICHE*) in 2020. They provided platforms for local and overseas professionals and practitioners to exchange educational practices and share success stories with regard to creativity and innovation in higher education. This book comprises the proceedings of the Symposium and the International Conference. It aims to further disseminate the successful integration of innovation elements in the higher education curriculum on a global scale. Hopefully, this book could provide a different perspective on creativity and innovation in globalised educational contexts.

We would like to gratefully acknowledge the financial support of the University Grants Committee (UGC) of Hong Kong. We are also grateful for all those who made the Symposium, Conference, as well as the publication possible.

* *ICHE is organized by City University of Hong Kong, with Hong Kong Baptist University, The Chinese University of Hong Kong, The Education University of Hong Kong, The Hong Kong Polytechnic University and The Hong Kong University of Science and Technology as the co-organizers.*

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The International Conference on Higher Education — Curriculum for Discovery and Innovation

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The New Normal: An Instructional Development Infrastructure for an R1 Setting

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ABSTRACT

CSIE|UM (Chemical Sciences at the Interface of Education at the University of Michigan) is a comprehensive program built upon improving the professional readiness for our students interested in academic careers. Our strategy is wholly unique, in that we have provided a sustainable model for engaging the faculty in the ongoing process of instructional development. In short, faculty members who wish to pursue education projects can form "teaching groups" made up of undergraduate, graduate, and post-doctoral collaborators analogously to the way they form "research groups" in laboratory research.

INTRODUCTION

When the concept of scholarship was broadened to include teaching and learning (Boyer, 1990), an implicit, underlying strategy we recognized was that the infrastructure for doing scientific research could be broadened to include educational projects. The analogy for working on education was created by studying how research is accomplished in scientific research groups. Thus, in an education setting, faculty can also team with student collaborators, i.e., undergraduates, graduates, or post-doctoral students, to get advanced work done (the faculty agenda) by training them through the work they do (the student need). In particular, disciplinary research students who are interested in faculty careers team up with multiple mentors so that they develop their ability to design, implement, assess and document instruction at the same time they develop such abilities in doing research. In this article, I will discuss how new educational projects get started, as well as how they can get done in a research setting.

Faculty involvement in education and instructional development varies widely, so I begin with simply dividing the faculty into three categories, i.e., *believers*, *agnostics*, and *non-believers* (see Figure 1). *Agnostics*, the class I am interested and will discuss about, refers to the group of people who are not quite believers but who may be curious, or who are looking for rewards to get them involved in the instructional development, or who may be waiting for an instructional cultural change that moves them into instructional development.

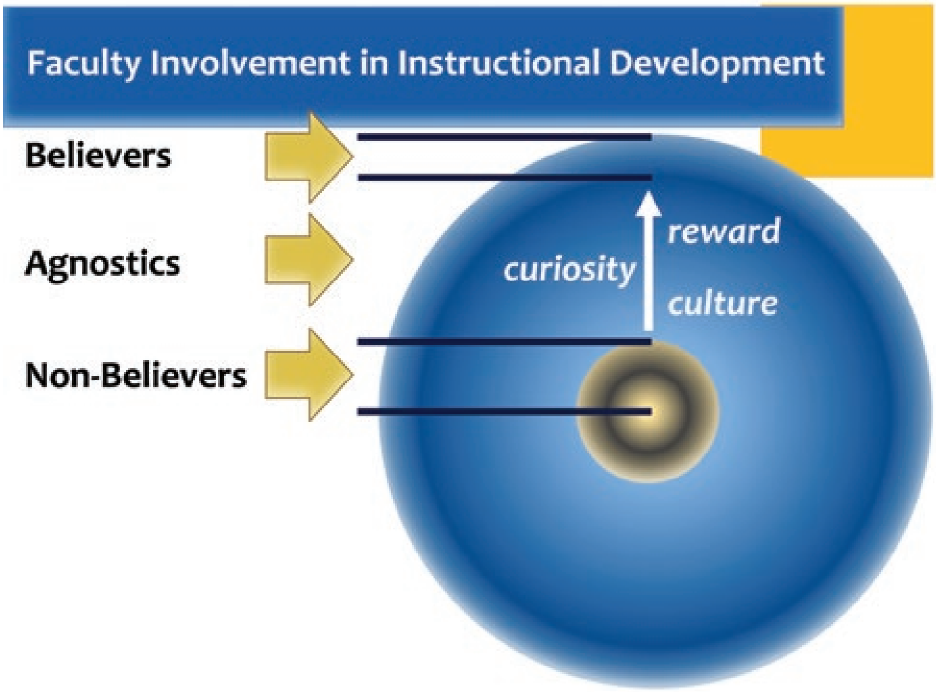

Figure 1

WE ARE IN THE U.S. SYSTEM

The Carnegie Classification has been the leading framework for recognizing and delineating institutional diversity in U.S. higher education since 1970 when the Carnegie Commission on Higher Education initially proposed the classification to support its program of research analysis (The Carnegie Classification of Institutions of Higher Education, 2020a). The classification categorizes institutions mainly based on their number of PhD programs, the number of students, the amount of resources, and so forth. In this framework, R1, the highest "research intensive" classification, refers to doctoral universities that support very high research activities, followed by R2 institutions (The Carnegie Classification of Institutions of Higher Education, 2019). Among over 4500 higher education institutions in the U.S., 131 institutions are classified as R1 universities and 135 institutions are R2 universities. As it turns out, about 50% of all PhD students are housed at 30 of these R1 universities, and about 75% of the people, who are going to become faculty members in the future, are also at those 30 schools (The Carnegie Classification of Institutions of Higher Education, 2020b). In my work, I am concentrating on the future faculty because if we consider their education and preparation, we have the chance of effecting change across this entire constellation of universities as that is where they are getting their jobs.

Furthermore, I am concentrating on the R1 universities because the majority of the future faculty are located there, they are the model institutions for pursuing academic scientific research. Two goals can be accomplished by institutionalizing a broadened conception of scholarly development in these R1 departments. First, it can move a group of influential and visible *agnostics* from just being curious observers into educational developers. Second, it will automatically do a better job at preparing their students, who are next generation of faculty members, to engage education professionally.

ENGAGING STUDENTS AS PARTNERS IN RESEARCH

Engaging students as partners in research, getting them to think about design, implementation, assessment, and publication, is certainly done differently in different disciplines, and here I am focusing on the physical science disciplines. If we look at the Arts, Humanities, and many of the Social Sciences disciplines, the professors tend to be the ones that come up with the ideas and then do the work to move their own ideas into scholarly output. PhD students in those disciplines tend to work very independently, constructing their own theses. Yet, the situation in Science, Engineering, Medicine and some other Social Sciences cannot be more different. Professors work as principal investigators - they are leaders of teams; ideas flow between all the members; team members are constantly learning for one another and the output comes from everyone. No research would get done without the students in the science disciplines. Engaging students as partners in research combines student training with faculty goals. Big research groups were not always the norm, but after the Manhattan Project, and the development of public funding for academic research (NSF, NIH), students training in the sciences has been coupled with the achievement of a faculty member's overall research objectives.

A research group represents a structure for intergenerational learning in practice. Intergenerational learning, which originally refers to familial contexts (Gadsden & Hall, 1996), has later broadened its concept to various extra-familial social situations where there would be "a purposeful exchange of knowledge among older and younger generations that yield individual and social benefits" (Orzea, 2012, p. 2). In a research group, the role of the research advisor, which is also called principle investigator, is not to run experiments but to direct the overall professional development of a group of people. All of the work is centralized around the research program. To some degree, the intergenerational community of postdoctoral researchers, PhD students, and B.S. (Bachelor of Sciences) students are similar to the kinds of one-room schoolhouses in the U.S. a hundred years ago. Here is an image from 1921 (Figure 2; Hine, 1921). We see there is the teacher in the room with a group of students at different ages. The routine business that is not captured in a photograph is that the older students worked with the younger students, and teamed with the teacher to pass knowledge along. This demonstrates how things work in a scientific research group where the older (postdoctoral students), middle (PhD students), and younger (B.S. students) students are all living learning and working with one another. My argument here is that the infrastructure for intergenerational training which works incredibly well for research is also something that can be extended to education,

Figure 2: "School in Session"

Library of Congress, Prints & Photographs Division, National Child Labor Committee Collection, [reproduction number LC-DIG-nclc-04354] because some fraction of our students are always interested in becoming faculty members one day and being involved in a career that exists, by definition, at the interface of both research and education.

ADAPTING THE RESEARCH GROUP IDEA TO TEACHING GROUP IDEA

The classic faculty triumvirate for responsibilities and obligations include research, teaching and service (Centra, 1979). In the scientific disciplines, we have perfected the research group system, where faculty research productivity is coupled to a system of student development. As I started this work, my basic argument was that what works well in research could also work well for the other aspects of faculty work and provide an educational platform for the next generation of faculty members (see Figure 3).

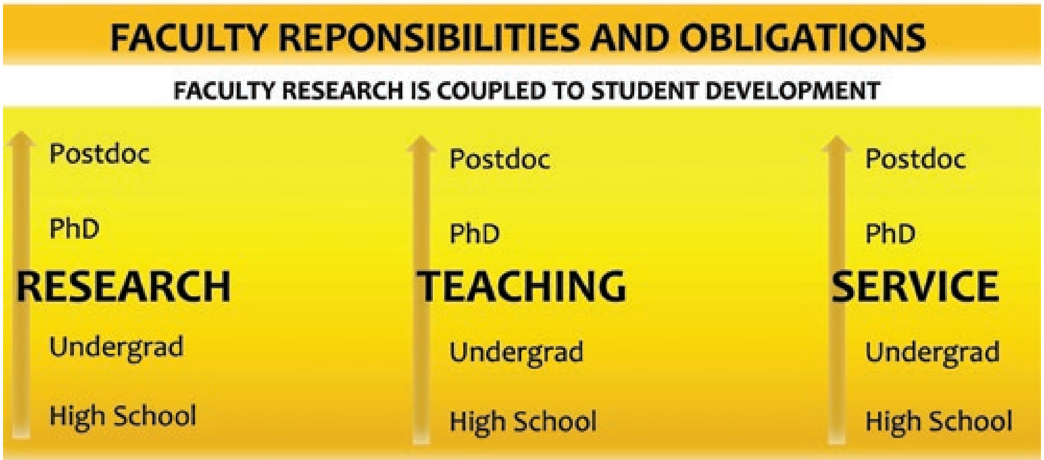

Figure 3

The academic scientific research infrastructure in the U.S. illustrates the success of students working in a system where everybody in the team, the principal investigator and the students, are all working back and forth as a community, sharing and swapping leadership roles. In the U.S. system, we rely strongly on the role that financial support plays, whether it is in the form of a TA-ship, a fellowship, or a research assistantship. Students earn a respectable stipend, and get the high level of tuition as well as insurance paid for, so the work done in exchange is real and the money needs to be earned. In addition to a living wage, students get all kinds of programming to support their intellectual and professional development, e.g., courses, seminar, certifications.

Getting faculty to adapt the research group idea into the teaching group idea is a mechanism that I intend to be a temptation for those who are "just" ready to pursue work in education. I cannot do the work, nor do I want to take on everyone else's projects, but I can build the structure that enables them to form a teaching group around their interests in education. Hence my strategy to model this effort on their prior and deep understanding of building a research group on their research ideas. Every semester, I solicit descriptions of course/program projects from faculty colleagues in my department who may be *agnostics* but who may also have an idea in education - in addition to research - that they want to pursue. Upon building the infrastructure, we go out and find some future faculty students in our department, the Department of Chemistry at the University of Michigan, as a team to work on the projects. In doing so, the department does not only provide a future for their research training, but also a future for their education training. Students develop critical organizational management, interpersonal skills, and leadership that they might not otherwise obtain during their research training (Coppola, 2016).

As a department, we have to consider the different roles that people play in these projects, such as undergraduates, PhD students, postdoctoral researchers. We understand these things well in research and need to figure out what it means to be involved in a team-based education project. We have to think about the sources of support. Undergraduates are terrific to work with, because whether it is education or research, they tend to work for little bits of pay or they will work for free because they accept credit. For graduate students, we have developed a hybrid TA positions where students can spend half of their time on regular TA work. They can devote half of their time, meaning ten hours a week, to an educational development project as a part of one of these teams. We also provide opportunities for post-doctoral students to join these teams and to also to pick up 25% of the salary of a post-doctoral position in exchange for having them as instructors in the department (in a mentored position, usually as one of the members of the teaching team in a large, multi-section course). Additionally, we consider about programming activities, such as education related workshops, seminars, courses, combined degree program, and thesis chapters. We have a combined degree program with our School of Education where the PhD students in Chemistry can get a master degree in university education. Since 2002, it has been routine for graduate students in our department to present dissertations that may have one to three chapters of their education work that they did as a part of their PhD program.

There are 35 professors in my department. Last year, after the solicitation, I received 21 projects from those 35 professors who were trying to recruit students to work on an educational or instructional development project. The following examples illustrate the way that my faculty colleagues, all of whom are running world-class discovery research programs, incorporate future faculty to participate in their educational projects.

Case 1: Course-based Undergraduate Research

At the University of Michigan, a semester-long general chemistry laboratory course with the focus on snow chemistry research, entitled Chem 125–Snow, was initiated in 2015 and 2016 (May et al., 2018). With my colleague, Professor Kerri Pratt, being the leader, the instructional team resembled the composition of a research group made up of one postdoctoral fellow, two graduate student instructors, and two to four undergraduate assistants (May et al., 2018). This course was designed to offer undeclared, first-year undergraduate students an authentic research experience, wherein they were guided through all stages of the research process, i.e., "research question development, data collection and processing, interpretation of results in the context of scientific literature, and both written and oral presentations" (May et al., 2018, p. 543). To gauge student confidence in their familiarity with the snow chemistry research topic and their ability to perform general research skills, CHEM 125–Snow was actually implemented simultaneously with the traditional general chemistry laboratory course (CHEM 125–Traditional), which did not contain a research project (May et al., 2018). Survey results showed that "students who received lecture- and research-based instruction on snow chemistry exhibited significantly higher confidence, compared to Chem 125–Traditional students" (May et al., 2018, p. 547).

I am absolutely certain about one thing: if Kerri needed to do all of this work herself, she would still be in her office wondering if this is a good idea. Instead, with her in the lead, within a matter of months, students in the team developed, tested, and implemented the materials; they helped teach when it was time to give those classes; they also helped collect the data. The undergraduates who were enrolled had, in fact, been part of a brand new laboratory experience, analyzing the authentic research samples. For some of those who were able to go to Alaska to collect new samples, they came back to the course afterwards and became co-instructors or assistants. It follows that Professor Pratt had her first publication in the Journal of Chemical Education soon after (May et al., 2018).

Case 2: Integrated Lab-Lecture General Chemistry

Professor Mark Banaszak Holl, another colleague of mine who is now at Monash University, was interested in the one-room schoolhouse approach to General Chemistry. He created the idea of studio chemistry and implemented the studio chemistry course, in which students integrate their lecture and lab experience in one room setting rather than taking them separately in different rooms (Gottfried et al., 2007). In implementing the course, he put together an eight-membered team of two faculty, a postdoctoral associate, four chemistry students, and a graduate student in education (Gottfried et al., 2007). The course contained four components: *Studios, Interstudio, Student enrichment activities (SEAs)*, and *watershed project*. After the initial work, in an experimental space with lecture seating and laboratory benches in the same space, the project moved back to the chemistry building to see if it could be translated into a traditional setting. The studios, SEAs, and watershed project were executed in conventional laboratory space, whilst the interstudio was organised in a typical classroom (Gottfried et al., 2007, p. 266).

It turns out that this course "successfully provides significant 'value added' while maintaining the key content mastery needed to continue in science or engineering classes", and achieves the goals of "creating an interactive environment for students to gain conceptual and algorithmic chemical knowledge through observation, interpretation, and construction of meaning from chemical phenomena", as well as "assisting students in creating an integrated understanding of chemical principles by relating these principles to other disciplines through a variety of media and to applying their understanding to new situations" (Gottfried et al., 2007, p. 266).

Case 3: Computer-to-Learn (CTL)

Professor Eitan Geva is a theoretical physical chemist. Based on the theories of situated cognition and meaningful learning, he and his team of graduate student collaborators developed a novel *compute-to-learn* pedagogy (Jafari et al., 2017). The pedagogy involved students in authentic scientific practices when they construct interactive, computer-based demonstrations of physical chemistry notions (The Geva Group, 2015). This pedagogy was firstly implemented in a chemistry course at the University of Michigan in 2015, in which "a team consisting of faculty members, graduate students, and a pair of undergraduate peer leaders met regularly throughout the semester to develop course materials, review progress of students, and prepare for studio sessions" (Jafari et al., 2017, p. 1897).

According to Jafari et al. (2017), formal interviews were conducted at the end of the course to assess student experiences and outcomes. It turns out that the course provided students with an environment in which they could learn how to code within the context of a required chemistry course. Many students expressed that they gained the sense of accomplishment as they are able to independently learn complicated topics or navigate various resources to resolve programming problems without formal instruction from teachers; many students learned the benefits of knowing when and how to seek assistance and they found peer-review useful; also, some students uncovered the interdisciplinary aspect of research via their involvement in the studio.

EARLY IDENTIFICATION FOR TALENTED UNDERGRADUATES

A vast amount of literature has provided empirical evidence in support of early identification of exemplary students who have potential in faculty careers (Barnett & San Felice, 2006; Gillian-Daniel & Walz, 2016). My personal interaction is completely in line with the discussed instructional framework, and I have worked almost exclusively with undergraduate students as my team members. I have had a great time doing what I consider myself to be imaginative undergraduate education by teaming up with these undergraduate students as my teaching partners and collaborators. A number of my students who had taught with me as undergraduates are currently in faculty positions at different universities, such as being my colleagues at the University of Michigan, or in faculty positions at Vanderbilt University, The Scripps Research Institute, the University of California-Irvine, etc. They were influenced positively about education as undergraduates, and even if their graduate experience did not reinforce these kinds of values, every single one of these individuals will say that part of their motivation for going into faculty work and faculty careers is tied to the work during their undergraduate studies when getting involved in teaching.

CONCLUSION

In summary, to engage faculty in the work of instructional development, we accomplished two essential tasks. First, we broadened the existing support infrastructure to include the idea of teaching groups. When we consider every piece of support that people provide for research, we ponder the analogy of such support for teaching as well. Second, we identified and invited the future faculty to work with us, i.e., the students in our department who are interested in faculty careers, so that they are as ready to participate in education when they become faculty members. The nature of a scientific research group determines that we have always been enthusiastic about the team-based methods, and such infrastructure has been applied to education as a new normal. It is inevitably true that there are simple things that you can do as a team but impossible to do on your own, which now includes teaching.

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Technology-Enabled Academic Innovation in U.S. Higher Education: Current Models and Emerging Trends

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ABSTRACT

U.S. higher education faces a bevy of issues, including the persistent issues (e.g., accessibility, affordability, relevance, student success) and the emerging COVID-related challenges (e.g., social distancing, forced remote learning). To address the persistent issues and new challenges, many higher education institutions have been exploring and experimenting with innovative ideas enabled by the Internet and digital technology. This paper summarizes and discusses the current technology-enabled academic innovation models that are transforming higher education. It also touches upon the emerging trends that call for fundamental change of the traditional higher education structure, system, and mindset.

INTRODUCTION

Higher education holds an increasingly pivotal role in economic and societal development. It rather shapes a country's workforce and consequently determines the country's socioeconomic performance. The demand of college-educated workforce is rising, and the case will continue over the next several decades. Yet, despite opportunities, a range of challenges and criticisms also emerges for U.S. institutions of higher education.

The major challenges the U.S. higher education faces include affordability, accessibility, accountability, the skills gap between academia and industry, and curricular stagnation. Moreover, at the time of writing this paper, the COVID-19 pandemic has become the biggest challenge for higher education. The criticism over higher education is centered around the rapidly rising tuition and mounting student debt. In 1971, the average cost of one year college accounted for 15.6% of the median household income, which did not necessarily lead to student loan debt for many families; however, in 2018, the cost took up 35.2% of a median household income (Comet, 2018). In consequence, more Americans are now burdened by student loan debt than ever - about one third of those aged 18 to 29 currently have active student loan debt. Following mortgage debt, college loan ranks the second highest consumer debt in the U.S. (Friedman, 2018).

The mentioned skills gap between academia and workplaces is also highly controversial. The business world has been complaining that traditional college education is not preparing students well enough for the workplace. A recent 2017 McKinsey study demonstrated that only around 25% of employers believe that traditional colleges education works for preparing graduates for the workplace (Laboissier & Mourshed, 2017). Also, according to Brown (2016), a third of Americans do not anticipate that a four-year college degree prepares students well for the jobs in today's economy.

Digital technology plays a significant role in helping address those issues. Since its invention in mid-twentieth century, digital technology has changed the ways people communicate, live, work, and learn. With the ubiquitous access and everything enabled by the Internet, and the rapid advancement of digital technology for digital learning, technology has played an increasingly important role in teaching and learning. Now it is a catalyst of academic innovation.

The purpose of this paper is, therefore, to identify and delineate current technology-enabled academic innovation models that are transforming higher education. It also touches upon the emerging trends that call for fundamental change of the traditional higher education structure, system, and mindset, including a viable model that holds great potential to move higher education forward and facilitate student learning during the pandemic.

MODELS OF ACADEMIC INNOVATION IN HIGHER EDUCATION

To address the above-stated challenges, higher education has been exploring and experimenting with innovative models to facilitate students' access to higher education, support their success, transform their experiences, and prepare them for the increasingly complex economy and society. This section highlights four technology-enabled academic models, namely competency-based education, experiential education, open education, and lifelong education.

Competency-Based Education

Competency-based education was initiated by the U.S. Office of Education as a teacher training model in the early 1960s. Different from traditional course-based, credit hour-required college curricula, competency-based degree program is focused on discipline-specific "competencies" - what students know and are able to do in the real-world situation, and the students' learning and degree attainment are confirmed through a series of assessments on the competencies (Klein-Collins, 2013).

A pioneer in competency-based education is Southern New Hampshire University's College for America, which provides fully online competency-based degree programs to working adults. The president of the University, Dr. Paul LeBlanc always says, "In higher education, time is the constant and learning is the variable. In competency-based education, learning is the constant, and time is the variable" (Southern New Hampshire University, 2016, para. 8). Another successful example in public higher education is the University of Wisconsin System's UW Flex. Their learner-centered curriculum model allows students to progress at their own pace. Competences are constantly updated by professors in consultation with business and industry leaders (UW Extended Campus, n.d.).

The impact of online competency-based education lies in its accessibility and workplace relevance. Shifting away from the traditional on-campus, course-based degree program model, online competency-based education is opening up higher education to millions of people who otherwise would have no access to a college degree. This degree model is particularly useful to non-traditional college students, such as adult learners, working professionals, and traditional aged students who have little or no access to a campus-based education. In light of the COVID-19 pandemic with a high unemployment rate of 14.7% in April 2020 (The Washington Post, 2020), competency-based education comes as an effective degree model that helps people earn the credential they need to quickly re-enter the workforce when the time comes.

Experiential Education

As a well-established pedagogical framework, experiential education has existed for several decades in both K-12 and higher education. It provides students opportunities to learn, reflect and implement learning in the real world. Many higher education institutions use experiential learning or the variations of it, such as service learning, community-based learning, co-op learning, at the undergraduate level. Nevertheless, its implementation in online education is still in its infancy.

Northeastern University's College of Professional Studies piloted the university's first online experiential learning at the graduate level in a Project Management course in 2012. Unlike traditional online learning, Northeastern's online experiential learning is characterized by the integration of classroom learning and real-world work throughout the semester, as well as by the interplay of the feedback and evaluation between professors and employers (Northeastern University CPS Blog, n.d.). The online Master of Arts in Education - Educational Technology program at Louisiana State University is another exemplar of online experiential learning. Students in this program, mostly working professionals, start the program by planning their professional e-portfolio which is an accumulation of a series of experiential learning projects that are highly relevant to their profession or career aspiration. These experiential learning projects document and showcase their implementation of theoretical and practical knowledge acquired from the relevant coursework at their workplaces (Qian, 2019).

The impact of online experiential education lies in its relevance to the real world and job skills with a focus on immediate applicability of knowledge in real-world projects and ongoing feedback from professors and employers. It bridges the gap between classroom and workplace, theory and practice. As stated in my previous article "Online experiential learning: A game changer in online education" (Qian, 2019), online education has long been criticized for the lack of real-time interaction and for the impossibility of learning by doing through hands-on opportunities, while the integration of experiential learning projects in online courses holds great potential to transform students' online learning experience, and it also points to a promising direction for online graduate education.

Open Education

Education has a long history of being "open" and "free" to the public. Open education, in essence, is about accessibility – access to knowledge and learning. With the advent of the Massive Open Online Course (also known as MOOC) in the early 2010s, the magnitude of open education has multiplied at an unprecedented rate.

In 2012, Harvard University and MIT co-founded edX, a non-profit online platform which offers free online courses, training modules, and MOOC courses to the public. Likewise, Stanford University, the birthplace of MOOCs, built Coursera in 2012, an online learning platform that serves the same purpose as edX. Open education in the format of MOOC, as an innovative educational movement, has opened up the door for learners around the world to gain access to teaching from top universities and learning cutting-edge subject areas. Some elite universities are taking a step further by offering more opportunities. For instance, to expand the potential of MOOC as a springboard for degree pursuing by adult part-time learners, Harvard Extension School and MIT have collaborated in creating a new MicroMasters credential pathway that allows learners who complete an MITx MicroMasters credential to apply and continue their work toward a master of Liberal Arts degree at Harvard Extension school (Harvard Extension School, 2018).

The most prominent contribution of digital technology-enabled open education, such as MOOCs, is that it can truly democratize education globally by eliminating the barriers to access to and participate in educational opportunities to people around the world. With the emergence of adaptive technology, artificial intelligence, and machine learning, open education will become more individualized, interactive, thus more meaningful.

Lifelong Education

One complaint about higher education is its slow-changing curriculums that fail to catch up with the needs of job skills in today's economy and workplace. The emergence of Industry 4.0 technology is changing the fundamental nature of work. Manyika et al. (2017) estimated that a third of the workforce could be replaced by robots by 2030. Therefore, continuing education to reskill or upskill has become a necessity, rather than an option, for people to stay competitive in today's economy and workplaces. Lifelong education, which refers to the continuing development and improvement of knowledge, skills, and competences in a field after formal education and it has never been as imperative as it is in digital age (London, 2011).

University of Washington (UW) leads the way in this area. In 2017, The UW Continuum College debuted the Career Accelerator program for working professionals to earn a non-credit certificate in high demand career fields, such as Data Analytics, Data Science, Machine Learning, Project Management, and Python Programming. Each year, over 50,000 students earn professional certificates and advanced degrees from the Continuum College (University of Washington, Continuum College, n.d.). Because of its achievements in innovation, University of Washington ranked the fifth most innovative university in the world (Ewalt, 2018; Holtz, 2019), and its Continuum College's Career Accelerator program was recognized as the 2018 outstanding Non-Credit Program by the University Professional and Continuing Education Association (University Professional and Continuing Education Association, 2018). In addition to UW's Career Accelerator Program, which is an exemplar in this area, lifelong education can be achieved in other ways, such as MOOCs offered by Harvard and MIT's edX, Stanford's Coursera and Khan Academy.

EMERGING TRENDS

The four models as discussed above, competency-based education, experiential education, open education, and lifelong education, set the ball rolling in responding to and addressing the issues higher education is facing, including accessibility, affordability, relevance, and skills gap. Their impact and potential have been enabled and amplified by the power of internet and digital technologies.

In addition, some forward-thinking institutions have taken bolder strides to boost "disruptive" innovation – fundamental change of the traditional higher education structure, system, and mindset. Three most prominent emerging trends will be discussed as follows.

Ivy League's Embrace of Online Degrees

The University of Pennsylvania (UPenn) launched its fully online bachelor's degree in the fall of 2019, targeting working adults and other non-traditional students. This first Ivy League fully online degree program made the history in the U.S. higher education because it has redefined the notion of "who can get an Ivy League education" (Penn Today, 2018, para. 2). Its alternative admission path, called "prove your way in," makes the program accessible to anyone who demonstrates the potential to earn it. The program aims to serve thousands of students, with an emphasis on instilling liberal arts education in professional and career development (McMurtrie, 2018). While the misconception still lingers that online learning seems less rigorous and legitimate than traditional on-campus learning, UPenn's offering of fully online bachelor's degree starts a profound perceptual and a cultural change in higher education.

Business/Industry's Inroad into Post-Secondary Education

Business industry's inroad into post-secondary education is another emerging trend. The skills gap between academia and industry has long been a controversial issue in higher education. Large companies, in particular those in the technology sector, such as AT&T, Amazon, Google, and IBM, have launched their own courses in emerging high-tech fields, including virtual reality development, digital marketing, big data, artificial intelligence, and machine learning.

To embrace business industries initiatives, some universities are agile and quick in responding and adapting. For instance, in September 2018, Northeastern University announced that learners who complete Google's IT Support Professional Certificate could receive credits toward a bachelor's degree in information technology at Northeastern (Callahan, 2018). Another example is the collaboration between Walmart and six non-profit universities. Walmart associates can earn degrees and certificates from six universities, including University of Florida, Southern New Hampshire University, and Purdue University Global. The most recent example for this trend is Amazon. By October 2019, 10 Virginia Community Colleges and six public universities, including George Mason University, have collaborated with Amazon to implement associate and bachelor's degree programs in cloud computing.

The partnership between education and business industry grows exponentially. The increasingly blurred boundary between academia and business industry will diversify the traditional education and credentialing ecosystem in the years to come.

Flexibility Is the New Normal: HyFlex Model

The HyFlex (hybrid flexible) model is a highly relevant instructional model during the COVID-19 pandemic. According to Dr. Anthony Fauci (as cited in Murphy, 2020), COVID-19 makes our timeline, and we are yet to know what the shape of the economy recovery from the pandemic would look like. It could be V-shaped, W-shaped, U-shaped, Z-shaped, or the worst, L-shaped. Whatever the shape the virus will form the economy, colleges and universities need to move on with their mission and vision, which is student success. While higher education institutions are exploring and thinking through a range of options from returning to normality to go in fully online for the coming fall semester, HyFlex model stands out as a viable one because of its flexibility in learning environment and course structure.

As a course design model, HyFlex is not new. It was created and implemented in 2006 by Dr. Brian Beattie, an educational technology professor at San Francisco State University. This model combines face-to-face teaching and learning with online learning for the purpose of providing a flexible learning environment. It allows students to choose their mode of attendance according to their needs or preferences: face-to-face, online, or doing both. During the pandemic, the HyFlex course model, with its attributes of student-centricity and flexibility, allows for social distancing and low density in the face-to-face classroom, especially in large universities.

CONCLUSION

A silver lining of COVID-19 could end up being an accelerator for advancing curricular innovation. As discussed, the four academic innovation models are especially relevant and useful during and post the pandemic. With the increasing rate of unemployment, people need to reskill or upskill to seek for new employment opportunities. Competency-based education, which is online, self-paced, and with no credit hour constrain, stands out as a pragmatic curriculum model. Therefore, it is imperative that colleges and universities provide a parallel education system incorporating competency-based education, along with open education and lifelong learning, to serve learners who currently need the post-secondary credential the most during and post the pandemic. For traditional college students who may have to learn online during the Fall 2020 or in the future semesters, online experiential education will provide a more engaged, relevant, and meaningful learning experience.

U.S. higher education has been criticized for being slow to innovation and resistant to change in comparison with other sectors of the society, such as business and industry, but higher education's tradition and spirit of exploration and experimentation has never ceased. Also, if there is one lesson drawn from colleges' and universities' responses to the pandemic, it is that higher education and its faculty are fully capable to change and adapt rapidly when it is in the best interest of students. With this spirit and tradition, higher education will come out of this pandemic stronger, wiser, and more innovative.

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Feedforward with uRewind: Video-based Formative Assessment for Professional Learning

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ABSTRACT

Unlike traditional approaches to assessment and feedback, formative assessment coupled with feedforward offers students a high degree of control and emphasises their future development and positive improvement. It is not simply 'given to' students: instead, they are responsible for deciding on success criteria and have opportunities to assess their own performance and receive peer comments first before engaging in dialogue with a tutor. Combining formative assessment and feedforward with video can enable students to improve their performance in a wide range of professional disciplines. By viewing recordings of themselves and their peers, students can focus on the professional behaviours targeted in their programmes: micro-behaviours, holistic skills or verbal, paralingual and non-verbal aspects that support communication. Recent advances in technology have made it possible for students to record themselves completing a task and analyse their performance using digital tools. These enable students to observe activities and interactions from multiple camera angles, edit their recordings and search videos for instances of a particular word. Students can then create time-stamped reflective comments within videos or share recordings with tutors and peers, who can also engage in discussion around their performance. This paper, a work in progress, outlines suggested video-based formative assessment tasks related to professional disciplines offered at The Hong Kong Polytechnic University. Drawing on the literature on video-based formative assessment, it explores how these tasks could be used in case studies, to measure the effectiveness of this approach in developing discipline-specific communication skills and to evaluate the effectiveness of specific task designs. It also seeks to understand how students actually experience video-based formative assessment and how they engage in the process using the affordances of the online platform.

KEYWORDS

Video, Formative assessment, Peer assessment, Feedback, Feedforward

BACKGROUND

Unlike more traditional approaches to assessment and feedback, formative assessment coupled with *feedforward* emphasises students' future development and positive improvement and affords them a higher degree of control (Hirsch, 2018; Nicol & Macfarlane-Dick, 2004; Wheatley et al., 2015). It is not simply 'given to' students: instead, they are responsible for deciding on success criteria, and have opportunities to assess their own performance and receive peer comments first before engaging in dialogue with a tutor to explore specific suggestions that they can implement (Hirsch, 2018). Feedforward thus involves a shift from assessment *of* learning to assessment *for* learning. Since students receive it during a course or programme and not at the end, it allows them to take meaningful action; if it is consistent, regular and documented, it can support longitudinal development (Ferrell & Gray, 2016).

Combining formative assessment and feedforward with *video* can enable students to improve performance in a broad range of professional disciplines (Fukkink et al., 2011). By viewing recordings of themselves and their peers, students can focus on professional behaviours targeted in their programmes: more concrete *micro-behaviours*, such as nodding, looking at another person or asking questions, each of which can be counted; more abstract *holistic skills*, such as showing sensitivity, warmth and kindness, which can be rated using a scale; or other core skills or essential qualities for effective interaction (Fukkink et al., 2011). This may also take place following a communication model with stages, e.g. initiating, gathering information and closing the interaction (Fukkink et al., 2011). Video viewing also trains learners to notice and develop verbal, paralingual and non-verbal aspects of communication (Hargie & Dickson, 2004), which are the basis of professional communication skills: receptive skills (e.g. asking open questions); informative skills (e.g. explaining things clearly and coherently); and relational skills (e.g. displaying empathy; Duffy et al., 2004; Hulsman et al., 1999, as cited in Fukkink et al., 2011). Video-based feedforward is most effective if it emphasises positive empowerment, focusing on specific behaviours that learners are doing well (Hattie & Timperley, 2007; Dowrick, 1983), and if a structured observation form is used to help students discover elements of their behaviour and evaluate their performance (Fukkink et al., 2011).

For decades, researchers have observed the technical affordances of video that make it an ideal tool for professional learning (Dowrick, 1983, 1991; Hosford & Mills, 1983). For example, learners can play recordings in slow motion or at faster speed, pause to focus on specific moments in interactions, review images without sound, or replay audio without pictures (Hosford & Mills, 1983), use a split-screen technique to show the impact of behaviour on another person, edit recordings to focus on part of an interaction, or join recordings together to show development over time (Dowrick, 1991).

More recent advances in video technology have made it possible for students to analyse recordings of themselves performing professional skills using digital tools. Platforms such as Echo360, iRIS Connect, Panopto and VEO allow students to observe activities and interactions from multiple camera angles, edit recordings or search for instances of a particular word. They can then create time-stamped reflective comments within videos, or share recordings with tutors and peers, who can also engage in discussion around their performance and make specific recommendations for future improvement (Panopto, 2019). This can take place asynchronously or in real time, and recordings, reflections and discussions can be archived for future reference.

RESEARCH TOPIC, PROBLEM AND PURPOSE

The Hong Kong Polytechnic University (PolyU) offers a wide variety of professional programmes in disciplines that include design, engineering, health sciences, marketing and hospitality, each of which requires students to develop discipline-specific skills and behaviours. However, despite widespread usage of the uRewind video management system for content delivery and lecture capture, no programmes currently make use of the platform for formative assessment as outlined in this paper. Recent events such as the autumn 2019 campus closure and the COVID-19 pandemic of 2020, resulting in the repeated suspension of face-to-face teaching, have drastically limited opportunities for in-person formative and peer assessment of professional learning. This has created an urgent need for an online alternative, which could be met by the video-based approach suggested above.

This paper, a work in progress, outlines four possible formative assessment tasks related to professional disciplines taught at PolyU and suggests how the effectiveness of these tasks could be evaluated. Using a mixed-methods, case study approach, it aims to investigate students' experiences of video-based formative assessment across the University and compare the impact of individual approaches to assessment task design. Individual components of task design could include:

- *Task focus:* Does the task focus on microbehaviours, core skills or stages of a communication model? Does it focus on verbal, visual or vocal aspects of communication?
- *Task interaction:* Do students complete the task in groups, pairs or individually?
- *Task evaluation:* What success criteria do students use? Do students help decide on these criteria? Do they carry out self and peer assessment? Will they use an evaluation form and, if so, what form will this take?
- *Longitudinal development:* Will students measure their development over time? Will they repeat the task or perform a similar task at a later date?

RESEARCH QUESTIONS

Given the potential range of programmes involved and the current context of socially-distanced online learning, my research questions and sub-questions would include:

RQ1: How do students experience video-based formative assessment?

RQ2: How do students make use of the online platform and other asynchronous and synchronous tools to engage in video-based formative assessment?

RQ3: How effective is video-based formative assessment in developing (a) different types of communication skills and (b) different aspects of communication? For which skills or aspects is it most effective?

Based on the findings from the literature on video-based formative assessment in other professional learning contexts, I also plan to investigate the following:

RQ4: Is video-based formative assessment made more effective by the use of (a) an assessment-for-learning approach, in which students decide on their own task success criteria, (b) self and peer assessment, and (c) structured evaluation forms?

RQ5: To what extent does video-based formative assessment support longitudinal development?

CASE STUDIES FOR VIDEO-BASED FORMATIVE ASSESSMENT

Case 1: Demonstrating a design prototype

Engineering or Design

- Communication skills: Informative
- Verbal aspect: use of specific technical language
- Non-verbal aspect: use of prototype as visual aid

Case 2: Performing an eye examination or nursing procedure Optometry or Nursing

Optometry or Nursing

- Communication skills: Receptive, informative, relational
- Verbal aspect: use of specific language
- Non-verbal aspect: use of gestures and medical equipment
- Paralingual aspect: use of reassuring tone

Case 3: Making a sales pitch

Marketing

- Communication skills: Informative, relational
- Verbal aspect: use of descriptive, persuasive language
- Non-verbal aspect: use of visual aids as part of presentation
- Paralingual aspect: use of positive, persuasive tone

Case 4: Handling a customer complaint

Hotel and Tourism Management

- Communication skills: Receptive, informative, relational
- Verbal aspect: use of polite language, summarising the conversation
- Non-verbal aspect: use of visual aids as part of presentation
- Paralingual aspect: use of reassuring tone

Task	Discipline	Skill	Aspect	Interaction
Demonstrating a prototype	Engineering or Design	IN	V, N	Individual
Performing a procedure	Optometry or Nursing	IN, REC, REL	V, N, P	Pair
Making a sales pitch	Marketing	IN, REL	V, N, P	Individual
Handling a complaint	Hotel and Tourism Management	IN, REC, REL	V, N, P	Pair

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Classroom Flipping with AI Chatbot Software: An In-Person and Online Teaching Perspective

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ABSTRACT

We give an overview of classroom flipping for in-person and online teaching using software technologies like mobile AI chatbot. In particular, we discuss how mobile chatbot software can enable various pedagogical aspects of Peer Instruction, Just In Time Teaching and to leverage them to address a few key challenges in real-time online teaching that universities worldwide have to adapt to due to the COVID-19 pandemic in 2020. We also discuss how the chatbot software technologies can improve online interaction and adapt the teaching pace by closing the feedback loop between the teacher and students.

KEYWORDS

Online Learning, Classroom Flipping, Peer Instruction, Just In Time Teaching, Real-time Online Teaching, AI Chatbot Software Technologies.

INTRODUCTION

The landscape of higher education is ever-changing. Besides playing a role of knowledge acquisition, universities have to play a dual role of applying the latest technologies to improve teaching and learning (Wieman, 2017). From computer-assisted assessments to Massive Open Online Courses (MOOC) like edX and Coursera, technologies have become an integral part of teaching and learning. Recently, the focus is on teaching methods like blended learning and classroom flipping that have become increasingly important to deliver better and improved educational experience to both students and teachers. What roles do technologies play in classroom flipping? Is classroom flipping in a face-to-face classroom the same as in virtual classrooms? Can technologies improve knowledge assimilate by students and help teachers avoid developing expert blind spots, taking into account efficiency and bias in pedagogy?

Starting from the spring semester in 2020, the unprecedented COVID-19 pandemic has thrust institutions of higher learning worldwide abruptly to online teaching. Many has since continued with remote instructions in the fall semester and possibly beyond (Bigman & Mitchell, 2020; Vilela, 2020; Gewin, 2020). Overnight, instructors and students have had to grapple with online tools like remote videoconferencing. There are however huge differences between in-person teaching and online teaching. The physical distancing makes it harder for communications between teachers and students, and the lack of feedback can exacerbate inequity issues in learning. This leads to disruption in the pace of learning and teaching that can have downstream consequences.

The power of feedback underlies all forms of classroom flipping (Hattie & Timperley, 2007). It can be said that online teaching in the time of COVID-19 makes an urgent case for technology to improve real-time feedback between the teacher and students, especially for large classes. Since students are likely to have personal mobile devices like a smartphone or tablet, mobile software technologies can enhance online teaching and learning. This paper describes a mobile AI chatbot software for classroom flipping for both in-person and online teaching.

CLASSROOM FLIPPING

Classroom Flipping is a pedagogical idea that class time can be used to engage students in learning through active learning, rather than through delivering lectures alone. The classroom flipping approach has a few main teaching theories; Peer Instruction and Just-In-Time teaching and now real-time online teaching.

Peer Instruction

Peer Instruction, as pioneered by many scholars (Mazur, 1997; Lasry, Mazur, & Watkins, 2008; Deslauriers, Schelew, & Wieman, 2011; Wieman, 2017), encourages students to share their understandings with peers who in turn challenge their interpretation during group activities. Teaching with peer instruction relies on the use of clickers – a kind of audience response system – to query students in classes and actively encourage them to seek out peers with different perspectives on a question to discuss before giving them the correct solution. Typically, students are first given a question and asked to vote individually before they get to see a whole-class response in the form of statistical illustrations (e.g., histogram or pie-charts), and thereafter students are asked to reflect on their votes and to engage in peer discussions. Thus, a prominent feature of Peer Instruction is for the individual student to receive feedback from their peers while the teacher receives feedback from the entire class, all enabled by the clickers in a synchronous manner.

Peer discussions can be implemented in small groups or in a whole-class setting and driven by questions that possibly have more than one defensible answer. For example, instead of picking one correct answer out of several options, students can be asked to rank the given options on answering the question, and then to move on to short lecturing of "fundamental knowledge" that can yield new options to the same question. The polling in peer discussions can also be followed by a low-stakes quiz that is of the same nature as the poll question. Peer instruction using this poll-quiz routine therefore can be a good way to check-in with the students' understanding of course material, and help the teacher to avoid experts' blind spots. Smart audience response system like our chatbot software can provide instant feedback to students, leading them to a higher level of understanding. Classroom flipping with peer instruction thus creates a more engaging and student-focused class.

Just in Time Teaching

Another classroom flipping approach is Just-In-Time Teaching that works for both in-person and remote teaching. The basic idea is for teachers to adapt instruction by using some form of feedback before coming to class to meet the interests and needs of the student cohorts (Novak, Patterson, Gavrin,

& Christian, 1999). Such a pedagogy is known as Just-In-Time Teaching (often abbreviated as JiTT), and teachers can close the gap with students by identifying areas where students are struggling in order to allocate time accordingly. Typically, some short diagnostic assessment (JiTT quiz) is carried out preceding in-class teaching, and teachers use the diagnostic results as talking points in class to engage students (Novak et al., 1999). In fact, in addition to feedback, the JiTT quiz can double as a low-stakes assessment when they are carefully designed. Thus, a teacher can receive feedback via a summary of JiTT quiz response preceding the in-class teaching. Our mobile chatbot software can leverage massive data analytics to connect the performance of all previous JiTT quizzes and to automatically provide recommendations to the teachers, thus providing teachers with insights on how to pace teaching in the classrooms.

The format of Just-in-Time Teaching can also have other different interpretation. It can mean that teaching materials are arranged so that extensive technical details are introduced "bit by bit", with each "bit" presented just in time for the question raised (Chiang, 2012). Instead of first starting with technical knowledge presentation, a teacher may start with interesting applications or talking points to motivate the students. "Fundamental knowledge" in the subject matter is then taught as "by-products" in answering questions that arise as part of the talking points so that students assimilate knowledge as part of a conversation in the classroom. Such an approach can be especially useful for short online courses, and the teaching effectiveness thus relies much on pre-class intelligence gathering to kick-start a conversation in class (Chen et al., 2019).

In summary, mobile software technologies can serve a role in gathering feedback before a class to serve different forms of Just-in-Time Teaching format, with an aim to provide the teacher with analytical insights to learning efficacy and a prediction of teaching effectiveness to moderate the teaching pace. Although Just-in-Time Teaching can be time consuming and challenging for the teacher, it can certainly enhance student engagement as the teacher comes prepared.

Real-Time Online Teaching

Real-Time Online Teaching is virtual classrooms where teachers and students are able to interact in real time, so that learning happens synchronously. One challenge is how to make classroom meeting time effective. Another challenge is that students who miss a couple of classes due to the online learning setting such as different time-zone or less ideal learning environment, have no easy way to catch up so they get discouraged and learning slows down. In addition, students are mostly learning individually and do not interact regularly with their peers. This isolation makes it harder for students to know how they perform and for instructors to adjust their course progress, whether to slow down or speed up. Hence, from a pedagogy viewpoint, classroom time should be reserved for structured collaborative activities and more interaction. Real-time online teaching also emphasizes that students take charge of their own learning and develop a self-regulated learning capacity.

Technologies can help both students and teachers as real-time feedback becomes ever more important in real-time online teaching. Like classroom flipping with peer instruction, teachers can rely on automated audience response system to provide instant feedback to students and to remotely guide students. Tech-driven gamification can be integrated into classroom activities to make remote teaching and learning engaging. Remote assessment can be made low-stakes in nature, and technologies can help students to gauge where they stand instantly and to encourage self-reflection. Like Just-In-Time teaching, massive data analytics provide teachers with insights on how to structure classroom discussions so that students are actively contributing to the classroom's conversation. Technologies like AI, machine learning and mobile AI chatbots can allow students to self-regulate their learning capacity and allow teachers to rapidly individualize training pathways in real-time, enabling the full potential of real-time online classroom flipping.

MOBILE AI CHARBOT SOFTWARE TECHNOLOGIES

In this section, we introduce the mobile chatbot implemented as a mobile software application on top of popular mobile chat software like Facebook Messenger or Telegram that we have used for teaching a number of university classes in the last few years in-person and also remote teaching.

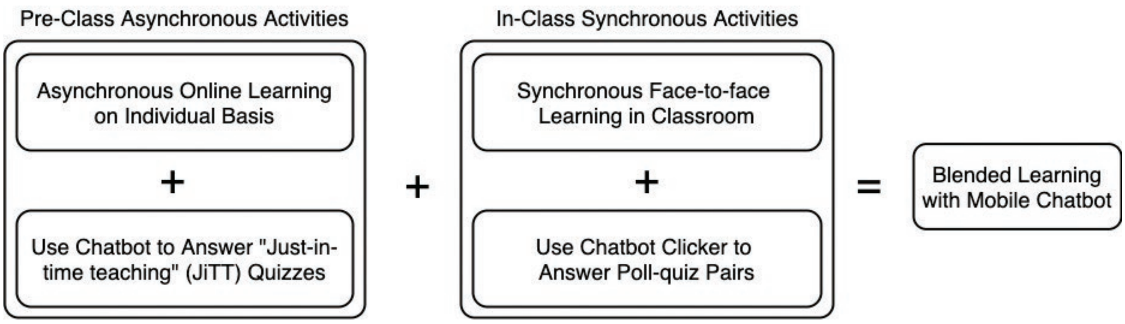

Figure 1. A high-level overview of the AI chatbot software implemented in Facebook Messenger and Telegram system that blends Peer Instruction and Just-In-Time Teaching pedagogy together in a common mobile software platform for feedback and setting the pace of teaching.

Digitizing the Clicker in Peer Instruction

Clickers are feedback tools in peer instruction widely-used for teaching at a number of institutions of higher learning (Martyn, 2007). The traditional clicker is a physical input device that uses short-range wireless signal to connect to a portable wireless receiver installed at the instructor's computer. Its purpose is for collecting the students' response in real time, possibly anonymously, so that the response outcome can be shared by the instructor. There are however disadvantages to the traditional clicker (e.g., costs, battery issue and non-transferable between classes or schools) (Bruff, 2009). Beyond a standalone clicker, our AI chatbot software can digitize all aspects of the traditional clicker, to collate the poll-quiz routine and data in a common platform, intelligently analyze the data to provide feedback to both students and teacher, and finally to provide a collated learning report summary to the student on how the student has fared over the course (if the poll-quiz routine is used as a form of low-stakes assessment).

The mobile chatbot software leverages existing popular chat software such as Facebook Messenger and Telegram that have intuitive human-computer interface design. The polls and quizzes are all multiple-choice questions (MCQ), and the poll allows a student to see the instantaneous poll response outcome once the student has voted. As the quiz question is related to the poll question that comes a priori and with the answer to the poll question explained, the quiz in the form of a MCQ assessment should be considered low-stakes and no-pressure for the students.

Setting the Pace for Students and Teachers in JiTT

Just as peer instruction relies on a poll-quiz routine to be effective, JiTT relies on quiz diagnostics to set the pace for not just the teacher but the pace for the individual student too. Pre-class feedback query can be extensive and diagnostic in nature, providing individual students with the freedom to adapt their learning pace. If JiTT quizzes are used as low-stakes assessment, an instructor can create MCQs that are of a low-threshold and high-ceiling type with more points being awarded for more challenging questions, thereby providing an incentive to encourage students to work on harder questions. Automated prompts can be sent regularly by the system to allow students to choose whether they want to attempt questions whose difficulty levels are either moderate or more challenging.

Our mobile chatbot software system can provide automated short answers to students within the chatbot or point students to a more comprehensive software platform (e.g., Jupyter Notebook platform) for detailed submission. Massive data analytics are then used to analyze the data collected from JiTT quiz diagnostics to provide teachers with insights on student learning and to set the pace for classroom teaching.

CONCLUSION

Technology-enabled teaching offers both teachers and students the agility, scalability and flexibility to benefit from pedagogy innovations such as classroom flipping in any kind of classroom. Online technologies like mobile chatbot software, data analytics and artificial intelligence algorithms can bridge the gap between the teacher and students through real-time feedback as well as pacing the teachers and individual students.

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Discovery-enriched Curriculum (DEC) Symposium

Date: 14 March 2018

Venue: City University of Hong Kong

Thinking Student Learning in New Dimensions: A Discovery-enriched Curriculum Under the GBSM Program as an Example

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ABSTRACT

When presented with the challenge and opportunity brought by the revamped academic structure that imposed a 4-year undergraduate programme in 2011, City University of Hong Kong resolved to reinvent the undergraduate experience and redefine the teaching–research nexus. In this paper, new dimensions of perceiving student learning, i.e., systemising and formalising the innovative elements into curriculum, are explored and discussed. A discovery-enriched curriculum (DEC) under the program of Global Business Systems Management (GBSM) is elaborated as an example.

INTRODUCTION

With the support of the University Grants Committee (Hong Kong), City University of Hong Kong (hereinafter referred to as "CityU") started the transition of three-year undergraduate programme to four-year programme in 2011. The implementation of the new academic structures brings students opportunities to receive a more comprehensive and balanced education, and also triggers educators' re-consideration of student learning in new dimensions, where research, education, entrepreneurship, interdisciplinarity, entrepreneurship, and action for the public good, are integrated to better equip students with sustainable skills and competences for future careers and facing the changing world.

As such, CityU has been adopting the Discovery-enriched Curriculum (DEC) since 2012, the focus of which on innovation lies at the heart of the CityU's academic strategy and four-year curriculum for teaching and learning, advanced scholarship, and community-related activities. It aims to offer all students the opportunity to make original discovery during their stay at CityU (Office of the Provost, 2013). In doing so, a DEC team that represents a large and diverse community of colleagues at CityU has been in shape since 2011.

This paper explores the new DEC dimension by first discussing DEC in its theoretical basis, and it is illustrated by the example of how it was embedded in the academic exchange under our GBSM program at CityU.

THE DEC CULTURE

The DEC aims to foster a culture that brings together research, education, interdisciplinarity, entrepreneurship and action for the public good, among students and staff at CityU. According to the revised Bloom's Taxonomy, learning takes place at the basis of the six developmental stages: remembering, understanding, applying, analysing, evaluating, and creating (Anderson, Krathwohl, & Bloom, 2001). Creating, defined as generating new ideas, products, or ways of viewing things, is on the highest level (Anderson, Krathwohl, & Bloom, 2001). The DEC culture is in compliance with the "creating" tier in the taxonomy (see Figure 1), and therefore the curriculum is designed to provide students with unique discovery experience during their four-year undergraduate studies so as to enhance their creating capability.

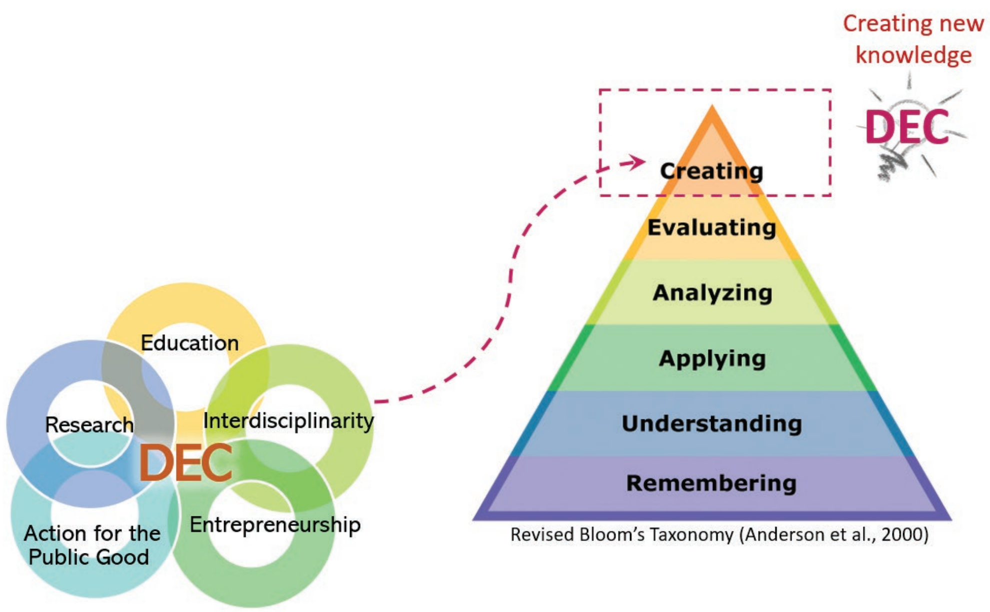

Figure 1: Professional, Creative, For the World

EMBEDDING DEC IN ALL PROGRAMMES

The DEC consists of three elements: attitude, ability, and accomplishments (3As). As stated by Hodgson (2013), students are expected to develop the attitude in raising inquiries, discovering and devising innovative ideas with a sense of curiosity towards learning. In addition, students should be equipped with abilities such as communication skills, analytical skills, logical thinking skills, critical thinking skills, when they apply academic knowledge to solve real-life problems. At the end, students are supposed to demonstrate evidence of their original discovery or innovation such like projects, patents, exhibits, portfolios, so as to display their accomplishment.

To address the University's Graduate Attributes, the curriculum brings the above-mentioned 3As into alignment with the outcomes-based teaching and learning (OBTL) framework which has been adopted by CityU in all its academic programmes (Office of Education Development and Gateway Education, 2010). According to Biggs and Tang (2007),

> *OBTL starts with clearly stating, not what the teacher is going to teach, but what the outcome of that teaching is intended to be in the form of a statement of what the learner is supposed to be able to do and at what standard: the Intended Learning Outcome (ILO). When students attend lectures, however, their main activity is receiving, not doing. Hence we need to devise Teaching and Learning Activities (TLAs) that require students to apply, invent, generate new ideas, diagnose and solve problems—or whatever other things they are expected to be able to do after they graduate. Similarly we need Assessment Tasks (ATs) that tell us, not to how well students have received knowledge, but how they can use it in academically and professionally appropriate ways, such as solving problems, designing experiments, or communicating with clients.*

This implies the stated 3As should be aligned to the Intended Learning Outcomes, including the Course Intended Learning Outcomes (CILOs) at a micro level and Programme Intended Learning Outcomes (PILOs) at a Macro level (see Figure 2).

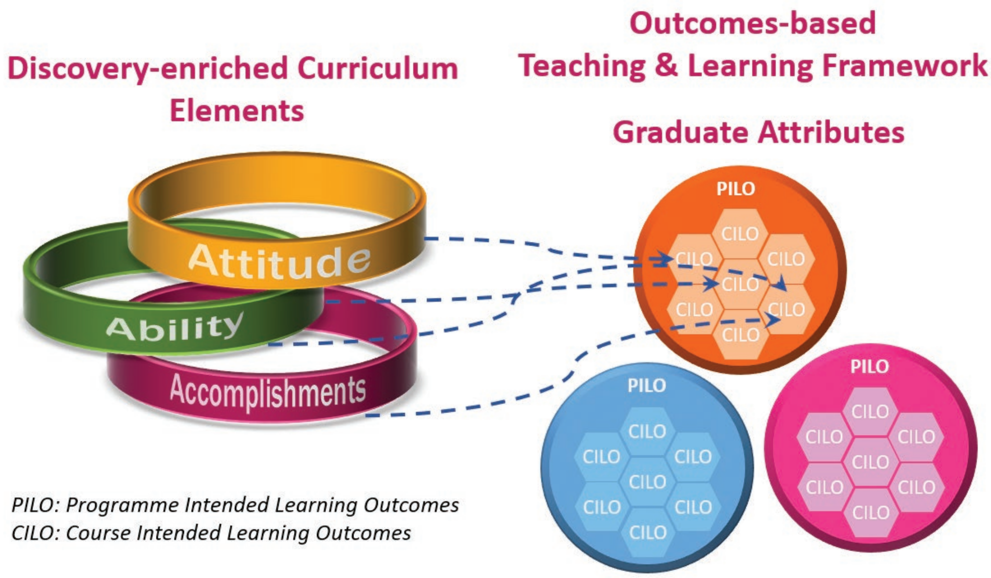

Figure 2

Auxiliary support has been provided by the University in order to fertile the ground for DEC ideas to flourish at the campus. A range of resources are offered to program leaders and course leaders, including but not limited to workshops, facilities, project funding, and rewards. In the workshop series, the concept of DEC would be introduced as well as how the DEC elements are incorporated into courses. For facilities, a technology-enriched active learning space (with different sorts of facilities such as 3D printers and digital show-and-tell studio etc.), named Gateway Education Laboratory, was built by the Office of Education Development and Gateway Education to support students' active learning. The Knowledge Transfer Office of CityU also gives guidance to students when they come up with any innovative ideas. Funding and rewards are attainable to support co-curricular activities and to boost colleague's/students' incentive (e.g., DEC teaching award).

EMBEDDING DEC IN ACADEMIC EXCHANGE

Kim and Ruben (1998) have proposed the intercultural transformation theory (ITT), maintaining that students grow during intercultural encounters; this dynamic process consists three elements: stress, adaptation and growth. Individuals experience stress when they encounter a new culture, the extent of which depends on how they interpret the negative outcomes (Folkman & Lazarus, 1985; Bhargava, Trivedi, 2018). Such stressful experience impels them for new cultural learning to make adjustments in their original cultural practice and also brings about an improved adaptive capacity with which to face subsequent new challenges (Kim & Ruben, 1988). This adaption process enhances students' problem-solving skills and therefore leads to their growth (Cohen, 2011; Kim & Ruben, 1988).

Derived from the stress-adaptation-growth model in the intercultural transformation theory (ITT), we contend that two extra elements are also vital for students' growth and can be added to this existing framework. They are support (for enhancing the individual's knowledge and thinking styles) and motivation (for boosting students' exchange experiences and quality of creative inventions) (Sivakumar & Kwok, 2017). This updated theory is named the "enhance intercultural transformation theory" (EITT) (see Figure 3).

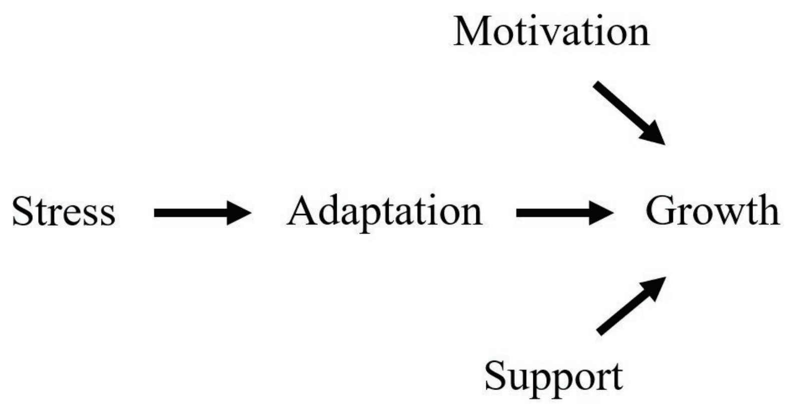

Figure 3

When entering a brand-new environment, students possibly think more creatively as they would have never thought about the implemented ideas in the environment they grew up in (Sivakumar & Kwok, 2017). Besides, researchers claim that students' creativity can also be enhanced via proper training programmes with educators' guidance (Reese & Parnes, 1970). Our experience of embedding the DEC components into students' learning was based upon the enhanced intercultural transformation theory (EITT). A course named "exchange experience assessment (EEA)" has been designed with 27 students enrolled, in which each student was provided with two compulsory exchange opportunities: one overseas and one in mainland China. By immersing students in a new cultural environment, the course aimed to help them develop innovative thoughts that lead to patentable ideas/solutions during their exchange studies and co-curricular activities. Before it started, we put forward the following research questions:

1. What factors drive the undergraduate GBSM students to discover and innovate during academic exchange?
2. What factors help students obtain patents from the ideas generated in the academic exchange?
3. Find reasons why some students can get their ideas patented while some cannot

Students took the mandatory 3-credit course during the two exchanges, which required them to identify problems they observed in the exchange countries and figure out solutions. In the EEA course, students must attend a series of briefing sessions, workshops, and seminars to acquire the basic patent knowledge in their home counties; they were required to engage in co-curricular activities in their exchange counties; they were expected to develop patentable ideas (utility design and business method) based on their knowledge of IT and business knowledge that they had learnt in prior courses. Data collection was conducted simultaneously as evidence of student invention, including survey (pre, post 1st, post 2nd), email correspondence, assignment, reports, patent applications, blogs, interviews etc.

Support and motivation, as mentioned above, cannot be more important for students especially when they were outside Hong Kong. In addition to helping them broaden and deepen the knowledge on innovation, since students come up with creative ideas but normally at conceptual level, two patent advisors, who acted as facilitators in the curriculum, were invited to support them in monitoring their idea development to patentable ideas and transforming their innovative inventions into patents. Specifically, the patent advisors interacted with students throughout their academic exchange and offered instant assistance beyond time place via email correspondence, which ensured the ongoing invention process and allowed time flexibility as well as geographical independence (Leidner & Sirkka, 1995). Feedback was solicited concerning student understanding of course material on patent knowledge.

We motivated our students to reach the highest level of learning outcome of getting creative ideas learning to patents. The course laid responsibility and motivated the students to monitor their learning progress during academic exchange while their instructors/facilitators were far away from them. To monitor students' involvement in the course, we created a blog so that they could upload their cultural, social, and personal experiences in every semester and raise feedback on each other's blogs (Sivakumar & Kwok, 2017). Besides, we motivated students via assisting them to file their creative inventions through patent application which could further enhance their future career development (Sivakumar & Kwok, 2017).

A Case: Business Method Patent (Smart Bin)

The following case demonstrates how one of our students (student A) turned his innovative idea to a short-term Hong Kong patent during the academic exchange. The invention is an electronic bin that includes a signal generator, camera, speaker and shredder on the top, with balance and tiers at the bottom. Information of shredded and weighted rubbish could be recorded in the bin so that people could remote the bin though the pre-installed microchip when full level is detected by the level sensor with infrared. Table 1 shows the EITT factors in the case that leads to the student's innovation.

Factors	Extracted email communication between student A, facilitator and instructor and reports
Stress	"City was not kept clean." (Student A)
Adaptation	"City had the problem of waste disposal. Wastes are accumulated in the rubbish bins. The situation becomes worse in rush hour and weekend, where cleaning workers are not noticed or during day off. Rubbish are not being placed properly in rubbish can or recycling bin as well. Collection and transportation work within the city is difficult. Hygiene problem and inefficient recycling is thus induced in the city." (Student A) "To increase the awareness of proper waste disposal, I would like to design an electronic bin." (Student A)
Support	"I am not sure if a garbage compactor/shredder has any commercial value, but it may be novel. Again, she needs to do some research and see what is already out there (become someone skilled in the art)." (Facilitator) "I encourage you to include the solar technologies you decided to use in your final report as part of your detailed description. But you no need to include it in your claims." (Facilitator)
Motivation	"The successful application may grant you a greater competitiveness in job hunting, I therefore hope that you can complete the application as soon as possible." (Instructor)
Growth	Smart Rubbish Bin was developed and filed for patenting. (Student A)

Table 1: EITT Factors Leading to Invention

In the EEA course, students filed 31 short-term patents (e.g., movable training equipment, virtual reality shopping center, smart dumbbell, anti-spill cup). Some of the successful outcomes were showcased at the GBSM Business Innovation Exhibition and Award Presentation in 2016.

CONCLUSION

In conclusion, the transition of the University's undergraduate education from three-year to four-year curriculum enables educators to review and re-think the student learning in new dimensions, namely to systemise and formalise the creative elements into curriculum. Thus, in accordance with the outcomes-base teaching and learning framework as adopted by CityU, discovery-enriched curriculum components are embedded in all programmes. This paper takes the off-site DEC curriculum with international exposure under the GBSM program as an example to demonstrate how the DEC elements are actually incorporated in student learning. The multicultural experience obtained via this academic exchange is proved to trigger students' creativity and leads to their accretion of knowledge on patenting.

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Innovation as Epistemology in the Social Sciences

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ABSTRACT

In this article, I argue that the epistemology (ways of knowing) in the fields of liberal arts and social sciences can and should be grounded on "innovation" as learners (i.e., professors and students) seek the realms of possibilities (what could be) as the primary ways and means of making social scientific progress. Defined as the introduction of and pursuit of novelty, innovation can be adopted as the guiding principles to assist learners discover new possibilities and reason why and how things work or do not work, and think "what could be" instead of merely "what is". This article unpacks my experience in applying "the epistemology of innovation" to enhance teaching and learning processes using several well-rehearsed approaches including 1) visual thinking, 2) experiential learning, and 3) the metaphor of high performing athletes. The article is contextualized in courses related to social innovation and social entrepreneurship, a relatively new discipline that seeks to explain and understand the why and how of social progress. Examples and outcomes of the application of these approaches will be illustrated in the article.

INTRODUCTION

Epistemology, the study of the nature and grounds of knowledge, manifests differently in a range of domains (Merriam-Webster, n.d.). It addresses questions associated with the ways of knowing such as: What do I know? How do I know that I know? What does it mean to say I do not yet know? (Chandra, 2017). From a realist perspective, Ramoglou and Tsang (2016) stated that "We can know the world indirectly. Our observations are theory laden and fallible. We may use our imagination in explaining phenomena, but reality imposes constraints on what should be accepted as plausible knowledge" (p. 413). In the field of liberal arts and social sciences in tertiary education, the process of knowing could be grounded on "innovation" when students explore the possibilities of stepping into the realms they are formerly unfamiliar with.

It is generally accepted that innovation has, especially during the last three centuries, been a pivotal element of economic growth and societal change (Floud, 2012; Verspagen, 2005). Social innovation, defined as new ideas that resolve existing social, cultural, economic and environmental challenges for the benefit of the public, increases at rapid rate (Phills, Deiglmeier, & Miller, 2018). From a related field, social entrepreneurship, defined as the organizing approach and organizations which combine social welfare with commercial logics, e.g., entrepreneurship for social purposes, also come to light (Mair & Marti, 2006; Chandra, Simon, & Fandy, 2020). In an educational context, social innovation and social entrepreneurship are interdisciplinary areas in which the logics of the social welfare and business are combined to solve a number of different social problems, such as poverty, environmental issues and other kinds of disability discrimination. In this article, I will address how innovative approaches can be implemented in the social sciences discipline so as to solve those social issues.

WAYS OF KNOWING IN THE TEACHING AND LEARNING IN THE SOCIAL SCIENCES

Ways of knowing (or epistemology) in the teaching and learning varies. Educators hold different theories, e.g., empiricism, realism or constructivism, as their basis of knowing about reality (Ramoglou, & Tsang, 2016). I dedicate to exploring how these can help develop better teaching and learning practices. There are a lot of social sciences courses concentrating on "what it is". That is, they focus on describing or explaining social reality 'as it is'. This is commonly found among well-established fields, from history, sociology, political science, to public administration and social policy. My point here is that rather than just raising "what is" or "what happened" questions, we could also ask "what could be", which has its own epistemology in innovation and entrepreneurship. Among others are the effectuation (Sarasvathy, 2001) and exaptation principles (Dew, Sarasvathy, & Venkataraman, 2004). Effectuation is about asking "what could be" question in constructing a new reality while exaptation is about co-opting a feature for its present role from some other origin. For instance, instead of asking what has already happened, we could also ask if country A had not invaded country B 200 years ago, what would have happened to the current world politics? What would have happened if someone had introduced a new intervention to a social work practice?

The way we formulate wisdom also matters. A number of the conventional ways in the teaching of social sciences focus on a one-way wisdom model in which there is an impartation from a knowledgeable lecturer to students but lacking other ways of impartation. However, there is another alternative approach that I have seen working very well elsewhere and I am also adopting – the multiple-way wisdom model. Instead of having a single content source, we could integrate a number of different sorts of wisdom in a learning environment, which I will describe next.

An increasing number of educators have realized the significance of active learning nowadays, which is in line with a famous Chinese saying by Confucius "I hear and I forget; I see and I remember; I do and I understand". To take a further step, besides the "doing" part as emphasized in Confucius' quote, we could also create or build something new, such as building new organizations or products or interventions in order to help solve social problems. For example, in today's world, when the poor look for a loan from a bank, they will be asked for a collateral such as a piece of house certificate or a piece of land. Then here comes the contradiction – how can the poor provide those things? Muhammad Yunus, at that time, came up with the idea of lending the poor a small amount of loan without collateral but with a certain modest amount of interest and ensure people pay back the loan using their social networks; thereafter the concept of Grameen Bank was born (Milaap, 2016). In 1976, Yunus launched the activities of Grameen bank, offering microloans to the poor (Milaap, 2016). For the great influence brought by Muhammad Yunus in eradicating social poverty, he was awarded the Nobel Peace Prize in 2006 (The Nobel Prize, 2019). Muhammad Yunus experienced with Grameen bank as a solution to poverty offers us valuable lesson in how to "what could be thinking" to improve the world, and Grameen Bank indeed presents one of the earliest forms of a social enterprise. But the "what could be thinking" is more than just for use in specific discipline but rather a way of knowing about the world and a way of knowing about knowing.

To apply the epistemology of innovation to enhance teaching and learning, the following paragraphs demonstrate how I utilized and developed some well-rehearsed approaches during my class.

VISUAL THINKING

Learning should take place holistically rather than part by part. In social sciences, we usually look into details whist missing the bigger picture. Social scientists can learn from computer chip designers in their ways of knowing, i.e., by observing the reality as squares with many connections. Visual thinking skills help students learn about the world from the view of a complex system, as in many cases, visualization conveys more meaning than verbal descriptions alone (Marentette, 2018). The "Input-Process-Output" model realized by visualization improves learners' understanding of the context as well as facilitates communication and debate among learners in a group. Let me describe more about the visual thinking next.

Self-Made Videos as Stimulants

To incorporate visualization into my teaching, I transformed my research into entertaining visuals such as videos. For instance, I went to Singapore to interview a former gangster who had spent 10 years in the prison. As he often cooked in the prison ward, he discovered his talent and passion for cooking. When he was released, he got an opportunity to learn from Jamie Oliver in London in his famous restaurant, and he came back to Singapore afterwards and started his own restaurant. He employed a lot of young people with criminal backgrounds like himself. The restaurant ran pretty well with their innovative cuisines. I narrated the story through an interesting video within ten minutes. It would be tedious for students if the video is long. I can narrate the rich and thick information about this organization in minutes. And importantly, nobody fell asleep! I also visited a former engineer who intended to help the elderly. He launched a social enterprise, recruiting the disabled, both physically disabled and mentally disabled, to have them look after small food stalls. Each disabled staff looks after one dish stall (e.g., Chicken Rice stall that sells only one menu), as a way to simplify the work processes for the disabled. This story has also been transformed to a video as one of my original innovative materials. Students love them! These videos are captured in my YouTube channel. You can easily find them by typing my full name in YouTube and the videos will appear.

Flowchart Thinking

The "input-process-output" model of knowledge acquisition can be realized through flowchart thinking, another kind of visual thinking. According to Lynch (2019), displaying ideas and concepts in an organized and structured way by flowcharts will aid understanding and learning, and they also help learners overcome information overload as well as the limitation of temporary memory. Flowchart breaks a complex process down into smaller and more manageable steps, and it could be used to schematically delineate a complicated system. In using it in the classroom, lecturers can impart knowledge better as students can understand faster.

Flowcharts are used commonly by lecturers in the science and engineering disciplines, particularly the electronic engineers, yet not so popular in social sciences. It has the potential applications in sociology, political science, public administration, social policy, to social work and psychology. I insist using flowchart thinking in my courses, and Figure 1 below is an example. The flowchart helps students break down the components of the solutions to solve social problems and can also be used for story-telling.

Figure 1:
An Example of a Social Entrepreneurship Project from a Group of Students

Manga Comics

Other forms visual thinking include developing manga comics. According to Murakami and Bryce (2009), the reason that manga makes a complex and difficult topic easier to understand lies in the hybridity of the manga text, which contains both visual and linguistic texts. Since "verbal and iconographic texts place multiple layers of information in context and project a focused content", manga comics effectively help promote the readers' knowledge acquisition (Murakami & Bryce, 2009, p. 50). Storytelling in the form of manga comics was related to high levels of learning experiences, and it offers readers an attractive medium to communicate concepts with a bunch of characteristics that might help student learning in a more effective manner than traditional textbooks (Short, Randolph-Seng, & McKenny, 2013; Short & Reeves, 2009).

I used the funding of $150,000 to work together with a number of young artists in Hong Kong as well as my colleagues to develop comics as a new medium to impart knowledge about social entrepreneurship and social innovation. I introduce concepts through a story in visual format, during which I also ask students to give provisional conclusions in some hypothetical scenarios. For example, I ask students "what if" questions: If "A" had not happened, what would be the outcome? If "B" or "C" had happened, would the outcome be different?

My comics contain summaries of key concepts and glossary of concepts that I would normally use in my lecture notes but narrated in an entertaining way. We read the comic together with the students in the class and we allow students to think creatively if they were in the position of each of the characters in the comics. My comics contain a series of three stories. The first is based on a real-life inspirational story about a homeless person who finds his talent in cuisine and cooking and he finally launched a restaurant social enterprise that employs the homeless as chefs and culinary workers. The second comic is based on an imaginary under water life where the animals create a marine life aquarium (think Ocean Park's fish aquarium) to showcase the talents of different sea animals and earn income. It contains plenty of messages about how to make decisions in a social enterprise. The third comic is based on the emerging sustainable living concept where people 'fix' objects instead than buying new objects. It contains messages about voluntary simplicity and being environmentally friendly.

EXPERIENTIAL LEARNING

According to Dewey (1897), "[E]ducation must be conceived as a continuing reconstruction of experience: . . . the process and goal of education are one and the same thing" (p.79). Similarly, as noted by Kolb (1984), learning should be "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (p. 41). The theory is named "Experiential Learning" in order to highlight the central role thawt experience holds in the learning process (Kolb, Boyatzis, & Mainemelis, 2001). It offers students opportunities to learn through reflection on doing it in the real world.

Doing It Together

Although PowerPoint has been the most commonly used teaching tool nowadays, I prefer using hands-on learning, a form of experiential learning, in my lecture while PowerPoint only serves as the supplement. During the lecture, I involved students in the *doing* process. For instance, when I was talking

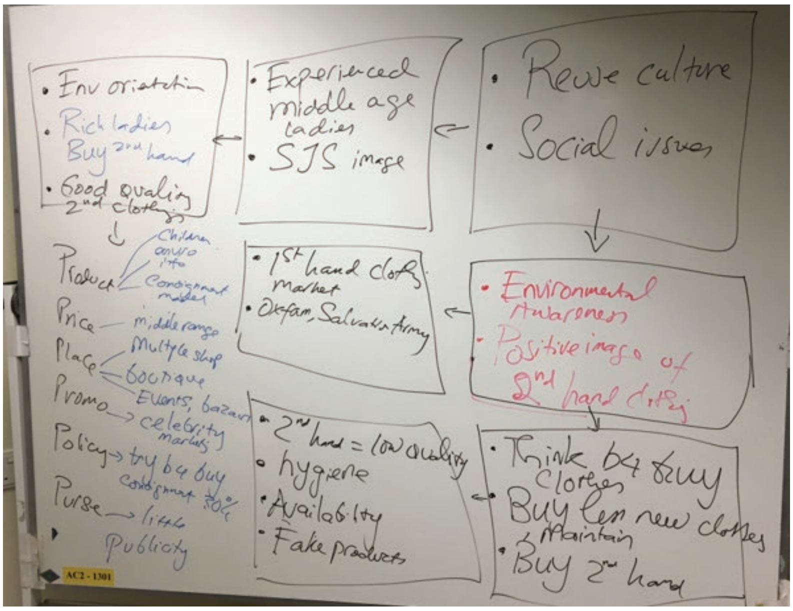

Figure 2

about how to solve a specific problem in a social enterprise or how to do a financial modelling in social enterprise, I got my students to think and do the hand-drawn together (see Figure 2). We start by making realistic assumptions that are logical (e.g., you need to pay rent to open a social enterprise, you need to pay *employee salaries*, you need to know the *price* of your product and the *quantity* you sell etc) and expand the analysis "together" with the students to get to the final results. This approach is utterly not using PowerPoint slides and gets everyone thinking. Students need to pay attention to understand the whole process of thinking and doing on the whiteboard. But the same process helps de-mystify what looks like a complex topic into understandable smaller pieces of tasks. At times I purposefully made mistakes (e.g., using the wrong numbers, using the wrong assumptions, use incomplete components in the analysis) to let them learn how to fix them in doing the scenario analysis.

Live Case Analysis

The case method is also described as one of a number of experiential learning approaches (Roth & Smith, 2009). Conventional case approach involves reading 40-page document with dense words which puts people to sleep, but this is the standard approach in any business schools and most social sciences schools. Compared to conventional case analysis, I used the live case analysis where "direct interaction with a live organization is employed" (Roth & Smith, 2009, p. 59). I invited guest speakers and we solved the case problem together in the classroom. For instance, at the end of one of my courses, a group of students worked on a project on environmental issues caused by the paper receipt. They came up with the idea of e-receipt to replace the paper receipt. I invited experienced experts who have done social entrepreneurship to the class to give feedback to the students. This teaching method is actually enlightened by a famous British television programmed called "Dragon's Den".

METAPHOR OF TOP ATHLETES

Students are like athletes to a certain extent. Athletes are capable in different fields; so are students. A teacher's role is to lead them to discover their strengths and assist them in developing relevant skills rather than pushing them to master what they are not good at or not interested in. In addition, most athletes set specific goals so as to improve their performance and prepare for competitions. Likewise, I set clear and measurable goals for students, towards which they take steps to achieve the outstanding result.

For instance, a group of my students developed the web/App to connect young parents who have a little child and middle early retirees in the same neighbourhood. Through the App, the latter can offer childcare services to their neighbours who are working parents (Youngpost, 2017). It helps boost social harmony and brings positive social influence, and it won the Gold Prize of the "Challenge Cup" in China and Runner Up in Hong Kong (Youngpost, 2017). Other award-winning projects by my students include such as a stick that can vibrate to remind disabled that their bus has approached, or a device help young people be protected from any crim on the street when he or she walks alone at night (City University of Hong Kong, 2020). Those students are not from engineering or science disciplines but social science students; they have high potential with the right guidance by instructors, which resemble the top athletes.

CONCLUSION

In reflection, social sciences education not only concerns learning or researching about "what it is", but also "what could be" - what could have been, what could happen in the future, and what we could manipulate in order to produce better results and find new ways to solve social problems. Also, instead of using a single teaching approach alone, methodological pluralism, as a form of multiple-way wisdom, could be extended from a research setting to a teaching and learning context. Quoting back Confucius' saying, "I do and I understand", in the process of doing, students obtain real-world learning experience as well as seek and discover possibilities of creating novel solutions to social problems.

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Arts-Based Field Research: The *Extreme Environments* Program

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ABSTRACT

This chapter documents the history and operational structure of a 9-year teaching experiment at the School of Creative Media at City University of Hong Kong. The Extreme Environments program connects the disciplines of science and media arts to generate a better understanding of issues of sustainability while promoting interdisciplinary arts-centered research and immersive education. Working in remote science field stations, undergraduate artists and experienced scientists collaborate by leveraging technologies to collect environmental data and interpret it in new creative forms. The results are presented to the public in an exhibition, catalogue and website. The Extreme Environments program is now considered by many to be one of the most elaborate and challenging study tour programs offered anywhere. A course that teaches field research as a creative strategy and media art as a scientific visualization strategy is now one of the most respected discovery-based education initiatives in the world, discussed in top international journals, news media and conferences.

KEYWORDS

discovery-enriched curriculum, experiential education, art/science collaboration, interdisciplinary learning, environmental analysis, alternative data visualization

INTRODUCTION

In the Extreme Environments program, student teams travel to isolated endangered ecosystems and join existing field research stations already in operation and dedicated to the preservation of the sites. With the help of leading scientists working on-site, the students collect meaningful environmental data using cutting-edge sensing technologies. Upon returning to Hong Kong, they convert the data into new media artworks that promote the message of environmental awareness through games, interactive cinema, immersive environments, mobile applications and more, presented to the public through large-scale exhibitions.

The program has now worked in seven distinct ecosystems: the Mojave Desert (2012), Tierra Del Fuego Argentina and Antarctica (2014), a recently-discovered cave network in central Vietnam (2015), and two sites in the Coral Triangle (2017): underwater in Sipidan and Mabul, Malaysia, and on disappearing atolls in the Solomon Islands. In 2019, Hong Kong itself was selected after Typhoon Mangkhut ripped through Southeast Asia with the most recent iteration of the program focusing on the datasets collected by the Hong Kong Observatory and other local science and research organizations.

THEORETICAL FOUNDATIONS

Although this chapter will present the program more structurally from an operational and logistics perspective, other papers have considered the experiment from a variety of art and pedagogical theories that should be briefly recognized.

It is easiest to divide the experience into separate science and art emphases. Onsite in the selected remote ecosystem, students focus on the science and the development of critical and analytic thinking by partnering with expert scientific researchers who share their approaches as well as sophisticated sensor and locative technologies. Once back in Hong Kong, the emphasis shifts towards the arts. The presentation of the collected data requires in-depth research in visualization strategies that result in new insights in directions that are often unforeseen. Students learn computational and procedural programming as a generative art strategy, with new interactions, new styles, and new formats.

However, a more holistic overview of the program reveals deeper theoretical underpinnings. *Blended Learning*, usually referenced as lecture formats enhanced with online media, increases substantially in the program. A private Facebook group provides a place to link interesting stories about the region, inspirational art and design projects and equipment studies and research. Individually, each student presents their experience to thousands through their own Facebook pages, Instagram accounts, Twitter, the localized versions of each. *Experiential Education* is another touchstone, offering the essential ingredients for deep, multi-faceted learning by placing interdisciplinary teams in extreme challenges that encourages the natural evolution of a broad range of skills. Team members learn how to succeed as well as how to support each other. Their mutual reliance enables students to see their own contribution as part of the success of the greater scheme. The learning model of sequenced proficiencies can be traced to *Morphological Course Design*, replacing the morphological analysis not on artifacts but the accomplishments of specific skills as a method to achieve a structured, yet fluid learning design.

One of the most interesting understandings is the program's alignment with the emerging theory of *Research-Creation*, referring to a set of undertakings in which the artistic endeavor is integral to the research, not just an added component. In other words, it is understood that the research topic could not be addressed without engaging in this creative or experimental process. The method questions the traditional ways institutions have defined and measured acceptable forms of the production of knowledge based on the scientific model. While a scientist works to remove himself, his influence, from the experiment's results, an artist does the opposite, with their point of view and presence becoming an integral part of the experiment. In this regard, research-creation approaches usually strive to deconstruct or at least disrupt the research model hierarchy that places scientific inquiry at the top. The Extreme Environments program seeks to render scientific-type knowledge legible through other types of creative approaches. The students' work exposes the inherently embodied and intuitive nature of all forms of research, including scientific ones, and additionally provides a unique entry point for a much larger public to access important concepts.

COURSE OVERVIEW

Student Selection and Course Schedule

The program begins when students are selected in the semester prior to the course offering. An orientation meeting is offered to explain the site, the possibilities, the program concept, and the steps to submit a proposal. Students write a short proposal that states what they hope to study and how they will mediate their results into creative displays and artworks. The school provides the students' GPA, and a panel of faculty and interested scientists ranks the proposals based on research, creativity, portfolio and potential. The highest ranked proposals and top GPAs receive an interview which is rated on presentation, verbal and written skills, and additional proficiencies that could support the larger group (e.g. medical training, graphic design, cooking). Of these students, the team is selected and has always included a broad international mix. PhD and MFA students are hired as assistants, usually a ratio of one Research Assistant for every eight undergraduates. Depending on accessibility and resources of the sites, the total group numbers have ranged from 16-28.

The entire course occurs in a 13-week semester with the on-site expeditions usually taking place over 10-15 days in mid-semester. Students are excused from other classes during the expedition dates by directive from the university but are encouraged to use elements from their experience in their other courses. The exhibitions occur at semester's end, either on-site at the university or hosted by museums and cultural centers in Hong Kong.

Sequenced Interdisciplinary Proficiencies

The compressed schedule and the diversity of skills required are approached in steps to avoid overload. Sequenced interdisciplinary proficiencies provide a natural evolution of skills within large, diversified, task oriented, interdisciplinary teams. While the extreme challenges provide deep and multi-faceted learning, careful structuring of skills development allows for a high sense of individual responsibility within a larger context.

To achieve success, the course defines sets of proficiencies that are appropriately sequenced, so learning becomes more natural. Many of these proficiencies are interdisciplinary in nature and require partnering students across disciplines. While the focus is often on the expeditions themselves, they are part of the larger picture which involves research, planning, lab work, library work, lectures, seminars, workshops, guest speakers and site visits. Regardless of the site chosen, the course outline provides opportunities for every student to acquire the same sequence of demand-based skills:

1. Equipment Training: The development of tangible field skills in both the operation and modification of scientific or media equipment used in research, through remote site readings and partnerships with experts from leading science organizations.

2. Team Development: The enhancement of team and personal development skills through interdependency, interaction and collaboration, and the ability to overcome site-specific difficulties.

3. Computation and Programming Learning: The ability to use computational data mining and visualization skills through programming and art-centered media software.

4. Project Management: The acquisition of fiscal and project management skills through the development of new media artwork from design to fabrication to presentation.
5. Media Systems Research: The development of technical proficiency in a range of computational media systems that interpret the data in alternative venues, systems and contexts through research and partnerships with engineers, programmers and media artists in the information arts.
6. Presentation Skills: Professional growth in the presentation of research through media interviews, serving as tour guides, and research and writing for the public.

These six proficiencies are developed on a weekly basis over the duration of the course. The knowledge is incremental and timed so that skills match the moment they are required within the larger framework. For example, in the first week, the student must submit a single sentence description of what they hope to study onsite, a single sentence about why that topic is of personal interest, and a rough concept drawing of how the collected data will be presented. These initial documents are developed each week both in text and visual form over the course of the semester and ultimately become the artwork description and artist statement that appears in the print and web catalogue.

Lectures

Each week, part of the classroom time is dedicated to artistic approaches that emphasize empirical working and adaptation from the natural forces intrinsic in the sites. Models from art history are presented in which the picturesque view of nature usually associated with art is replaced by a dialectical landscape, highlighting dynamic natural systems and relationships. Students are shown kinesis and patterns in natural forces to provide visual inspiration and review cultural definitions and interpretations of nature to be able to put their projects in larger contexts. Art History provides examples of masterpieces engaged with natural sites, in particular the Land Art and Earthworks movements as well as contemporary art practices utilizing forces of nature. Students also review iconic works in the Information Arts, alternative forms of data visualization, and sustainable design practices.

Preparatory Workshops

The same incremental approach is used for technical skills including weekly learning on camera or sensor operation and computational skills. For example, the 2017 underwater diving team started getting certification as open water beginners and then onwards to advanced and scientific diving certification. Equipment lists are organized early in the semester and training in all the media technologies as well as sensor and scientific hardware takes place weekly leading up to the mid-semester expedition.

In addition, each week the students research the sites and present incremental information regarding safety, unique cultural discoveries, natural features, etc. that are compiled into larger lists and documents for subsequent referral. Students also investigate the ongoing science research at the sites. The class is highly transparent. The students are all involved in the development of larger processes like emergency protocols for safety, fund-raising and budgeting, exhibition design and media relations.

Field Research and Data Collection

The sites are selected based on invitations from science organizations, the publicity generated by the program has resulted in offers from dozens of respected global field stations. The team arrives onsite and each student works daily to collect materials in their chosen field. The scientists present workshops and explain their research. Local guides take the students to key sites and ensure safety through familiarization with the dangers and areas to avoid. A cook is hired and the students are required to assist. Each evening the memory cards are recovered from every camera and sensor and backed up to hard drives. The evening backups become a group activity as each student shows their progress, images they've collected, and tell the story of their day. The students are on-site from 8-10 days with daily short trips to sites of unique ecological concern. Students are exposed to as many landscapes and contexts as possible and, with regards to the Discovery Enriched Curriculum, make their own, unique discoveries.

Artwork Development and Exhibition

Upon return, the students begin the individual project construction as well as the planning, design and organization of the public exhibition, website and print catalogue. The finished works are presented in an exhibition that utilizes many of the School of Creative Media's unique display tools including the i-dome, the 360-cinema, inflatable and kinetic displays, and an array of specialized screens and projection systems. A website is launched on the school's portal which joins the previous expeditions also permanently hosted there. The print catalogue is presented to donors and guests on opening evening with copies distributed to primary and secondary school libraries. The exhibitions and tours extend over 2-3 weeks. To increase public visibility, City University's Community and Public Relations Department organizes dual press conferences both prior to the expedition and the exhibition.

THE EXPEDITIONS

Extreme Environments 2012: The Mojave Desert

The first expedition involved partnerships with a dedicated coalition of academic and scientific organizations. The team stayed in California State University's remote research station in an idyllic oasis on the edge of a massive dried lake in the Mojave Desert. From this working science field station, The California Desert Studies Consortium staff made the students' fieldwork possible, performing complex readings in a variety of desert sites including Joshua Tree, Death Valley, the Singing Dunes and the Salt Flats. The renowned database project, The Center for Land Use Interpretation, provided a tour of alternative, often damaged sites that powerfully showed how the use of desert resources reflects what is best and worst about a culture.

Figure 1: Student capturing wind speed and direction data in the Mojave Desert

As the team passed through Los Angeles, UCLA's Art/Sci Lab and the California Nanosystems Institute demonstrated how scientists are engaging with artists at one of the world's most sophisticated research laboratories and discuss the changing relationship between the sciences and the arts. The Getty Conservation Institute gave us a behind-the-scenes tour demonstrating how scientists in their laboratories are preserving art's antiquities, and UCLA's Center for Research in Engineering, Media and Performance (REMAP) introduced ways that the performing arts are partnering with engineers and scientists. Each of these encounters clearly demonstrated that the old boundaries between art and science are crumbling.

Extreme Environments 2014: Antarctica and Tierra Del Fuego

Based on the Mojave success, CityU broadened this initiative to be University-wide and to collect data in one of the most remarkable science sites on the planet: Antarctica. The team flew to Buenos Aires and then to Ushuaia, Argentina on Tierra del Fuego. They explored and studied the dramatic ecosystem there, hiking deep into the Andes and canoeing on the rivers flowing through the forests.

Figure 2: Students measuring air quality with laser measurements in Antarctica

Figure 3: Students conducting thermal studies of penguin chicks in Antarctica

Figure 4: Student trekking with equipment to field site in Antarctica

The students then boarded The Akademik Ioffe, a highly regarded scientific research vessel that has been in use for a quarter-century. Designed for hydro-acoustic oceanic research in 1989, the Ioffe and its Russian crew and science team are the pride of the Russian fleet. The guide through the various locations in Antarctica was One Ocean, a tour company dedicated to environmental awareness, scientific exploration and active conservation. One Ocean's team of ornithologists, historians, botanists, geologists and other specialists supported our students as they studied such subjects as penguin colonies, glaciers, icebergs, wind patterns, plant life, and animal behaviors. Each day, the students visited two important ecological sites and collected a range of scientific data, capturing characteristics of this unique environment.

Extreme Environments 2015: The Vietnam Caves

The team first visited the historic port town of Hoi An in Vietnam, toured the UNESCO ruins at Hue, and stayed on a farm near the karst mountains of Phong Nha before trekking into the remote, wild jungle caves. Supported by The British Cave Research Association and their organization, Oxalis, students followed local tribe guides through dense jungle, scaled jagged mountains and swam hundreds of meters along underground rivers in complete blackness all while carrying a range of media and scientific gear. The students camped in the jungle and in the caves themselves. In total, they explored six distinct cave networks, sometimes entering one side of a mountain and exiting the other after hiking and swimming underground for hours. Only discovered three years earlier, the students were the first group of artists and designers to see many of these rare and endangered underground formations, one of the last untouched places on the planet and home to a variety of plant and animal life that appear nowhere else.

Figure 5: Student conducting light studies in cave entrance in Vietnam

Figure 6: Students entering cave network with equipment in Vietnam

The art and design students did a wide range of creative research while underground. Some worked with scientific sensors to measure cave acoustics and echo, color spectrums in the beams of light, wind movement, water flows, stalactite formations and more. Others used media technologies to project images, light patterns and laser scans in the caverns. A range of cameras accompanied the expedition from the latest digital models to old-fashioned black and white film—valuable in places of such low light. All this was done in order to collect the raw materials to create artworks each directly connected to unique phenomena in the caves.

Extreme Environments 2017: The Coral Triangle (The Solomon Islands and Malaysia)

The 2017 expeditions in late February studied two locations in the Coral Triangle. CityU's State Key laboratory in Marine Pollution (SKLMP) trained eight of our students in scuba diving and led the expedition to Malaysia. An additional twelve students trekked to a remote cluster of small islands in the western region of the Solomon Islands to participate in the work by The Nature Conservancy.

Training for the scuba diving began in December and was supervised by the SKLMP in partnership with Diving Adventure. Eight students attended the classes and reached varying levels of diving certification. The expedition travelled first to Tawau in Sabah, Malaysia and then to their base in Mabul Island. Dive days

Figure 7: Student setting up sound installation on disappearing island in the Coral Triangle

included multiples sites in the region including Sipidan, one of the highest-rated underwater sites in the world. Student observed SKLMP scientific research as well as explored caves, coral reefs and wrecks. They swam alongside a broad diversity of aquatic life including sharks, turtles, moray eels and a plethora of fish species. Day trips included visits to local towns, mangroves and other cultural sites.

The island team left the Solomon's capital city of Honiara by small plane to a muddy jungle airstrip on the far western edge of San Isabel. From there, they travelled by small outboard motorboats for four hours west to The Arnavon Community Marine Conservation Area, a collection of atolls endangered by rising ocean levels and now protected in partnership with The Nature Conservancy. Off the grid without phone, internet or electricity, the students worked with the local rangers and the KAWAKI women's group to collect amazing images, scientific readings and stories. They joined in crocodile wrangling, capturing and tagging turtles in the ocean (quite a strange 'rodeo'), watching thousands of frigate birds returning to the islands at sunset, fishing with traditional tools, and paddling through dark mangrove forests.

One of the most profound experiences on the expedition was the students assisting in four hatchings of the endangered hawksbill turtles. They cleared the path to the ocean as the sand began to bubble with hundreds of baby hatchlings who must race to the ocean moments after their birth. Students chased off predator birds and threw rocks into the ocean to ward off predatory reef sharks and in doing so directly helped hundreds of newborn turtles of a struggling species survive.

Figure 8: Student assisting the hatching survival of a newborn turtle in the Coral Triangle

Extreme Environments 2019: Hong Kong and Typhoon Mangkhut

In September 2018, Hong Kong itself became an 'extreme environment' as Typhoon Mangkhut, an extremely powerful and catastrophic tropical cyclone, ripped through Southeast Asia. As the highest typhoon warning signal No. 10 remained in place for 10 hours, the rainfall and storm surge caused serious flooding as strong winds knocked over more than 47,000 trees, blocked roads, and shattered glass windows. More than 200 people were injured and the city's transportation networks devolved into chaos. The trauma reminded the city that our protected world cannot withstand the escalating effects of extreme weather.

Students worked directly with meteorological data from the Hong Kong Observatory and the researchers at the School of Energy and Environment to create artworks that address the experience through new media arts. Each project moved beyond data visualization, using the sophisticated sensing technologies of weather science as a creative impetus, looking for a deeper emotional connection to the raw numbers. Experimental film, interactive animation, time-lapse photography, programming and sound interpreted the data in new ways, highlighting the personal drama, sadness, loss and resilience of our complex and evolving relationship with the natural world.

The student projects were presented first at HKO's Open House, reaching thousands of primary and secondary students followed by a large exhibition at the Tai Kwun Centre for Heritage and Arts over a 3-day weekend. The show reached thousands of local and international guests, provided research interviews that resulted in valuable quantitative data, was successfully covered in both traditional and social media, and created materials valuable for further outreach.

CONCLUSION

This chapter does not cover the massive behind-the-scenes requirements on the course leader and administrative assistants who must arrange travel logistics, staffing, legal issues, financial support, medical emergency protocols, parent liaising, project development, hardware and software resources, publicity and media outreach and more. Perhaps the most important success of the program is that despite leading inexperienced undergraduates to some of the most dangerous and remote sites on the planet, no student has ever been injured. That fact alone demonstrates the enormous background preparation that each iteration has required.

The spark triggered by this shared experience among students and professional artists, scientists and engineers has proven to be an effective pedagogical approach and often a transformational experience. Merging research methodologies creates a context where a skill—scientific or artistic—is no longer specialized but integrated into a larger context. Unexpected hybrids form when the established goal of a field of study is diverted—an engineering skill is applied to art, an art skill applied to science. Students thus realize that specialization does not mean a singular path; that the specializations from different fields can be applied to new contexts to yield innovative ideas.

Merging research methodologies creates unexpected hybrids and inventive thinking. Students develop skills and discipline-spanning abilities that are sought by employers worldwide. The demand-based acquisition of work-ready skills is learner-centered and authentic, produces transformational changes and enhances the students' love for learning. Students from the program have gone on to exhibit internationally as artists, study in the most prestigious graduate programs, or begin successful startup design firms. They represent creativity as stewardship and how the artist can contribute as a global citizen.

WEBSITES

The Mojave Desert: http://mojave.scm.cityu.edu.hk/Home.html
Antarctica: http://antarctica.scm.cityu.edu.hk/
The Vietnam Caves: http://caves.scm.cityu.edu.hk/
The Coral Triangle: http://coral.scm.cityu.edu.hk/
Hong Kong and Typhoon Mangkhut: http://weather.scm.cityu.edu.hk/

DEC and School of Law: Reframing the Coursework Curriculum

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ABSTRACT

City University of Hong Kong's Discovery Enriched Curriculum ('DEC') is a unique pedagogical framework emphasising discovery, innovation, and creativity. With its focus on invention and experimentation, this approach lends itself naturally to the artistic and science-based disciplines, yet with an open mind, it can also be implemented within the undergraduate curriculum in law. This chapter recalls the successes and ongoing challenges in implementing the DEC framework within the existing School of Law curriculum. Already, some established law teaching practices fit the DEC model. Nevertheless, to fully implement the DEC within the Bachelor of Laws curriculum (and within School of Law's taught postgraduate programmes), some changes to long-standing teaching practices and the list of core courses are necessary. Overall, DEC has the potential to become a model for other law schools to follow in adopting discovery-based learning methods.

INTRODUCTION

City University of Hong Kong's Discovery Enriched Curriculum ('DEC') is a pedagogical approach involving discovery, innovation, and creativity (Office of the Provost, 2020). With its focus on invention, experimentation, and solving real-world problems, the DEC lends itself most naturally to the artistic and science-based disciplines, yet with an open mind, it can also be implemented within the undergraduate and taught postgraduate curricula in law. This chapter describes the way in which the DEC has informed curriculum design at City University of Hong Kong's School of Law ('SLW'), as well as the challenges that legal educators have encountered in ensuring that the SLW's Bachelor of Laws ('LLB') and Juris Doctor ('JD') degrees each speak to the university's overarching pedagogical framework.

According to City University of Hong Kong's website (Office of the Provost, 2020), the DEC involves:

> 'Discovering knowledge that is new to:
> - the student, and to
> - the field (the discipline(s) that the student is studying)'.

Although different scholars have interpreted the DEC to mean different things, to my mind, the framework incorporates two steps: first, using discovery-based learning as a constructivist pedagogical approach[1] for students learning established doctrine. Second, during the duration of their degree, each

1 For background on discovery-based learning, see Balim (2009), Saab, van Joolingen and van Hout Wolters (2005) and Alfieri et al. (2011).

and every student, no matter what their field of study, should be given the opportunity to make a 'discovery' new to their field, to expand the ambit of human knowledge.

The DEC's two limbs demand distinctive approaches within different subject disciplines. In the legal context, Professor Roger Brownsword of King's College London equates the distinction between a 'mere discovery' and an 'invention' in the law of intellectual property governing patents (Brownsword, 2015, p. 2).[2] One way of thinking about DEC as a pedagogical system is that the first limb, discovering knowledge new to the student, provides the skills to facilitate the second limb – expanding human knowledge. If students master the methodology of discovering new knowledge for themselves (even if it is already well-established legal doctrine), then they will be in a good position to contribute to the growth of the field itself, both later in their degree and after they graduate. Using Brownsword's intellectual property analogy, students acquire skills as they discover pre-existing problems, before they later make an original invention themselves, seeking to resolve one or more of those problems. The second step cannot proceed before the first.

DEC AND THE LAW CURRICULUM

At the CityU School of Law, the pressing question has become: how can we 'fit' legal education within the DEC framework? Is it even possible? If the School of Law is not to be the odd department out, then it is important to find a way to do so.

Thankfully, following a detailed review of SLW syllabi and of related literature, I can reasonably claim that legal educators are *already* speaking the language of the DEC through their existing teaching methods. Although not all courses can realistically allow students the opportunity to generate new knowledge within the field, there is not a single course taught at the SLW where discovery-based learning *skills* are not relevant and cannot be implemented.

To fulfil the DEC's first limb, on pedagogy and methodology, legal educators can adopt a number of different approaches to teaching established legal doctrine. A literature review reveals four distinct categories of teaching methods, some of which SLW staff have already adopted in their own courses. I provide examples of the latter in the footnotes below.

First are activities requiring *legal principles to be distilled from caselaw* by the student, with a commonly overlooked example being outlining: students distilling a legal principle from a case itself, rather than being told what the case stands for by the lecturer, or by reading a summary in a law report headnote or a textbook (Usman, 2016).[3] Second are activities and modules involving *problem solving* through legal research or the *simulation* of legal practice, such as mooting (formerly a compulsory course as part of the LLB degree)[4] (Roper, n.d.; McDevitt, 2009), trial advocacy (Lubet, 1987; Ivković &

2 The analogy is not a perfect one, as in intellectual property law, even a first-time 'mere discovery' of a 'pre-existing and naturally occurring entity' advances the ambit of human knowledge. An 'invention', on the other hand, is an original technical solution to a pre-existing yet unresolved technical problem. Only the latter can be the subject of a patent (MacQueen, Waelde & Laurie, 2011, p. 512).

3 e.g. LW2604A Legal Research and Writing I: https://www.cityu.edu.hk/catalogue/ug/current/course/LW2604A.htm. A second example is summarising recent caselaw developments, whereby students summarise the impact of very recent case law at the levels below the Hong Kong Court of Appeal for the benefit of classmates and the lecturer, before these cases are picked up by loose-leaf services and textbook writers (Pascoe, 2017).

4 See LW2665 Mooting: https://www.cityu.edu.hk/catalogue/ug/201415/course/LW2665.htm.

Reichel, 2017), problem-based learning (York Law School, 2017; Scott, 2005) or simulated case files (Toole, 2019). Third are *student-led teaching activities* whereby the legal educator hands over control of a traditional teaching activity to students, such as peer review of student work (Zariski, 2002; Usman, 2016), introducing new topics to the class (Herndon, 2010; Pascoe, 2017), students designing their own reading lists (Brownsword, 2015), or limiting teaching of the 'general part' of the doctrine so as to allow students to find and interpret specific statutory provisions themselves (Pascoe, 2017; Burns et al., 2017).[5] Fourth and finally is *learning through observation*, whereby students observe legal processes in action and attempt to understand, explain and situate within the relevant literature what they have seen and heard. Relevant examples are court visits,[6] observing the work of prisons, legislatures and government departments (Roper, n.d.; Phillips, 2010; Maranville, 2001), externships within law firms (Maranville, 2001), and even taking photos of contractual clauses, legal signs, fixtures and easements that students come across during the week (Maranville, 2001).[7] Within each of these four categories (distillation, problem solving / simulation, student-led teaching and observation), students engage in legal research using primary and secondary materials to discover the relevant law and to complete the assigned task.

It is the second limb of the DEC which has proven far more difficult to implement at the SLW. Here, students and educators move beyond discovering existing legal doctrine, and developing the skills required for further discovery, to the actual need to *produce* new knowledge: the need to provide evidence of DEC output. And in implementing the second limb, law as a social science discipline focused on deductive reasoning possesses a particular disadvantage vis-à-vis the 'hard' sciences and the creative arts.

While intellectual property is an elective subject at CityU as in other law schools,[8] legal practice is not traditionally concerned with the *creation* of intellectual property – lawyers work in the service sector assisting more inventive and creative professionals. Among their other tasks, intellectual property lawyers document the inventions of others, protect the rights of inventors and help to resolve related disputes. Traditionally, they do not engage in invention and innovation themselves. As a result, most law students are not going to design an app, register a patent, or complete an artistic or musical composition by the time they complete their degree. If they do, and we should not discourage it, it will probably be as an extra-curricular activity, rather than by utilising their newly attained legal knowledge. But at first glance, this is what the DEC demands of teachers and of students.

DEC'S SECOND LIMB: INVOLVING STUDENTS IN KNOWLEDGE PRODUCTION

At the SLW, how have we been able to overcome this incongruence between pedagogical expectations and vocational reality? As lawyers in training, among several other competencies, law students learn to

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5 Several commentators have, however, urged caution is adopting student-led teaching activities. See variously Easteal (2008); Moust et al. (1989); Samuels (1995).

6 e.g. LW3606A Criminal Law I: http://www.cityu.edu.hk/catalogue/ug/201718/course/LW3606A.htm; LW3606B Criminal Law II: https://www.cityu.edu.hk/catalogue/ug/202021/course/LW3606B.pdf; City University of Hong Kong (2019). Court visits and other observation-based tasks may also be categorised as distillation exercises.

7 e.g. LW2604A Legal Research and Writing I (n 3).

8 See LW4641 Intellectual Property: Theory, Copyright and Design: http://www.cityu.edu.hk/catalogue/ug/201617/course/LW4641.htm; LW4642 Intellectual Property Law: Theory, Patents and Trademarks: https://www.cityu.edu.hk/catalogue/ug/201415/course/LW4642.htm.

construct logical arguments, to develop novel interpretations of existing caselaw and legislation, and even to draft statutory provisions as future legislators. These skills each speak to knowledge production and can be harnessed as part of the DEC's second limb, when communicated to a wider audience. As such, written contributions expanding the field that students can author, or at the very least contribute to, fall into the three categories below:

1) Pieces of doctrinal or empirical legal research primarily authored for an academic or a student audience (such as dissertations, case comments, law review articles, published collections of student essays or conference papers) (Roper, n.d.); [9]

2) Legal research pieces that seek to directly shape public opinion or government policy (such as submissions to the Hong Kong Law Reform Commission or to the Legislative Council, opinion pieces to local newspapers, contributions to talkback radio, or blog posts) (Roper, n.d.); and

3) 'Experiential learning' activities, where students learn and advance legal understanding by 'doing'. Unlike the previous two categories, within experiential learning, the student necessarily contributes as part of a larger team, and cannot claim sole ownership of the final 'product'. Typical examples of experiential legal education are hands-on internships in law firms (Usman, 2016), clinical legal education (i.e. running a free legal advice clinic, based in the law school) (Lasky & Sarker, 2015), or the student playing an active role as a research assistant on a staff member's research project (Healey, 2005).

Again, fulfilling a discovery and innovation agenda does not require overwhelming changes to pre-existing teaching and learning activities at law schools, but merely a shift in emphasis. The main challenge is to integrate these kinds of activities into the core curriculum itself, rather than relying on students taking them on as subject electives or as extra-curricular activities. At the SLW, we already have all the tools available to fully implement DEC into the undergraduate and taught postgraduate law curricula, but we still face programming and staffing challenges in doing so. Broadly speaking, there are two solutions: 1) to try to incorporate these kinds of outputs into our core courses, or 2) to make particular 'DEC friendly' courses compulsory in undergraduate legal education.

For the first option, it is worth keeping in mind that real DEC 'output' should be accessible to the outside world, whether that means accessible within the greater university community (for example, participation in the annual 'Discovery Contest', [10] celebrating student achievements on the DEC website,[11] or even by cataloguing student dissertations in the university library[12]) or among the general public (for example, as a newspaper op-ed). In the absence of any public display or exhibition, simply addressing policy questions as a part of the ubiquitous coursework essay, read only by a professor during marking, is not enough. The key is to produce student artefacts that, even indirectly, have the potential to shape life beyond the classroom and lecture theatre. As outputs, these are not dissimilar to the 'impact agenda' promoted by research assessment exercises at the faculty level (Smith et al., 2020), relevantly the Research Assessment Exercise (RAE) in Hong Kong and the Research Excellence Framework (REF) in the United Kingdom.

9 See Lakhani (2014) for an example in the CityU SLW context.

10 See Office of the Provost (2017) for further information.

11 See Office of the Provost: https://www.cityu.edu.hk/provost/dec/stafflan/DEC_coursework.htm.

12 See Run Run Shaw Library: http://www.cityu.edu.hk/lib/digital/thesis/dept.htm.

The second approach involves identifying existing modules that already mandate the production of DEC-type output, and making one or more of those modules compulsory in undergraduate or postgraduate coursework education. At the SLW, the relevant 'DEC-friendly' courses currently available to students are: Independent Research (requiring an 8,000-10,000 word dissertation);[13] editing the City University Law Review;[14] or conducting a Legal Placement (i.e. an internship).[15] At the time of writing, these are all elective courses undertaken by a minority of students each year. One option for the next stage of DEC implementation is to make one or more of these courses compulsory for LLB and JD students. All three courses necessarily involve producing research accessible to the university community or the broader public, or else working to resolve real-life legal disputes.

CONCLUSION

Through its discovery and innovation-based pedagogical framework, City University of Hong Kong as a whole provides a template to follow for other institutions which seek to maximise their students' learning efficiency, increase critical thinking capacity, and provide excellent transferrable skills for employment after graduation, among many other benefits (Pascoe, 2017; Office of the Provost, 2020). The way that the SLW has interpreted and adapted the DEC framework also holds lessons for other academic disciplines outside of the hard sciences or creative arts, where student innovation has not traditionally been prioritised. The DEC can, and should, benefit teaching and learning in all fields within tertiary education.

Yet, within the CityU SLW curriculum itself, we cannot yet claim that 'all students graduating [have] completed a DEC project' (Office of the Provost, 2020) and have thereby advanced human knowledge. Within this chapter I have suggested possible means to address this shortcoming, as well as further examples of innovative pedagogical techniques deriving from the established 'discovery-based learning' literature. Once CityU students develop the attitude and the skills to innovate (City University of Hong Kong, 2012), they must also be presented with opportunities to test these new-found virtues in a way which empowers them as undergraduate researchers, whether they are enrolled in science, arts or indeed law degrees.

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13 See LW4635 Independent Research: https://www.cityu.edu.hk/catalogue/ug/current/course/LW4635.htm.

14 See LW4667 City University Law Review: https://www.cityu.edu.hk/catalogue/ug/201516/course/LW4667.htm.

15 See LW4612 Legal Placement: http://www.cityu.edu.hk/catalogue/ug/201617/course/LW4612.htm.

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