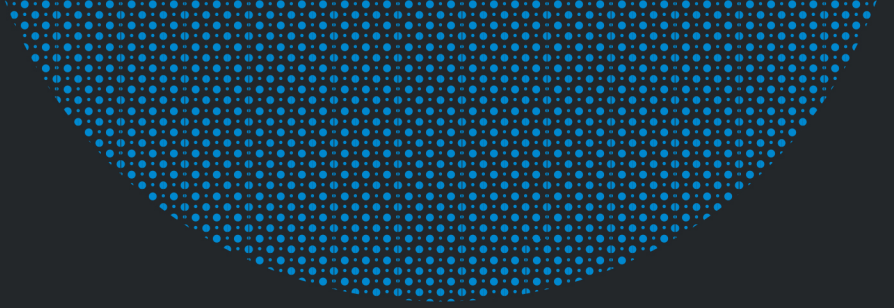

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DESIGN THINKING AND INNOVATION IN LEARNING

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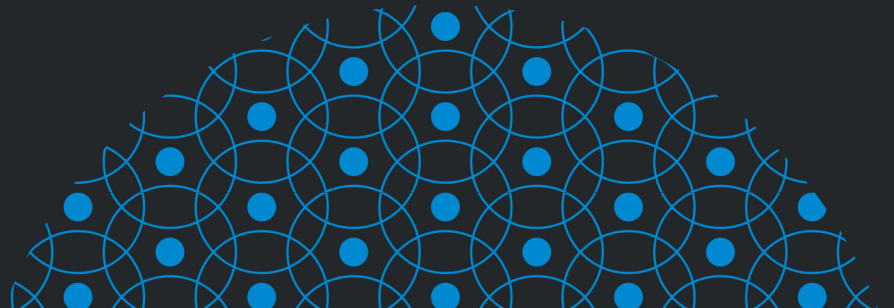

DESIGN THINKING AND INNOVATION IN LEARNING

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EDITED BY

ELLEN TARICANI

Pennsylvania State University, United States

United Kingdom – North America – Japan – India
Malaysia – China

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INVESTOR IN PEOPLE

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LIST OF CONTRIBUTORS

Ellen Th. W. Bastiaens, Maastricht University, The Netherlands

Theo J. Bastiaens, The Open Universiteit, The Netherlands

Nicoletta Di Blas, Department of Electronic, Information and Bioengineering, Politecnico di Milano, Italy

Camilla Casonato, Department of Architecture and Urban Studies (Dastu), Politecnico di Milano, Italy

Manuela Fabbri, Department of Education Studies "G.M. Bertin", Università degli Studi di Bologna, Italy

Luca Ferrari, Department of Education Studies "G.M. Bertin", Università degli Studi di Bologna, Italy

Patricia Fidalgo, Emirates College for Advanced Education, Curriculum and Instruction Division, Abu Dhabi, UAE

Xun Ge, Department of Educational Psychology, Jeannine Rainbolt College of Education, The University of Oklahoma, OK, United States

Carolyn Kirio, University of Hawai'i at Mānoa, HI, United States

Oleksandr Kulyk, Philosophy Department, Oles Honchar Dnipro National University, Ukraine

Wilfred W. F. Lau, The Chinese University of Hong Kong, People's Republic of China

Patricia Louis, University of Hawai'i at Mānoa, HI, United States

Michael-Brian C. Ogawa, University of Hawai'i at Mānoa, HI, United States

Elvira Strakhovich, Graduate School of Management, St. Petersburg University, Russian Federation

Ellen Taricani, Associate Teaching Professor, Department of Communication Arts and Sciences, Pennsylvania State University, PA, United States

Joan Thormann, Educational Technology Division, Lesley University, MA, United States

Jenny Yamamoto, University of Hawai‘i at Mānoa, HI, United States

INTRODUCTION: CONSIDERING THE NEED FOR APPLIED INNOVATION IN EDUCATION

Ellen Taricani

> *As we look ahead into the 21st century, leaders will be those who empower others.*
>
> *Bill Gates, Co-founder of Microsoft*

Empowering today's learner to find innovative and enriching experiences will bring about a deeper desire to learn and develop skills. This book offers a combination of innovative design ideas related to education and uses of creative pedagogy. Educational impacts are experienced and modified as the successful techniques are found. For global graduates to obtain quality experiences, they will require a blend of both knowledge and practical ability. They will thrive with these competencies enabling them to impact and lead in the global workforce. Cross-cultural functionality along with the awareness of opportunities can provide expansive value to the learner. Developing global leaders who are able to work across world boundaries using new techniques is important and necessary. Boundaries throughout the world continue to be less noticeable and more permeable with open forums of ideas and implementation.

As you read through each chapter, there are many concepts that cross the cultural boundaries and present numerous possibilities to assist in constructing new design ventures in the classroom. Each author offers a unique perspective in teaching and learning. The world is very complex and consists of many different socio-cultural contexts. Many authors take steps outside their comfort zones of keeping work similar to what was done in the past. These ideas can generate potential for innovation and lead to empowering others to dig deeper. Each of these chapters presents creative ideas that have opened spaces for new possibilities and application in design of learning.

Some of the topics that you will find in this book include digital storytelling, online tasks and performance, plagiarism, trends in international mathematics education, design thinking, collaborative construction of knowledge, innovation in pedagogies and reflections of changes in education.

Each chapter reflects on specific topics that will look at specific studies. In Chapter 1, there is a very distinct international dimension. The aim is to analyse the results of field-research looking at the differences there are among EAU, Portugal and Ukraine. Digital storytelling provides a short form of digital media production that allows everyday people to share aspects of their story as it relates to education. Some are differences between their educational systems and policies as well as between their educational patterns. The next chapter presents and discusses the multinational study of students concerning the use of technology and performance related to online tasks. It is very connected with important phenomena and practice in education. In most settings especially when more work is online, academic cheating can be a problem. Chapter 3 addresses issues that are different local/national/cultural attitudes. The assessment structure included a mixed methods approach to determine a statistically significant decrease in plagiarism, changes to perceived accountability of academically dishonest actions, increased knowledge of plagiarism, and a lowered amount of administrative time spent on plagiarism cases in practice.

Looking at the mathematics curriculum (chapter 4) in Hong Kong provides a glimpse of the socio-cultural background. This study consists of 10 curriculum components, including the rationale of the curriculum, aims and objectives, content, learning activities, teacher role, materials and resources, grouping, location, time and assessment.

Design Thinking is meant to construct a point of view that is based on a design user's needs and insights. It is important to consider the needs of the students and represent concepts to the specific needs. This method (found in chapter 5) is similar to the sequence of phases of the project life cycle, namely initiation, planning, execution and completion. Design Thinking method, namely empathy, definition, idea, prototype and test, is similar to the phases of project execution.

Student engagement through collaborative construction of knowledge in Makerspaces (Chapter 6) presents a case-history of new trends and innovative methods of engaging students using objects. These techniques provide active learning. Many times, groups gather and discuss ideas without really making connections with each other's ideas. Objects, such as found in maker spaces, can be introduced to enhance thinking and processing of concepts towards a better and more comprehensive product.

The final research study in Chapter 7 considers issues that look at higher education in a changing society. There is a need for an evolution of existing higher educational models. In this study, there are two case studies to release modern pedagogy for higher education. It involves a pedagogy that has a focus on real world problems and sees transfer of learning as utterly important. Technological development driven by global competition continuously increases the complexity of work and the related skill demands, whereas the educational sector should meet these demands by preparing and upgrading the skill level of the working population. The last essay discusses issues related to pedagogy and cultural changes. While exploring various innovative means of pedagogical approaches in education, we need to deliberate upon the following questions: Why do we need to seek innovative educational practice? What learning outcomes do we intend to achieve through innovative approaches in education? These are some of the questions to be considered as you read through these chapters.

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LITTLE-KNOWN HERITAGE AND DIGITAL STORYTELLING. SCHOOL AS PROTAGONIST IN THE REDISCOVERY OF THE LOCALITY

Camilla Casonato, Nicoletta Di Blas, Manuela Fabbri and Luca Ferrari

1. INTRODUCTION

The school as the driving force behind an action of rediscovery, enhancement and communication of cultural heritage: this is the 'heart' of the ScAR project ('School Activates Resources') by Politecnico di Milano, the largest technical university in Italy.

ScAR is one of the winning projects of PoliSocial 2017, a social responsibility programme by Politecnico di Milano, which in that year had as theme 'the suburbs'. ScAR puts some schools (levels 1 to 12) at the centre of knowledge-building processes (Scardamalia & Bereteir, 2006; Conole, 2013; Vuopala et al., 2015; Gillies, 2016) aimed at understanding and conveying, through technologies, the value of their everyday landscape: less 'glaring' with respect to 'official' cultural heritage, but not less interesting.

The students, in their own words, have turned 'from seeing to looking', realising 'that there is no need for planes and exotic destinations' since also 'your neighbourhood, after all, can be the starting point of a journey [...] if there is the spirit of discovery'. ScAR has put in place a wide range of activities, both tech-based and not, to prompt this discovery attitude. One of these, on which the article is focussed, is digital storytelling: a creative way of

presenting a topic using an interactive, multimedia language (Lambert, 2013). In the light of the project data, elaborated through the analysis of the educational reports teachers were required to prepare, this study aims to investigate whether and how digital storytelling can prompt pupils, of different ages, to care for their territory and its cultural assets.

The study focusses on the Italian context, where the (well-known) abundance of cultural heritage of all kinds and ages somehow inevitably leads to neglecting scattered, little known heritage. Italy therefore proved to be the ideal testbed for the project.

2. HERITAGE EDUCATION AND TECHNOLOGIES

The centrality of 'heritage education' as a tool for citizenship training has long been established in Europe (Council of Europe, 1998; De Troyer, 2005; Calcagno Maniglio, 2017, Van Lakerveld & Gussen, 2011). In the document produced in 2006 for the Council of Europe entitled 'European democratic citizenship, heritage education and identity', Copeland jointly explores the concepts of citizenship and heritage, examining their mutual relationships and examining their possible applications in the pedagogical field, in order to fight 'the mistaken belief that heritage and heritage education are marginal in the development of the European citizen' (Copeland, 2006, p. 7). Moreover, European policies identify heritage education as a means of guaranteeing the right of every citizen to participate freely in cultural life (Faro Convention, 2005).

Since 2015, the Italian government, in harmony with the reflection that was developing in Europe (European Landscape Convention, 2000; Faro Convention, 2005; Florence Declaration on Heritage and Landscape as Human Values, 2014), established the long-term objective of creating a heritage education system capable of involving a plurality of subjects and devising substantial forms of involvement in the management and safeguarding of cultural heritage and the acquisition of new and qualified knowledge, with mutual benefit for society and the heritage itself. Indeed, the training linked to cultural heritage offers the possibility of contributing to improve the life of each individual from a cultural point of view, developing a sense of belonging to one or more cultures and to the territory. However, current deficiencies in training actions and promotion of research favouring synergy between universities and schools are still significant.

An important contribution that universities can offer to schools in the field of heritage education consists, on the one hand, in the development of participatory methodologies of knowledge construction and communication (Prince, 2004; Healey et al., 2014) and, on the other hand, in the introduction

of advanced (but accessible) technologies within the processes. The usefulness of introducing forms of participatory culture related to communication technologies in schools has long been established.

> *A growing body of scholarship suggests potential benefits of these forms of participatory culture, including opportunities for peer-to-peer learning, a changed attitude toward intellectual property, the diversification of cultural expression, the development of skills valued in the modern workplace, and a more empowered conception of citizenship. (Jenkins, 2009, p. 3)*

The new media literacies, under this respect, should be seen as ways of interacting within a larger community, i.e. as social skills.

The use of new technologies may facilitate the approach to cultural heritage, due to the potential of the instruments and the strength of their attraction on new generations (Luigini, 2019; Ott & Pozzi, 2011). Students are immersed in a society that is technologically rich and pervaded by the media and digital technologies and cannot be left alone. It is important to encourage students to go from being mere consumers to being 'critical consumers' and 'producers' of digital content.

The ScAR project aims to face these questions putting into place an experimental set of actions in a context rich in critical issues and dealing with a fragile and neglected heritage such as that of the urban peripheries.

3. PROJECT DESCRIPTION

ScAR is a participatory project that involves diverse actors and interacts with multiple interlocutors such as municipal institutions (Municipalities 4 and 5 of the City of Milan), cultural institutions (the Prada Foundation, by the famous Italian brand, and the Urban Ecomuseum of South Milan), school districts, as well as local associations. The project involved five schools, located in southern Milan, with 16 classes ranging from primary to upper secondary schools. Students and teachers from other regions were also involved, thanks to the partnership with a larger digital storytelling project, called PoliCultura, which involved more than 700 students in 2018–2019.

The fieldwork activities were preceded by a phase in which the teachers were trained on the main principles of cultural heritage education and communication and on the potential of new technologies in relation to the representation and enhancement of landscape and cultural heritage. The projects that were conducted in these classes varied and were the results of the participatory nature of the project and its many facets. The activities that were carried out without any technological support (e.g. neighbourhood

visits, mental mapping, model making, interviewing witnesses, landscape drawing and participatory planning), are combined with other tech-based activities (e.g. digital storytelling, gamification, social media communication, multimedia guided tours, virtual reality tours in the neighbourhoods).

Various topics were tackled and conveyed a sense of exploring territory and reading a value system that is undergoing constant transformation. It is not a matter of opening a guide and visiting the official cultural places that are recommended, but rather constructing narrations and representations within an interpretative process that identifies landscape in a broad sense and in relation with those who live in it, as 'a determined part of the territory, as perceived by the populations, whose character stems from the action of natural and/or human factors and from their interrelations' (European Landscape Convention, 2000). In this sense, the most significant tasks investigate the landscape along paths that are connected to personal experience, like the roads from home to school, or a treasure hunt in the neighbourhoods through the most significant places of collective memories. Journeys into intangible heritage, for instance along a pathway traced by primary school students connecting the artisan businesses located along their way to school, traditional and historical or newly established ones, are also significant. They have also become an opportunity to entwine the cultures in the neighbourhood and reflect the multicultural composition of the class.

Through these processes, a territory that is generally considered 'peripherical' turns into a repository of values, a resource for exchanges among generations and cultures.

4. DIGITAL STORYTELLING AT SCHOOL

Digital storytelling was proposed to all the schools participating in the project. The opportunity arose from the partnership between ScAR and PoliCultura, a competition by HOC-LAB (Politecnico di Milano) active since 2006 and open to schools all over Italy, from K to 12.

Digital storytelling has a 20-year history: it is a form of expression mediated by technologies that has found different applications in different fields. Among these, cultural heritage and education are particularly relevant (Di Blas & Ferrari, 2014). ScAR has the merit of crossing these two strands, which normally run on parallel tracks, prompting schools to use digital storytelling to communicate their local heritage.

In October 2018, a special track dedicated to ScAR was launched within the PoliCultura initiative, in which the project's mission was explained and all Italian schools were invited to participate. A total of 13 classes participated, from 5 different regions. The result is flattering because it represents about 10% of the total number of participants, a figure never reached by any other special track within PoliCultura. Normally, the 'stories' proposed in PoliCultura touch on various topics, from curricular disciplines (mathematics, Italian) to social themes (bullying, condition of women ...). The high percentage of response to the special ScAR track dedicated to the rediscovery of the suburbs shows that the theme meets the interest of schools in a special way.

The teachers enrolled attended a 'Massive' Online Course (MOOC) offered on the PoliCultura platform. The course focusses on the use of storytelling in education, on how to organise the students' work, the various activities required to create a multimedia story and how to use the authoring tool made available for the activity: '1001stories' by HOC-LAB. The tool has a very low entry threshold (Resnick, 2019): it does not require sophisticated skills to use it. This allows any teachers and students to participate. The course, therefore, is not focussed so much on the technical as on the organisational and pedagogical aspects.

Work at school spanned a 3-month period, from January to March 2019. Each group was organised differently, but all dedicated from 20 to 25 hours on average to the activity. Beyond the differences related to the scholastic level, a common trait to all participants is that the activity is run collaboratively, thus making the result everyone's responsibility (Schul, 2012; Cook-Sather et al., 2014; Falcione et al., 2019). In most cases, moments in which the group is involved as a whole (like when the overall topic of the story is chosen) alternate with small groups work on a specific task (e.g. to create a chapter in the story).

Working with 1001stories to create a digital story entails a lot of 'traditional', non-digital activities: first of all, search for content, which in the case of the ScAR stories meant exploration of the territory, interviews with experts but also ordinary people from the neighbourhood. Then, re-elaboration of the content: to write texts, to decide on the use of videos or images (drawings, photos…). Along with the non-digital activities, there run the technology-based activities: recording of the audios, sometimes including musical tracks, editing of images and videos and, finally, inserting the various contents in the 1001stories tool, to create an interactive multimedia product.

The topics covered by the ScAR participants were the most varied, from 'street art' (Fig. 1), to a family-run puppet theatre (Fig. 2).

Fig. 1. Students Taking Pictures for their Storytelling About 'Street Art'. Credits: ScAR Project.

In the next section, we examine the impact by the activity and we try to give an answer to the question of whether digital storytelling can generate in the students a 'bond' with the territory. The discussion is based on the analysis of the reports each teacher delivered, which was organised along these lines: activity description, objectives, tasks and roles of the students, organisation of the work (spaces and tools) and overall evaluation of the experience.

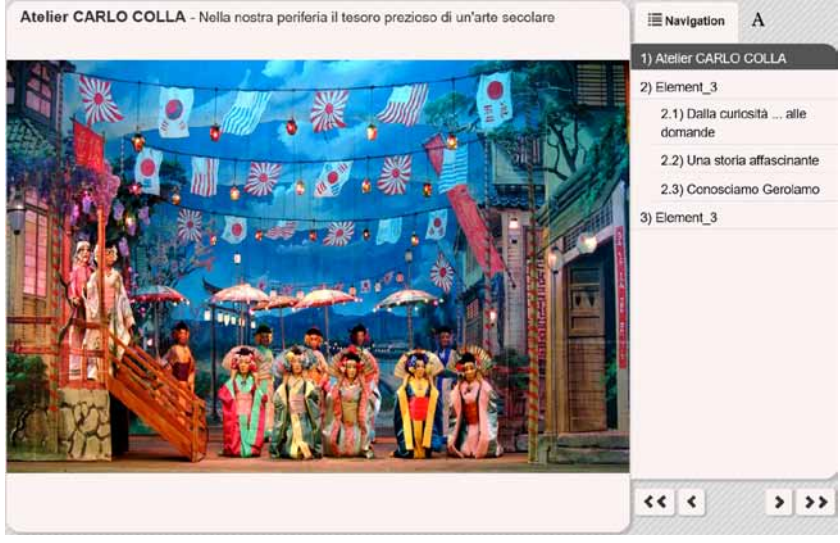

Fig. 2. The 'Puppet Theater' Storytelling (on the Right, the Organisation into Chapters/Sub-chapters of the Story). Credits: ScAR Project.

5. DATA ANALYSIS AND RESULTS

5.1. General Features

In the following paragraphs, we present through the *teachers' voice*, the recurring elements which have guided the design and implementation of Digital Storytelling (DST) experiences.

In most cases, DST was designed not only to face learning and socialisation needs of pupils, but also to improve teachers' collaboration:

> *the Class Council [...] decided to take part in the activity to strengthen the students' motivation to learn, to research and to be more productive. Furthermore, it was important to highlight the qualities of our students, and to consolidate relations between classmates increasing the sense of co-responsibility [...]. (R.13);*

'[this] project has been an opportunity for teachers and students to get to know each other' (R.3).

The connection between the cultural heritage and the enhancement of local historical areas was a feature found in all the educational reports by the teachers. In most cases, schools have promoted the cultural heritage underestimated in their territory:

> *I learned that the Sanctuary does not even have any informative brochure. The idea came from the desire to create a virtual tour of the Sanctuary, where citizens may actively use the DST to know this place [...]. (R.7)*

In this direction, the 'digital' was seen as a mediator through which promote/support the following processes an 'active' use of digital technologies by students; the active participation of students in decision-making processes (student agency); the transformation of learning environments; the knowledge of the local territory.

5.2. Aims, Disciplines and Relation With the School Curriculum

The reports outline direct and indirect benefits that have had a 'positive' impact on the teachers' professional development. On the one hand, the ScAR project has contributed to consolidate moments of collaboration and exchange among colleagues, enhancing a 'collegial decision-making' perspective. On the other hand, the participating schools have facilitated the promotion of

interdisciplinary (different disciplines address, in parallel but independently, a common topic) and multidisciplinary (the same 'cultural object' is co-constructed by integrating the different disciplinary contributions) didactic approaches. Considering the perceptions of the teachers, apart from one of them, most of the projects with DST have been declared as curricular. However, an initial qualitative analysis of all the reports has pointed out that there are minimal references to formal schools' curricula. For example, only one school has clearly explained the connection between the DST activities and the official curriculum published in the school's website.

Considering the curriculum subjects involved, there was a slight prevalence of humanities over scientific disciplines. This factor could be influenced by the specific field (cultural heritage) of the ScAR project.

Analysing the dimension of the didactic objectives declared by the teachers in the design of the DST activity, it is possible to identify two types of 'prevailing goals' which have guided the implementation of these experiences. The first typology refers to the definition of generic objectives (which can be considered, in reality, as transversal ones) that the different projects intended to pursue. For example: 'to become aware of the opportunities offered by a suburban environment'; '[to approach] the dynamics of the organization of life in the suburbs'; '[to be] aware of the meaning of being part of a community' (R.5). Or:

> *to give life to a different and effective learning based on the general knowledge of the territory, on the search for identity values typical of the peripheral reality that our children live daily. (R.9)*

The second type of objectives analysed, refers to more precise taxonomic criteria (even if not always formulated correctly) and they were related to the acquisition of specific skills, such as: 'write correctly texts using different multimedia tools; recognize [...] basic and specialist words; select and organize information comparing local history in relation to Italian, European and world history' (R.4).

Increased knowledge of the territory, 'digital awareness' to promote active and inclusive teaching, have been the main 'keywords' declared by teachers in the 'project goals' section of the reports. Evidently, the DST activities promoted during the ScAR initiative have made it possible, in some cases, to promote positive experiences of inclusion and didactic innovation.

The cultural heritage topic was addressed, on the one hand, by enhancing multi-perspective approaches on the 'cultural objects' dealt with; on the other hand, by providing students with cultural tools to interpret the work they were doing. Digital storytelling, in this sense, was intended as a technological

mediator, a transversal element to all school's subject, a way to accompany the implementation of different activities.

The DST experiences highlight the inclusive values (in terms of individuals and groups) promoted within these projects. To give just a few examples, one teacher states that

> *a student with relational and cognitive difficulties has been given the opportunity to interact with the class group, contributing to the knowledge of the territory and the suburbs in which she finds herself living (S.7) (e mettere il punto prima, in chiusura di citazione)*

Another teacher points out, instead, that

> *by dividing the work among the pupils, cooperative learning has been privileged. [Tasks] are assigned to each pupil, including tutoring, to strengthen the sense of responsibility and co-responsibility. The aim was to enhance and strengthen the expressive, technological and organisational skills of each student. (R.8)*

'The project [...] has strengthened the class group' (R.1).

As can be seen from the above-mentioned examples, the analysis of the project description has brought out, therefore, the adoption by teachers of didactic strategies capable to stimulate (also) the active participation and inclusion of students with more difficulties. Although these aspects undoubtedly deserve an in-depth research, some statements on the subject have been reported as examples, which will be examined in more detail in subsequent qualitative and quantitative surveys.

5.3. Tasks and Roles Within the Groups

All the teaching projects alternated 'plenary' sessions with work in small groups. In the vast majority of cases, the teachers set the goals for the various groups, the roles of their member pupils and their tasks, while the pupils were free to choose the specific educational topic to be elaborated. There was also alternation with regard to the constitution of the working groups: in some cases, groups were chosen by the teachers to guarantee a heterogeneous mix of abilities and gender and the inclusion of pupils with special educational needs, alternating both the composition of the group over the course of the project and the roles played by the pupils; at other times, the pupils themselves chose the groups they wished to work with, depending on their interests and skills: 'the groups [...] were created mainly by the children themselves,

under clear instructions always to choose different companions and to form groups with a mixture of boys and girls' (R.5). In some school contexts, groups formed by the pupils and others formed under the teachers' guidance alternated, depending on the various activities under way, while in three cases one leader/tutor per group 'responsible for control of and compliance with the planned activities' was appointed (R.7).

In many schools, the pupils' skills and aptitudes were considered when allocating tasks, playing to their strengths in order to increase their motivation. Some were tasked with coordinating activities, revising the outputs and leading teams, while other pupils, with a higher level of IT and language skills than their classmates, were assigned a specific role in constructing the DST:

> *all the pupils were allocated a role as appropriate to their talents […] they were all involved, but the pupils best at drawing expressed their ideas in graphic form by designing the film sets […]. Finally, the working groups were organised considering each member's strengths and weaknesses and the need to encourage* cooperative learning. *(R.3)*

Apart from the differences within the individual schools and areas, one common feature was the focus on the collaborative aspect of the project, which led the teachers to develop inclusive teaching strategies (Alterio & McDrury, 2003):

> *I aimed to increase the degree of cooperative learning, especially with regard to the class […] with the most obvious gap between highly motivated and less motivated pupils. For this class, I created 'mixed', uneven groups, and I tried to get them to focus on a precise common aim and on meeting delivery deadlines […]. By mixing them up like this, I increased the level of responsibility allocated to the least motivated pupils by making their step the central one in the specific output, [explaining that without their contribution the work of the whole group would be held up]. On the basis of the results achieved, I am very happy with the group dynamics, since [the project] developed a sense of responsibility in some pupils who previously did not have one or in whom it was very weak. (R.13)*

5.4. Organisation of Working Phases

The educational project was conducted mainly in classrooms and multimedia laboratories in normal lesson time. The various project phases took place in these environments, led and supervised by the teachers but always with input from the participants, through brainstorming activities and discussions

involving the whole class or small groups. These phases were: (a) the choice of topic, in some cases suggested by the teacher and in others by the pupils, intended to encourage the rediscovery and appreciation of the 'forgotten' local heritage; (b) the construction of the editorial plan and the choice of contents; (c) the planning of the activities by the teachers, in terms of both contents and time scales; and (d) the sharing of tasks and roles amongst the pupils.

In most schools, the intermediate phases were carried out independently by the children themselves, both at school and – even more so – at home, working 'individually and in small groups, meeting after school hours and at the weekends to gather additional useful material' (R.1). Following the guidelines provided in the storyboard designed in the classroom, pupils looked for sources, chose multimedia materials and produced the documentation (writing of written texts, photographs, video films ...), all of which were subsequently viewed and approved by the teachers and their classmates.

The local area was also fundamental in the creation of the multimedia storytelling: site visits, guided tours and interviews with key witnesses were organised, photographic and audiovisual documentation was acquired and paper materials only available from specific archives in municipal public libraries were consulted.

In the final phases, in which the various multimedia materials selected and/or constructed by the pupils were assembled, the DST was edited using specific software, and the digital product was uploaded onto the PoliCultura platform. This phase took place mainly back in the IT laboratories, under the supervision of teachers; they were occasionally carried out by pupils working independently.

Besides the paper documents in the school library, depending on the school's material and technological resources, desktop PCs and tablets and, in some cases only, digital cameras and video cameras, were also used in the production of the DST. One middle school used a drone for aerial filming, while the primary school used an interactive whiteboard and an Ozobot[1] robot. The pupils also used their own digital devices for both individual and small group activities.

As the teachers' feedback reveals, the purposes for which the various technologies were used during the course of the project were: the production of multimedia material (acquisition of images and videos using various devices, first and foremost the pupils' own smartphones); finding and downloading materials from the Internet (websites, repositories and specific platforms, social media networks such as YouTube, etc.); storing and sharing the multimedia documentation in cloud environments; and assembly and editing of the *storytelling*.

5.5. Distribution and Dynamics of 'Knowledge'

Due to its specific didactic potentials, the DST activity created new knowledge and reciprocal collaborations amongst pupils and teachers, generating positive and, to a certain extent, new dynamics and exchanges in terms of contents, relationships and digital and general skills (Di Blas et al., 2014):

> *it enabled both us teachers and the pupils to acquire new skills: the reciprocal exchange of ideas, the teamwork, the criticalities to be resolved and the demands to be met combined to offer us a particularly enriching experience. (R.2);*

> *the storytelling was a reciprocal learning opportunity […], since you learn as you go and learn from one another, in all four directions: teacher-pupil, pupil-teacher, teacher-teacher and pupil-pupil. (S.8)*

Collaborative learning encouraged inclusive learning dynamics amongst children (Kolb, 1984; Kolb & Kolb, 2009): 'the peer-to-peer learning activities […] taught pupils to include all members of the group' (R.12); 'pupils filmed videos and took photographs to produce a short film with a script they wrote themselves, even including the least able, least confident children' (R.10).

In the production of the DST, each teacher contributed to the educational project depending on their own disciplinary, organisational and technological skills, participating, individually or in a team, in the revision of the texts, in the deepening of knowledge – at school or during site visits – of specific topics, in the supervision of the editing, etc. This played an essential role in enabling the children to acquire knowledge of contents relating to the local historical, cultural and environmental heritage: 'pupils learnt a great deal about the area's local traditions, not only from the multimedia sources but also from the input provided by the teacher' (R. 2);

> *this definitely helped to deepen their knowledge of the historical period concerned and about aspects of which they knew nothing, even though for many of them they concerned the history of their own town. (R. 9)*

The collaboration of other subjects and support teachers within the school, not directly involved in the project, was also definitely very valuable: in most schools, this collaboration began in the planning phase, and in many schools it continued through to the end of the didactic project, providing considerable enrichment both with regard to the educational contents offered to the

children and in terms of organisation and technology, an aspect in which some teachers' specific digital skills were fundamental.

As we have already underlined, it was particularly important for the children to get out and about in the local area, visiting, photographing and filming areas of interest for their landscape, archaeology or history (Quay & Seamen, 2013). In almost all projects, the pupils also entered into a constructive dialogue with the local population, interviewing the inhabitants of the district on the streets, at association meetings or in school, in order to recover personal opinions and knowledge about current or past events and topics (Moon, 2004): 'books and the Internet still have their role to play, but in this specific case we also learnt new things from direct contact with the people of Caramagna themselves' (R.11);

> *the interviews with the people living in the places enabled the pupils to gather information that helped them to learn about, appreciate and respect the cultural heritage they were exploring (R.7);*

'every outing expanded our network of encounters, and we walked the streets without a script, but with a story just waiting to be written' (R.3).

Not only external experts such as architects, restorers, energy resource experts and the forestry service, but also street-art artists and retired teachers provided knowledge of the cultural, historical, landscape and architectural heritage, by giving interviews, supervising the children's work and providing first-hand accounts, guiding them in their discovery of the area:

> *the first help we received from outside was a lesson from a retired teacher […] he was our oral source, a real 'open book', and the children lapped up what he had to say. He told us about our town's forgotten beauty, its unappreciated cultural heritage and the potential of the Racale area, as well as its historical origins. (R. 5)*

'Adding the inputs of experts to the familiar school learning process further expanded the knowledge circuit' (R.12). Municipal and provincial local authorities, represented by mayors, councillors and tourist offices, also helped when requested by making their knowledge of the specific topic of the DST available to the school and supplying materials and documents it would otherwise have been difficult to obtain.

The pupils proved to be a fundamental resource, both for their classmates and for their teachers, providing technological knowledge, educating their classmates and teachers, and exploiting their language skills by translating the texts into English. In one high school, in particular, pupils wishing to obtain information about places and events of importance to their area turned to the schoolmates involved in the travel agency operating inside the school,[2] while

the pupils of a middle school studying the important local figure of Father Pino Puglisi made use of photographs produced in the previous academic year by another class in their school.

In some schools, families played a significant part in certain aspects of the DST project, often helping by organising and managing the extracurricular activities (especially in view of the age of the primary and middle school children), and by, for example, giving advice on which experts to be contacted.

In conclusion, in the opinion of the teachers, their skills in teaching and in collaboration with colleagues, as well as their knowledge of the local cultural heritage and their understanding of the pupils' characteristics and potential were all enriched and consolidated through participation in the project and the constructive collaboration with both colleagues and pupils: 'it was an opportunity for teamwork, for drawing up assessment score-sheets and observation protocols, and for deciding procedures for monitoring activities' (R.13); 'some features of the municipal area were unfamiliar even to teachers who live only a few kilometres from Caramagna, or have taught here for almost 30 years' (R.11);

> *as a teacher, I discovered talents, skills and interests which tend not to emerge during normal teaching activities […] pupils are only prepared to reveal and use their talents when topics are presented in a form designed to interest them. (R.6)*

5.6. Evaluation

The last aspect considered in the project description concerns the overall evaluation of the DST didactic experience. The analysis of the project's reports led us to identify a number of strengths and weaknesses which are summarised in Table 1.

The majority of teachers stated that they have improved the level of the educational relationship with their pupils. The introduction of digital technologies, together with the adoption of active teaching methods, has allowed the strengthening of both the relationship between teachers, and the cohesion of the class group, ensuring the inclusion of pupils with more difficulties. As one teacher underlines:

> *[this activity has] undoubtedly consolidated our relationship and made us a good team and this is, perhaps, the best result for me […]; I'm glad when I see my students growing in such a positive way, and when we work together. (R.1.);*

Table 1. Strengths and Weaknesses of DST Experiences.

Strengths	Weaknesses
– relationship between teachers and students;	– organisational aspects;
– relationship among students;	– collaboration with colleagues;
– motivation and transversal skills;	– dissemination of experiences;
– language and expression skills;	– several technical aspects related to the usability of "1001storia" authoring tool.
– critical use of digital technologies;	
– inclusion of student with difficulties;	
– knowledge of the territory.	

Another teacher says: 'The project has been particularly meaningful for its educational value, because it has improved the relationships between the pupils, especially encouraging [...] the inclusion of students with learning disorder' (R.10).

In addition to these important aspects, to be considered as fundamental dimensions for establishing a good educational relationship, the motivational dimension and the acquisition of transversal skills (even more than those purely disciplinary) seem to have been an ally of the DST experiences. Definitely, the following statement can be considered as representative:

> *[the] final balance of the activity highlights the benefits obtained in terms of increased motivation of students, the acquisition of transversal skills such as: responsibility, respect for deadlines and delivery of work, the development of critical sense, the critical use of digital media [...]. (R.4)*

Other teachers identify an improvement in expressive and linguistic skills of their students. The latter concerned the ability to decode specific languages that qualify the basic alphabets of the different disciplines, and digital technologies involved in the implementation of DST experiences.

Considering the aspects 'to be improved', teachers point out some technical problems related to the '1001stories' authoring tool. For example, they have highlighted some usability problems. Other critical elements were related to a difficult collaboration among colleagues, and the fact that the minority of didactic experiences were adequately disseminated in the territory. In this sense, in addition to widening the gap between the pedagogical

and technological knowledge of teachers, problems are related to the know-how transfer and project sustainability. Teachers stated that:

> *Sometimes it has not been possible to count on the complete collaboration of all colleagues; some of them were (erroneously) convinced that such activities – that go beyond the 'curricular programs' – are not an effective teaching tool. (R.6)*

Finally, other teachers underline that

> *the involvement of a greater number of colleagues has not worked, and it was the challenge that we had proposed to ourselves at the beginning of the year! Certainly not for lack of availability, but for objective difficulties to find available teaching staff. (R.13)*

6. CONCLUSIONS AND RECOMMENDATIONS

In conclusion, after an initial analysis of the main points that have characterised the teaching plans of the teachers, it is possible to argue that the experiences conducted within the framework of ScAR have allowed us to work in the school, at all levels, in an innovative way on the theme of cultural heritage. Considering both the strengths and the weaknesses that emerged in the teachers' reports, the educational directions undertaken allow us to outline a 'positive' scenario in which the theme promoted by ScAR has certainly represented a fertile territory, capable of triggering active learning processes and educational inclusion for a democratic school in which all students have the right-duty to receive quality education.

Regarding the specific theme of the ScAR project, the digital storytelling activity shows that an active approach is able to encourage the children to take an interest in the cultural heritage, in particular the less known one, on which 'the eye could slip'. The best stories (even in the past editions of PoliCultura) are in fact those in which the classes describe their own territory and tell stories about apparently minor topics (traditions, village festivals, characters, museums ...) that their words make irresistibly interesting. We believe this is a result not only didactically but also socially relevant, particularly in a nation, Italy, which brings together the largest number of sites included in the UNESCO World Heritage list. Relevant because to be able to communicate something one must first have discovered it, known it and made it one's own. And it is good that this process is lived by the 'citizens of tomorrow', those in whose hands we entrust this good, hoping that they will be able to take care of it.

ACKNOWLEDGEMENT

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NOTES

1. Pocket-sized robot used for coding and educational robotics, with the aim of introducing children to the programming language.
2. The travel agency was founded inside the school as a Simulated Training Enterprise to provide work experience and it now organises tourism events in the local area in partnership with Provincial associations in the Lazio region.

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2

A MULTINATIONAL STUDY OF STUDENTS' VIEWS ON THE USE OF TECHNOLOGY AND PERFORMANCE OF ONLINE TASKS

Patricia Fidalgo, Joan Thormann and Oleksandr Kulyk

INTRODUCTION

Learning in the twenty-first century requires many information technology skills and also understanding how to apply these skills to gain knowledge. It is generally thought that because young people are technologically savvy, that they know how use those skills adequately in educational contexts.

This first objective of this research is to provide guidance to universities about student computer literacy in an educational setting. The second objective is to find if there is variability of computer literacy skills at Institutions of Higher Education (IHE) in three countries. Undergraduate students in Portugal, Ukraine and United Arab Emirates were surveyed about their use of technological devices and their performance of online tasks. Students responded to an online survey about the frequency and types of use, and their level of confidence regarding online skills and use of digital equipment. There is a general belief that students' ability to use technology is extensive. However, this study indicates that students' opinion about their information literacy competence is not always aligned with their confidence performing online tasks. The data show that there are gaps in their knowledge, their perceptions and their actual digital literacy skills. IHEs may use these findings to improve curricula and help students enhance their knowledge.

LITERATURE REVIEW

Formal learning and lifelong learning are more and more dependent on the skills that technological environments require. According to Partnership for 21st Century Learning (2015), information, media and technology skills are among the ones the students need to master. These skills require new literacies that 'learners need in the Knowledge Society' (Gallardo-Echenique, Minelli de Oliveira, Marqués-Molias, & Esteve-Mon, 2015, p. 1).

Being able to recognise informational needs as well as searching, accessing, selecting, organising, presenting and evaluating information in a creative manner is what defines digital literacy skills (Donaldson, 2005; SCONUL Working Group on Information Literacy, 2011).

Alavi, Borzabadi, and Dashtestani (2014) have concluded, in their study, that computer literacy varies according to the context and that for educational purposes most students seem to lack adequate levels of computer literacy. These authors believe 'the majority of students need training for the efficient use of computers and technology for educational purposes' (p. 59).

Lloyd (2010) speaks about three broad information literacy landscapes: the educational, workplace and community landscape. All three have different topologies, climates and complex ecologies which require that students engage with each landscape to become information literate.

Prensky (2005) describes todays' students as 'native speakers of technology, fluent in the digital language of computers, video games, and the Internet' (p. 8). But despite our assumptions that young people live immersed in technology (Bennett, Maton, & Kervin, 2008) some studies indicate that their skill level can be much lower than we expect from digital natives (Kennedy, Judd, Churchward, Gray, & Krause, 2008). These researchers also found that only a quarter of the students were creating multimedia content to share online or using emerging technologies (like networking technologies for example). They conclude that 'there are clearly areas where the use of and familiarity with technology-based tools is far from universal or uniform' (p. 115). According to Lei (2010), we should pay attention to the quality of students' usage of technology, more specifically what they use, how they use it and for what purposes. For this author, the quality of technology use affects the impact technology has on learning and teaching.

Lei (2010) proposes that 'it may be unrealistic to expect dramatic changes in student performance through one or two specific technology uses' (p. 468). Also, several other factors contribute to how and why students consume technology such as hedonistic motivation, price value and habits. In its turn, those factors are moderated by age, gender, experience and individual

differences (Venkatesh, Thong, & Xu, 2012). According to Straub (2009), technology adoption is a complex process to study because of its inherently social nature. Also, individuals have a unique malleable perception of technology which interferes with the process of facilitating the adoption of technology that 'needs to address cognitive, emotional, and contextual concerns' (Straub, 2009, p. 645).

Regarding the use of the Internet, some large-scale surveys have been conducted (File & Ryan, 2014; Lenhart, Purcell, Smith, & Zickuhr, 2010; Lenhart, Rainie, & Lewis, 2001; Livingstone & Bober, 2004) and the results show that young people are very active online, but age and socioeconomic background affects the frequency and nature of Internet use. Other studies also revealed that demographic, economic, social, and educational differences may contribute to having different digital skills (van Deursen & van Dijk, 2008; Gui, 2007; Hargittai, 2002). Generalisations that state that a whole generation of young people have mastered the emergent technologies may neglect 'those less interested and less able' (Bennett et al., 2008, p. 780).

According to Madden, Lenhart, Duggan, Cortesi, and Gasser (2013), since 2006 most teenagers are online although their Internet use has changed over time. Regarding technological devices, smartphone and tablet ownership has increased substantially among teenagers. The most frequent (and sometimes primary) type of access tends to be mobile. In their study, Madden et al., found that 'teens represent the leading edge of mobile connectivity, and the patterns of their technology use often signal future changes in the adult population' (p. 3).

According to van Deursen, Courtois, and van Dijk (2014), Internet use depends on 'how to find and evaluate information, to communicate effectively, and to understand the dynamics of what the best means are to attain a particular goal' (p. 281). The different types of skills and Internet usage have moved the discussion about digital divide away from the initial simplistic definition of having or not having Internet access. Being motivated, having diverse skills and the way the Internet is used are also factors of the digital divide debate (Helsper, van Deursen, & Eynon, 2016). Acquiring Internet skills has become an important goal and seems to be a continuing process that starts 'with operational and formal skills that evolve into more established information and communication skills and are complete with the attainment of strategic skills' (p. 288).

The development of digital literacy skills varies and can be related, for instance, with internal obstacles such as confidence, self-efficacy and attitudes (Jeffrey et al., 2011). According to Jeffrey et al., the learning context should change to meet the conditions needed by the students such as safety, collaboration and a supporting community. Another aspect of learning digital

literacy skills relates to the fact that while 'some online skills are internet-specific, other aspects of these skills are likely to draw on social and technical knowledge acquired in other contexts' (Livingstone & Helsper, 2010, p. 17). From this perspective, more studies are needed to learn about the interaction between different forms of literacy. According to Oster-Levinz and Klieger (2010), the focus should be on integrating pedagogy in technology rather than on learning technological tools.

Students' digital skills and Internet usage are increasingly becomeing a part of academic life (Ren, 2000). Practices and policies in higher education need to take this into account. 'High levels of use and skill did not necessarily translate into preferences for increased use of technology in the classroom' (Kennedy et al., 2008, p. 110).

Understanding the students' experiences regarding the use of technology may help improve pedagogical models and consequently the quality of teaching and learning. By learning the types of technology that students use, what they use it for and how frequently can help educators leverage learning. Using students' abilities and interests can enhance students' motivation.

RESEARCH QUESTIONS

- Which technological devices do undergraduate students use and how often?
- For what purposes do undergraduate students use technological devices?
- How confident do undergraduate students feel using technological devices?
- How confident do undergraduate students feel doing online tasks?
- For what purposes do undergraduate students perform online tasks?
- How often do undergraduate students perform online tasks?
- What are the differences in the types of devices, frequency of use, purpose of use, confidence in using technological devices and doing online tasks by undergraduate students from Ukraine, Portugal and United Arab Emirates?

METHODOLOGY

Setting

This research was conducted in the spring semester of 2017 at a college in the United Arab Emirates, and in the fall semester of 2017 at Instituto Piaget in

Portugal and Oles Honchar Dnipropetrovsk National University (OHDNU) in Ukraine. Students had completed courses in teacher education, psychology, mathematics, philosophy and science. There were five sections of the UAE course which was taught by two teachers. The psychology course at Instituto Piaget was taught by one faculty member and the teacher education course in the same college was taught by two faculty members. At OHDNU mathematics, philosophy and science courses were taught by one faculty member. In the UAE course, students learn how to use a number of ICT tools and practice a range of activities. In the courses in Portugal and Ukraine, there was no particular emphasis on technology, however, technology was used by faculty and students as a learning tool.

Participants

In the UAE, 90 students in a B.Ed. programme were enrolled in the course. All of the students were female, and their ages ranged from ages 17 to 25. Fifty-two of the 90 students agreed to participate in the study. In Portugal, 28 agreed to participate. Their ages ranged from 17 to 25. In Ukraine, 108 students were enrolled and 74 students participated. Nearly all the students' ages ranged from 17 to 20. The sample was self-selected since all the participants agreed to complete the survey voluntarily. Respondents' answers were anonymous.

Data Collection

The survey used was adapted from ECDL Foundation (2017) and from Van Deursen, Helsper, and Eynon (2014) to address research questions that assess the technology use and tasks students perform online. It was completed online on Google Forms. The URL was sent by email to all the students enrolled in the courses. The survey took approximately ten minutes to complete.

There were eight closed questions about technology use and online digital literacy skills that undergraduate students might use. It addressed the following: (1) What technological devices students use and how often; (2) For what purposes do students use technological devices; (3) How confident do students feel using technological devices; (4) How confident do students feel doing online tasks; (5) For what purposes do students perform online tasks; (6) How often do students perform online tasks; (7) What is the student's age; and (8) What is the student's gender.

The survey questions included multiple response formats including Likert scales, select more than one response and multiple choice. The survey for students in the UAE was presented in English because English is the language that is used for instruction. The survey for Portuguese students was translated into Portuguese and the survey for Ukraine students was translated into Ukrainian.

Data Analysis

Participant responses were recorded in Google Forms and an Excel spreadsheet was used to collect students' answers. Most responses from all three countries were coalesced and the same figure was used to compare responses from each country. Descriptive statistics of the closed questions of the survey are presented, for each country, in a graphic format with percentages of the highest values for each response displayed.

RESULTS

Participants were asked if they use nine different technological devices (mobile phone, smartphone, tablet, laptop, desktop computer, video camera, photo camera, MP3 player and MP4 player) and how frequently they use each one of them. The four most frequently used devises are shown in Fig. 1. The smartphone is used most frequently by all students. Students in Portugal also seem to use mobile phones and laptops as frequently as their smartphones. For all three countries, tablets are used the least of these four devices although more

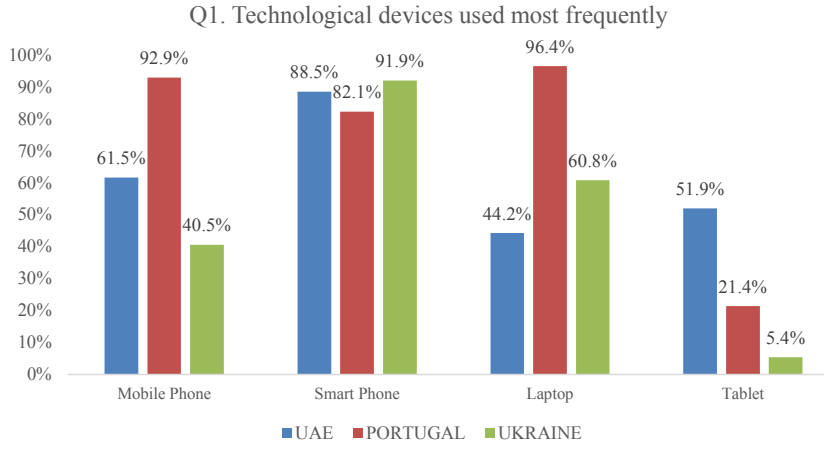

Fig. 1. The Four Most Frequently Used Devices.

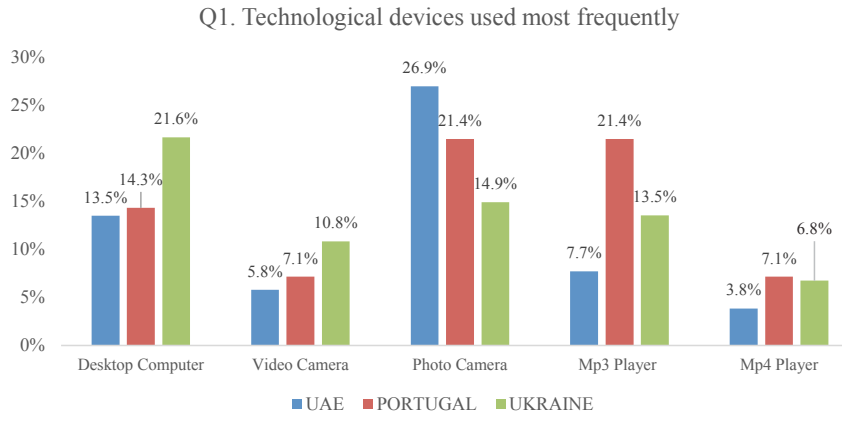

Fig. 2. The Five Least Frequently Used Devices.

than half (52%) of the UAE students reported they use their tablets a little more than their laptops (44%).

The five devices used least often were the desktop computer, video camera, photo camera, MP3 player and MP4 player (Fig. 2). The photo camera is used the most often and the video camera and MP4 player the least.

The four most common purposes for using the above devices were *For study*, *To find information* and *To connect with family and friends* and *For pleasure* (Fig. 3). However, students in the UAE shared that they use technological devices *For pleasure* 44% of the time while in Portugal and Ukraine they use

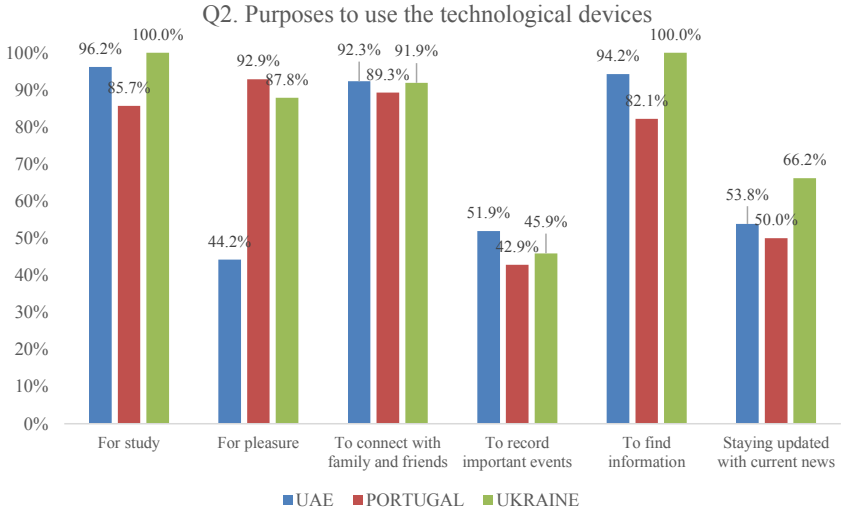

Fig. 3. Purpose for the Use of Technological Devices.

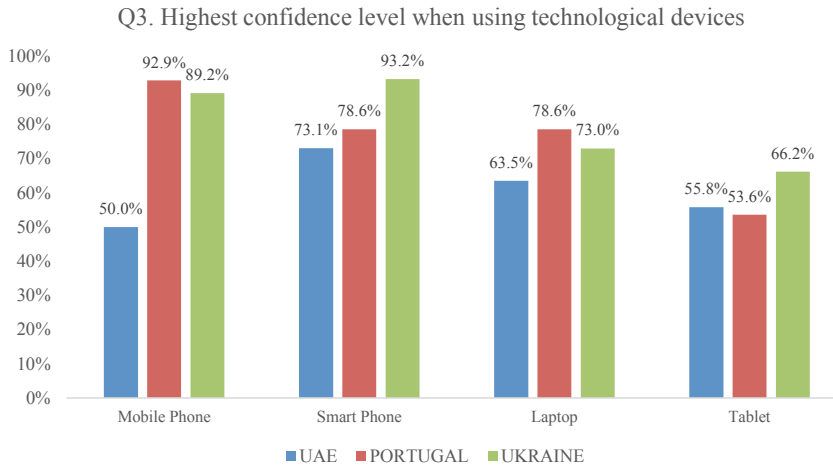

Fig. 4. Confidence Using Technological Devices Including Mobile Phone, Smart Phone, Laptop and Tablet.

it 93% and 88% of the time, respectively. *To record important events* and *Staying updated with current events* were other purposes mentioned less often (i.e. about half as often).

Participants shared their confidence level regarding use of technological devices in the survey. The confidence level appears to match the frequency of use for the Portuguese and UAE respondents for the mobile phone, smart phone and laptop but less so for the tablet. The Ukraine respondents match for frequency of use and confidence were similar for the smart phone and laptop but they indicated greater confidence with the mobile phone than their actual use.

The tablet was used infrequently but their confidence level was high (Fig. 4). Interestingly, participants from Ukraine and Portugal shared that they felt confident with a number of devices including the Video and Photo cameras as well as the MP3 and MP4 players although they did not use these devices frequently (Fig. 5).

Participants were asked about their confidence level relating to doing 17 different online tasks (Figs. 6–8). Students in Ukraine reported a higher confidence level on many more tasks (10/17) than students from Portugal or the UAE. The confidence level ranged from 78% to 97% for 10 of the tasks (Figs. 6–8). The remaining seven tasks were similar for all three groups of students. However, in 7 of the 17 tasks the Portuguese students indicated a slightly higher degree of confidence that the students from the UAE.

Figs. 9–11 (UAE, Portugal and Ukraine, respectively) show the results concerning students' purposes for completing 11 actions on their technological

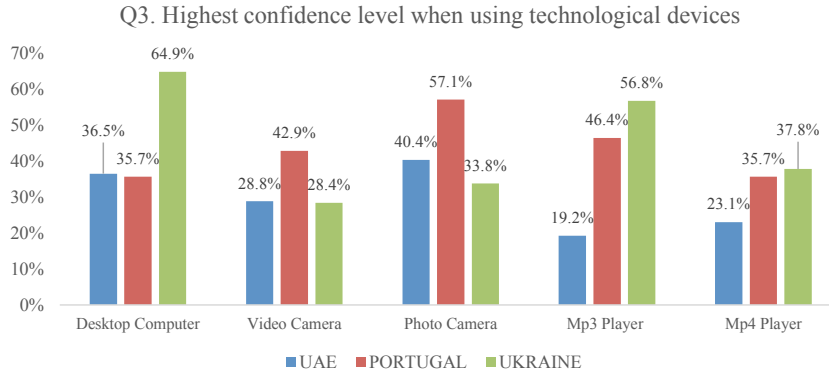

Fig. 5. Confidence Using Technological Devices Including Desktop Computer, Video Camera, Photo Camera, MP3 Player and MP4 Player.

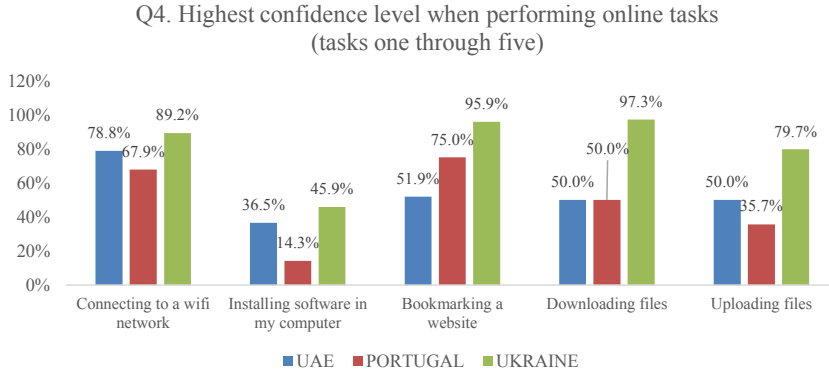

Fig. 6. Confidence Level When Doing Online Tasks (One Through Five).

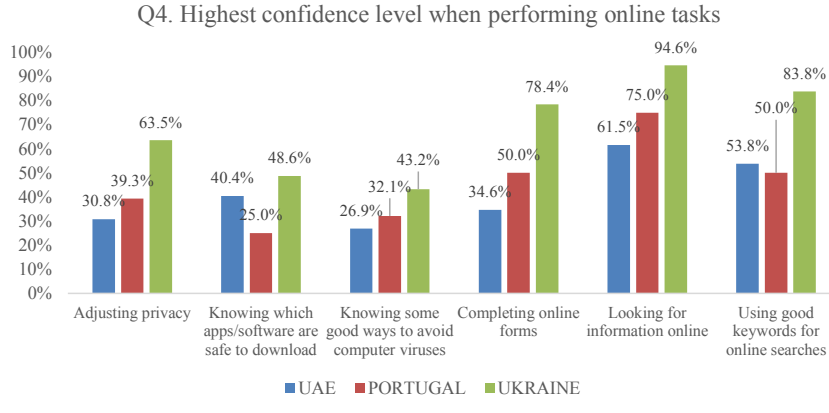

Fig. 7. Confidence Level When Doing Online Tasks (One Through Five).

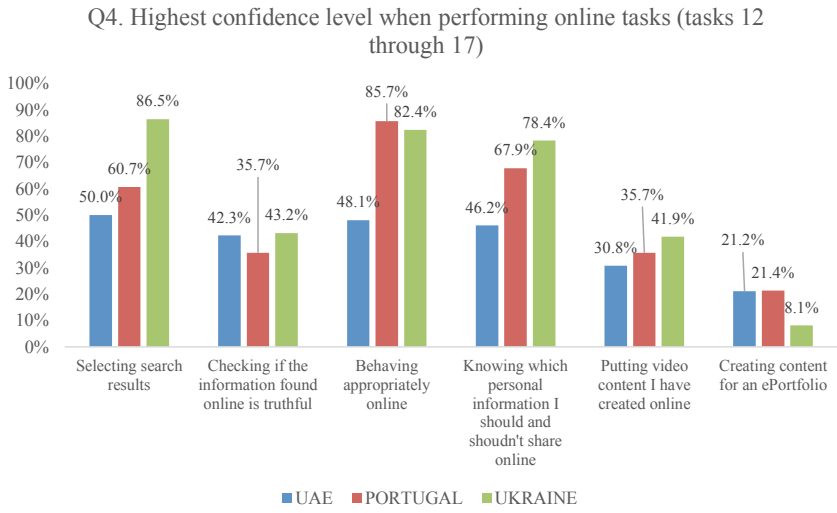

Fig. 8. Confidence Level When Doing Online Tasks (Tasks 12 Through 17).

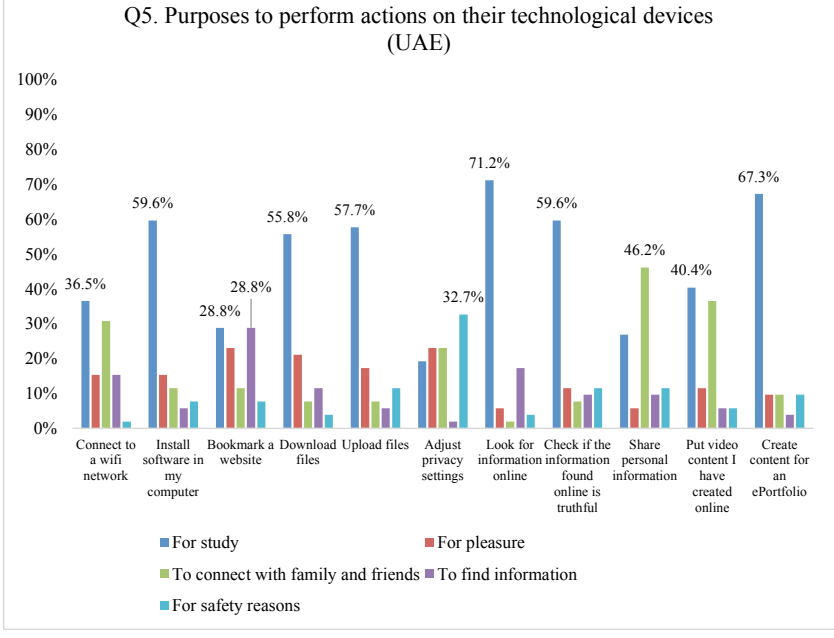

Fig. 9. Purposes to Perform Actions on Their Technological Devices for UAE Students.

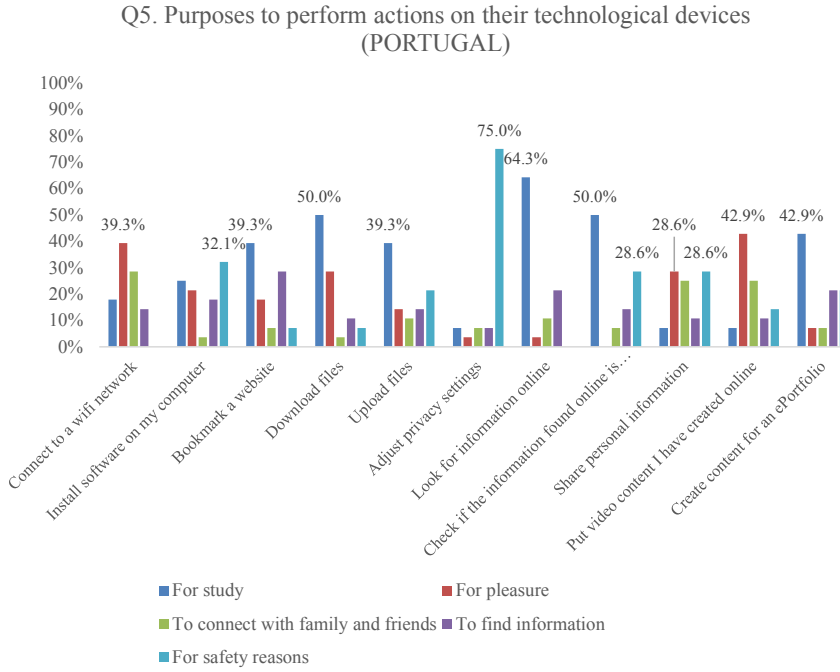

Fig. 10. Purposes to Perform Actions on their Technological Devices for Portuguese Students.

devices. UAE participants reported that 9 of the 11 actions were done *For study* (ranging from 37% to 71%). The two actions that were not scored very high by UAE students *For study* were *Adjusting privacy settings* and *Bookmarking a website*. In the *For study* category, Web search was the action that was the highest (71%) and Connect to Wi-Fi network was the lowest (37%). The remaining categories for the purpose of *For safety* ranged from 2% to 12%. They seem to be least interested in *To find information* except when applying it to their studies.

For the Portuguese students, 6 of the 11 actions were done *For study* (ranging from 39% to 64%). The category of *For connecting with family and friends* was the lowest category that these Portuguese students selected (Fig. 10).

Ukrainian students responded that 8 of the 11 actions were *For study* (ranging from 31% to 67%). The categories of *For connecting with family and friends* as well as *For safety* were the lowest categories that the Ukraine students reported (Fig. 11).

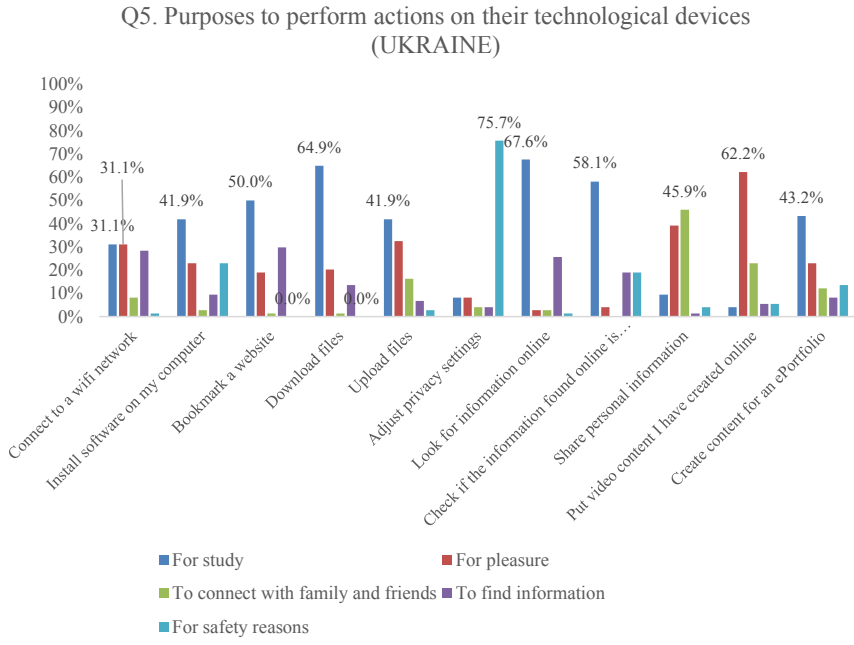

Fig. 11. Purposes to Perform Actions on Their Technological Devices for Ukraine Students.

For participants from all three countries, the primary purpose for actions was *For study* as shown in Figs. 9–11.

The last content-based question addressed 14 online task students performed most frequently. Eleven of the tasks were the same as in question five which dealt with the purpose or reasons for completing the tasks. Three additional online tasks were added including *Complete online forms*, *Use keywords for online searches* and *Behave appropriately online*. Figs. 12–14 display the frequency of performing tasks by students in the three countries.

Connect to a Wi-Fi network was performed most often by all three groups (85%–96%). The second highest for all three was *Looking for information online* (69%–99%). The third highest was *Behave appropriately online* (53%–86%). The remaining relatively high-frequency task was *Download files* (52%–81%). For these four tasks, the UAE students' percentages were the lowest. The 10 remaining tasks were reported as performed between 4% and 61%. *Put video content I have created online* was the lowest (4%–27%) and *Check if the information found online is truthful* was the highest (40%–61%).

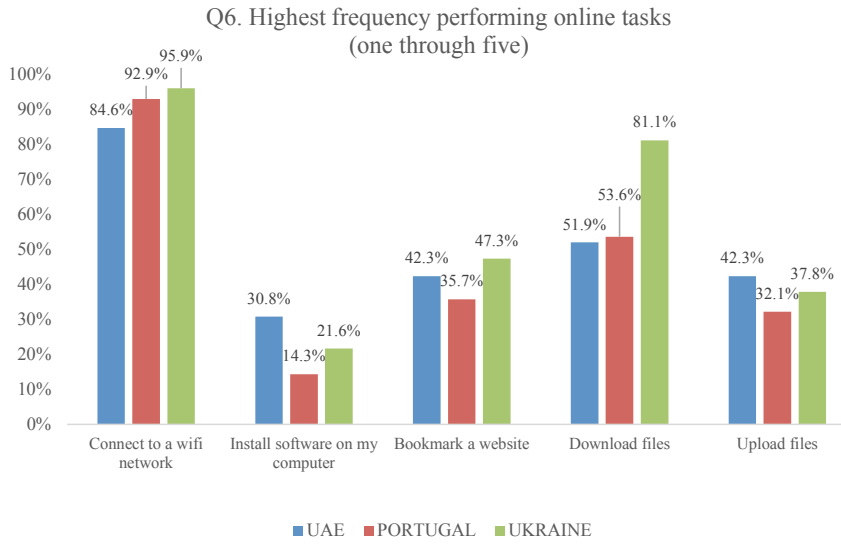

Fig. 12. Highest Frequency Performing Online Tasks (One Through Five).

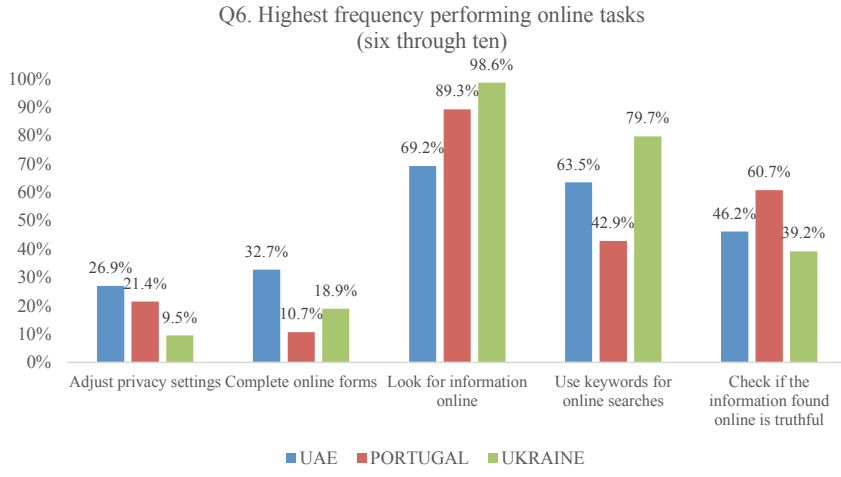

Fig. 13. Highest Frequency Performing Online Tasks (Six Through Ten).

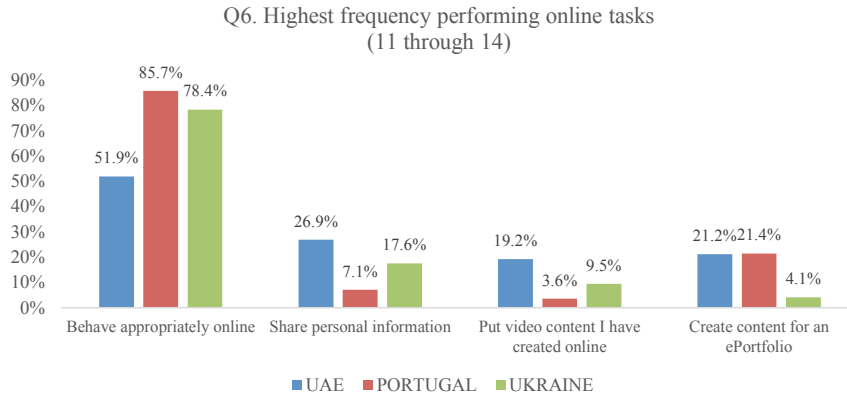

Fig. 14. Highest Frequency Performing Online Tasks (11 Through 14).

DISCUSSION

Use of Technological Devices

All students reported using their smart phones the most. This may be because they carry the phones with them and they serve multiple functions. They all use MP4 and MP3 players and video cameras the least which may be in part due to listening to music, viewing or making images or videos can be performed by using the smart phone. More than half of the UAE students shared that they use tablets while a quarter of the Portuguese students and far fewer Ukraine students (5%) use them. The data show a larger number of Portuguese and Ukraine students use laptops more than the UAE students. This may account for a greater number of UAE students using tablets than the other groups. Another interesting difference was that a much larger proportion of the Portuguese students use mobile phones and laptops than both other groups. This may have been reported because they consider mobile phones and smart phones as similar devices or that they use multiple phones. More research about the use of these devices may help explain the differential between the three groups of students.

Purposes for Using Technological Devices

The most common purposes for using devices were similar for all students which included *For study*, *To communicate with family and friends* and also *To find information*. Currently, the use of technological devices in post-secondary school is frequent, thus it is not surprising that all students

responded that they use them *For study*. Likewise, they use technological devices to communicate with family and friends. In addition, this generation never experienced a world without the availability of these devices, as a result, to some extent they are most probably unable to function without access to these communication tools. In both personal and school life, finding information with a technological device is now almost essential for functioning from finding out movie schedules and purchasing items to reading articles and doing research for school projects. Use of technological devices *For pleasure* is reported by Portuguese and Ukraine students as being used twice as much as UAE students. More in-depth research is needed to help explain why the UAE group of students reported less use of devices *For pleasure*.

Confidence level

The students' confidence levels for using mobile and smart phones, laptops and tablets when compared with their report of using each of these devices was somewhat similar. The only exception was for the Ukraine students that reported high confidence levels for using tablets (66%) while their report on using them is very low (5%). A little less dramatic but similar was their use of mobile phones (41%) with a confidence level of 89%. These Ukraine students may have reasoned that using these devices was not that different from using other comparable devices.

In examining students' confidence level regarding doing online tasks (Figs. 6–8), Ukraine students conveyed a considerably higher level of confidence than the other groups for many tasks. The Ukraine students may be required to do more work online than those enrolled in teacher education programs. The Ukraine students were taking mathematics, philosophy and science courses which may have involved heavier use of online work.

Less than half of all respondents indicated that they are confident in *Checking if the information found online is truthful*. This online task is vital for students so that they are not learning and then sharing misinformation. Safety issues such as *Knowing how to avoid viruses* and *Which software and apps are safe to download* were tasks that less than half of the students in all three groups felt confident about. These two tasks are important for students to be competent computer users and avoid infecting others' computers. In addition, less than half of the UAE students were confident about *Behaving appropriately online* and *Knowing which personal information should and shouldn't be shared online*. For successful navigation and safety, these skills need to be more robust for a greater number of students.

Performance of Online Tasks

Fig. 9 shows UAE students' report of why they perform actions on their devices. This showed that safety was the least important in most cases except to *Adjust privacy settings* (33%). These reports match their responses to their confidence level which was relatively low for tasks involving safety but does show an awareness that privacy is a safety matter. *For study* was the main purpose for performing actions (nine of the eleven) which may indicate that UAE students view use of technological devices as primarily for academic purposes. However, Portuguese and Ukraine students seem much less focussed on using their devices *For study*. The Portuguese students' purpose *For study* was the highest for only 5 of the 11 tasks (Fig. 10) and for Ukraine students it was highest for only 6 of the 11 actions (Fig. 11) in comparison with the UAE students which was 9 of the 11.

Connecting with family and friends seems to be the lowest priority for Portuguese and Ukraine groups except for *Share personal information*. However, UAE students marked 4 of the 11 actions somewhat higher than others for *Connecting with family and friends*. It seems that the UAE students use their devices more often than the other groups to connect with family and friends. It is difficult to speculate why UAE students are more likely to do this.

Regarding the frequency of performing online tasks, *Connecting to a wifi* network and *Looking for information online* had the highest frequencies which may be due to the fact these two activities are closely related. The most used technological devices (smartphones and laptops) have many features such as access to social media, email, web browsing, weather prediction and many other others depending on Internet connection.

A relatively high-frequency task was *Downloading files*. *Downloading files* is often a consequence of finding information online which may help explain the high frequency. Participants were not asked what type of files they downloaded thus it is not clear why Ukraine participants indicated that they downloaded approximately 30% more often than the others.

Finally, *Behaving appropriately online* also has high-frequency percentages especially in Portugal and Ukraine. A reason for this may be that cultural standards and fear of consequences accounts for the responses of the participants.

CONCLUSION

The data demonstrate that the students consider themselves as competent online content consumers. However, they do not always indicate that they are confident performing some online tasks such as installing software, knowing

which apps/software are safe to download, checking if the information found online is truthful, uploading videos and protecting their devices from viruses.

One of the skills the participants feel least confident in performing concerns ascertaining if the online information is accurate. The students of Ukraine, Portugal, and UAE actively use online resources for studying. For this purpose, they look for information online, download files, etc. However, they do not have strong skills in checking if the information found online is truthful. Therefore, some information that was learnt can lead to acquiring incorrect knowledge.

These issues reflect that the confidence level of the participants do not always align with their knowledge and performance doing online tasks. According to Hargittai (2010), there is a misconception that digital natives are 'universally savvy with information and communication technologies' (p. 92). The author refers to students being 'digital naïves' rather than 'digital natives'. This research confirms that students need to gain a deeper knowledge and learn additional practical digital literacy skills. Based on the findings of this study, the focus should be on (1) developing skills for their online safety; (2) checking if the information found online is truthful and (3) learning technical skills related to installing apps/software on their devices.

Future research could address greater detail regarding the online tasks performed, the reasons behind the tasks they choose to do, and why their confidence levels when performing online tasks vary. With this knowledge, IHE can adjust their curricula to contribute to students advancing their skills and confidence with digital literacy.

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3

CREATING AN ETHOS OF ACADEMIC INTEGRITY USING AN AUTOMATED ONLINE MANAGEMENT SYSTEM

Michael-Brian C. Ogawa, Patricia Louis, Carolyn Kirio and Jenny Yamamoto

INTRODUCTION

Academic honesty is a serious concern for many educators in higher education institutions (Levine & Pazdernik, 2018). The rise of access to information via the Internet increased student temptation and ability to copy content into work also increased at a high rate. The International Center for Academic Integrity (n.d.) reported statistics for academic honesty issues based on survey data from 2002 to 2015. Of the 71,300 undergraduate respondents, 39% admitted to cheating on tests, 62% admitted to cheating on written assignments and 68% cheated on either tests or written work. Approximately, 17,000 graduate students responded to the same survey. Seventeen percent admitted cheating on tests, 40% admitted cheating on written assignments and 42% admitted cheating on tests or written assignments. These statistics illustrate the challenges educators face with academic honesty in higher education settings.

Institutions attempted to combat this issue in a variety of ways including organisational policies, preventative construction, dedicated discussions, instruction, plagiarism detection software and learning support systems (Karon, 2012; Levine & Pazderik, 2018). Organisational policies are typically draconian in nature and target a failing grade or expulsion as a result of policy infractions. Preventative construction is the development of assignments in a way that makes it difficult for students to plagiarise content or otherwise

cheat on assignments. It is typically challenging and time consuming to craft assignments in this way, which creates an additional barrier for faculty to implement. In addition, preventative construction assignments can have more demands on time to assess student work adding to the complexity of implementation. Faculty also dedicate class time to discuss plagiarism and its impact on both students and scholars. These discussions help to engage students in the construction of knowledge and dispositions towards plagiarism and other academically dishonest behaviours. This approach helps students to develop a sense of empathy for authors and respect for their intellectual property. Follow-up to discussions are typically seen as a key component by ensuring passive students are also developing their knowledge and dispositions. Therefore, discussion strategies to involve all students are critical for this approach to be successful. Including face-to-face, on-line or hybrid instruction for students to learn about academic honesty is helpful to ensure students understand these foundational concepts. Assignments and quizzes to support instruction help to ensure students can demonstrate their level of competency of academic honesty content. Plagiarism detection software is typically used in conjunction with organisational policies. The automatic detection software helps instructors and students see the level of "copied" work in their submissions. Some software use colours (red for a high level of similarity, yellow for a moderate level of similarity and green for minimal similarity) to help students quickly determine if they may be cited for plagiarism. In some cases, it helps students to see an issue, revise their assignment, and resubmit to ensure appropriate guidelines are followed. The last typical approach to improve academic honesty is the use of learning support systems such as a writing centre to help students as they complete assignments. This approach includes benefits for students, as they are able to learn about the writing process while ensuring they are academically honest. It is not easy to implement on a large scale due to limitations of support teams such as availability of tutors and limited hours. Many institutions use a combination of approaches rather than a single method to improve academic integrity amongst students. With a variety of approaches used to improve academic honesty in higher education, it is difficult to ascertain the best approaches for a campus. Therefore, addressing targeted areas of concern can help to refine the approaches to ameliorate academic honesty issues.

UNDERLYING REASONS FOR PLAGIARISM

Plagiarism is a form of academic dishonesty, where a person presents someone else's work as their own (Hosier, 2015). Copying content from on-line sources

is one of the most common plagiarism-based concerns (Scanlon & Neumann, 2002). Additional types of plagiarism that concern faculty include submitting others' work, copying digital files, and using others' work without attribution (Yeo, 2007). The Internet gave rise to new and increased opportunities for students to plagiarise content based on the previously mentioned methods. Even though multiple approaches to representing content as one's own exist, the act of plagiarism is typically categorised as intentional or unintentional. Intentional plagiarism includes an author purposefully not including attribution to others' work when they are aware that the source content belongs to another author (Park, 2003; Youmans, 2011). This form of plagiarism includes purposefully uncited source material and submitting others' work as their own. Unintentional plagiarism occurs when authors do not have a strong understanding of attribution of work and include plagiarised content without knowing it was an issue (Park, 2003). Both forms of plagiarism are considered academically dishonest actions and have underlying reasons for their occurrence. A foundational understanding of why students perform academically dishonest tasks is a vital component in identifying effective approaches to prevent plagiarism.

Park (2003) identified underlying reasons for students plagiarising content. Auer and Krupar (2001), Howard (2002) and Davis and Ludvigson (1995) discussed additional insights that build on Park's original influences. They are:

1) lack of understanding of plagiarism,
2) efficiency gain to improve outcomes with minimal effort exerted (Auer & Krupar, 2001),
3) time management issues,
4) positive dispositions towards plagiarism,
5) defiance,
6) negative attitudes for specific courses (Howard, 2002),
7) blaming others for their plagiarism actions,
8) temptation with available sources,
9) benefits outweighing risks (Davis & Ludvigson, 1995).

Of the major reasons, lack of understanding and blaming others for their plagiarism actions are typically classified as unintentional plagiarism. The other seven reasons are categorised as intentional plagiarism because the plagiarism action is the outcome of each of the factors. For example, a student may plagiarise on assignments to improve their grades, when they run out

of time, if they believe plagiarism is acceptable, to defy a teacher, when they dislike a course, when they are tempted by the availability of content, and when the risks are acceptable for the reward.

Many prior studies on plagiarism focussed perceptions of plagiarism and student self-report of academically dishonest actions (Bokosmaty, Ehrich, Eady, & Bell, 2019; Gunnarsson, Kulesza, & Pettersson, 2014; Henslee et al., 2017; Howard, 2002; Hu & Lei, 2015; International Center for Academic Integrity, n.d.; Jereb et al., 2018; Park, 2003; Ryan, Bonanno, Krass, Scouller, & Smith, 2009). These studies highlighted the importance of teaching students the mechanics of academically honest writing and changing dispositions towards plagiarism. They also discussed additional factors that could impact plagiarism such as culture and gender. Plagiarism content knowledge and improved dispositions towards plagiaristic actions could account for the nine underlying reasons for academically dishonest behaviour. It could also improve behaviours for students who are likely to plagiarise content. However, few studies research the change in behaviours based on interventions.

Earlier studies to address plagiarism behaviours were conducted by Ogawa and Ikehara (2012a, 2012b). They developed the Academic Honesty On-line System (AHOS), which included a tutorial and quiz that were given to students at the beginning of the semester. The tutorial included instruction on both plagiarism content knowledge and improving dispositions towards academically dishonest behaviours. The quiz portion of AHOS included factual and scenario-based questions to help students understand how to respond to real-world situations. It was assigned to a large-enrollment undergraduate computer science course on the first day of the term. Students had unlimited attempts to pass the quiz with 100% accuracy within the first two weeks. Their study resulted in a statistically significant decrease in plagiarism incidents, where instances of plagiarism decreased by approximately 58% when analysed with a univariate analysis of variance. The AHOS was further refined by requiring students to review the tutorial and pass the quiz with 100% accuracy in the middle of the semester. In the second iteration, students were given one week to complete the tutorial and quiz since it contained no differences. The mid semester AHOS implementation reduced plagiarism by an additional 17% resulting in a 75% decline in plagiarism compared to the instances when AHOS was not used and remained statistically significant with $p < 0.05$ (Ogawa, Louis, Kirio, & Yamamoto, 2017) (Fig. 1).

Ewing, Anast, and Roehling (2016) conducted a study that focussed on using the TurnItIn plagiarism detection software with administrative policies to combat plagiarism in a Health Sciences course for graduate students. They used a 40% threshold of similar content in the software to begin the

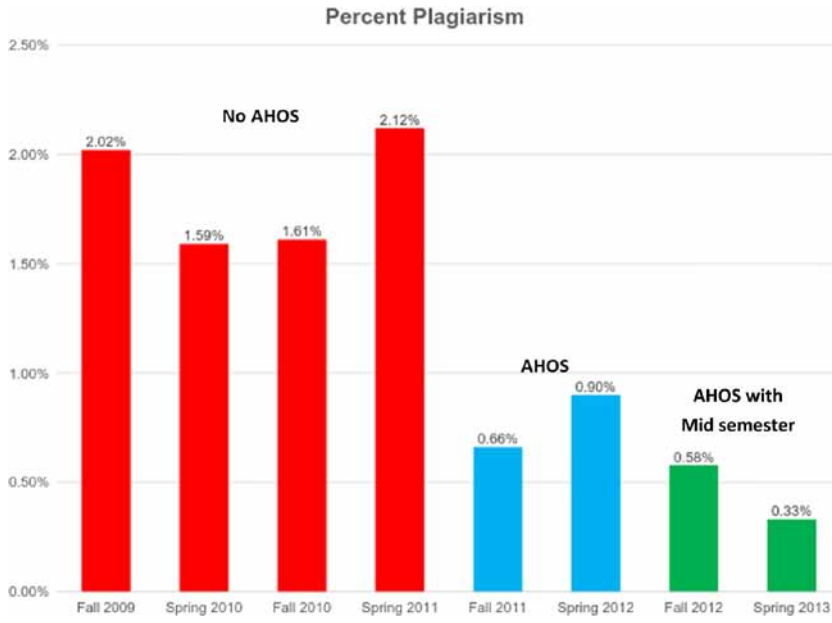

Fig. 1. Percent of Plagiarism Reported.

administrative process, which included (1) a failing grade on the assignment, (2) a failing grade in the course and (3) expulsion. This method led to approximately a 50% decrease in plagiarism. However, they did not report on the statistical significance and focussed on the instances in each term. A third study that addressed plagiarism behaviours for Post-Professional Doctor of Physical Therapy students was conducted by Levine and Pazdernik (2018). They used a four-prong approach to address plagiarism which included an instructional module, the TurnItIn plagiarism detection software, policies and procedures, and support from the writing centre at the university. Levine and Pazdernik used the same similarity index for the TurnItIn software (40%) for their metric to identify plagiarism. This approach decreased plagiarism by approximately 64%. These studies illustrated that interventions could lead to a decrease in plagiarism. Of the studies, the AHOS had the least overhead and largest decrease in plagiarism.

THE ACADEMIC HONESTY ON-LINE SYSTEM

The AHOS was initially developed in 2011 at the University of Hawaii. The system utilised a tutorial that was created and implemented by the library

at the university. The developers reviewed the content of the tutorial and determined that it addressed the nine underlying reasons for plagiarism. The major areas of the tutorial included the definition of plagiarism, helpful strategies for the writing process, skill development, practice scenarios, citation practice, available resources on campus, style guides and references. Next, they developed a set of 20 multiple-choice questions to address the underlying factors. One of the major tenants of the quiz is that it included scenarios to help students apply their knowledge to situations in context. The quiz was created in the university's course management system and deployed to all of the sections of a large-enrollment course. Since the tutorial was a link on the university's library Web site, it could easily be deployed to any course that was interested in using it. The university's course management system allowed the quiz to quickly be copied and administered to any other course at the university.

In addition to decreasing plagiarism by as much as 75%, the AHOS increased students' perceived accountability and reduced administrative time used towards plagiarism cases (Ogawa & Ikehara, 2012a, 2012b). After being required to achieve 100% on the quiz, students felt that they were more accountable for plagiarism because they were aware that their instructor knew that they scored 100% on the AHOS. Students also reported speaking with each other more often about plagiarism and used the scenarios to respond in peer pressure situations, such as a friend asking to 'borrow' an assignment.

Each case of plagiarism took approximately 90 minutes to resolve both before and after the implementation of AHOS, as the process included identifying the dishonest action, discussion with students involved, convening, and implementing a resolution. Prior to the implementation of AHOS, a majority of the discussion with students focussed on their lack of awareness of plagiaristic actions. After the AHOS was implemented, the students focussed their discussion on the resolution and why they should not receive specific academic actions for their infraction. The shift in discussion areas appeared to be a result of the increase in accountability for their behaviours where they took responsibility for their action but not the consequence. Overall, AHOS decreased administrative time by approximately 75% due to the decrease in plagiarism cases.

Adapting the AHOS for K-12 Education

The AHOS was used at the university for a total of 18 semesters with over 5,000 students. It has also been adopted and modified at several K-12 schools.

The developers identified school libraries as an optimal location to implement AHOS in the K-12 environment due to its function as a central learning centre for schools. The school library is also consistently seen as a hub for research and writing across the curriculum. The developers of AHOS collaborated with librarians in schools to modify the content to better fit their students. An elementary school librarian had difficulties with plagiarism when students transferred to her school even though they had formal instruction. The librarian adapted the AHOS structure with the students. Previously, plagiarism was estimated at the 10% rate with a majority of difficulties being with transfer students. The librarian modified the AHOS to build off the school's formal instruction to address the core issues that were common amongst the students. Students struggled with citing sources and ignored citations when they felt that it was not pertinent to their content area knowledge development. After the librarian implemented instruction and developed a quiz targeting the underlying purpose of citations, students did not plagiarise on their subsequent assignments that term.

A middle school librarian consistently worked with teachers on research projects. She noticed that approximately 10% of students plagiarised content on their research papers. The librarian worked with the AHOS developers to create a video-based tutorial featuring middle school-aged cartoon characters that would resonate with the students. The tutorial focussed on typical issues that middle school students face when dealing with plagiarism such as content knowledge (avoiding copying/pasting from the Internet, paraphrasing, citations) and peer pressure to aid others in plagiarising content. She found that the scenarios that focussed on peer pressure and ethical dilemmas were engaging for the students and impacted both their dispositions and behaviours. This implementation reduced plagiarism by approximately 50% each semester. The librarian felt that this approach was engaging, reduced plagiarism, and took substantially less time to implement than previous efforts. Her implementation of AHOS enabled her to use it with multiple classes to give a broader impact at her school.

A high school librarian collaborated with ninth-grade English teachers to teach students about plagiarism. The English teachers were pleased with her instruction but noticed that they consistently received approximately 20% of the submissions with plagiarised content. The high school librarian worked with the developers to create a version of AHOS for her school. The typical areas of concern for submissions included citations, copying/pasting content, submitting a friend's work, and additional pressure from peers. The librarian found that the AHOS content matched a majority of her concerns and made minor adjustments to it to include high school level scenarios and vocabulary.

She noticed that the underlying factors accounted for her major concerns citing peer pressure as a difficult area for 13–14-year-old students to consider. Once she implemented the tutorial and quiz, there was a decrease in plagiarism by approximately 66%. The librarian believes that she can use this tutorial with additional grade levels to improve academic honesty, save time, and improve learning outcomes.

In all three schools, the students were able to use the AHOS as a form of common language when speaking with one another about plagiarism and its consequences. The shared knowledge and vocabulary appeared to be helpful in creating a dialogue amongst the students to create a culture of academic integrity.

APPLICABILITY ACROSS THE CURRICULUM

The authors identified the flexibility of the original AHOS, which could be easily adapted and implemented in elementary school, middle school, high school and college settings. A summary of the modifications are included in Fig. 2. In each of the cases, the primary developer was able to take liberties with the content to match their audience. In all of the cases, the general structure of having a tutorial and quiz at the beginning of the term was used. The differences occurred due to the needs of each target audience. Overall, there were minimal modifications between high school students and college students in terms of its design and implementation. The adjustments were typically focussed on lexicon, scenarios and school policies being different

Original AHOS (College)	Elementary School	Middle School	High School
• Tutorial developed and implemented by the university library	• Developed in-library instruction to focus on problem areas and build on formal instruction: mechanics and relevance of citations	• Developed in-house video tutorials with middle school-aged cartoon characters. Instruction highlighted areas of concerns including content knowledge and peer pressure	• Developed a Web-based tutorial which cited original tutorial with minor adjustments
• Quiz based on underlying factors for plagiarism	• Developed quiz associated with mechanics and relevance of citations	• Adapted quiz to focus on content knowledge and peer pressure	• Minor adjustments to quiz to account for school specific concerns and wording to ensure readability

Fig. 2. AHOS Modifications Summary for K-16 Implementations.

than the university. The elementary school implementation built on existing resources to target areas of concern such as mechanics and the pertinence of citing sources. The middle school librarian developed her own video instruction using middle school-aged scenarios to resonate with her students. However, she noted that a particularly important new content area that she focussed on was peer pressure due to students submitting each other's work.

CREATING AN ETHOS OF ACADEMIC INTEGRITY

The AHOS had promising results to improve academic honesty behaviour among students in the K-16 environment. Its effectiveness, simplicity and flexibility in design allow it to be used in a wide range of educational institutions. The automation allows for reuse across grade levels and classes with minimal effort. Initial data from the K-12 implementations were encouraging, as the automated system decreased plagiarism at all grade levels tested. As students completed the AHOS, the developers noticed that the underlying benefit across the K-16 continuum was how the shared knowledge and vocabulary helped to create opportunities for discourse between students. With the 100% requirement, students knew that others had the same background information and could cite the examples provided to prevent plagiarism. The increased interactions among students lead to a shift in culture. Most did not initially know how to respond to friends who want to commit academically dishonest actions. After completing the AHOS, students could use the examples to avoid academically dishonest behaviors even when pressured by peers. This increase in interaction lead to the creation of an ethos of academic integrity among students that perpetuated academic honesty.

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4

ANALYSIS OF HONG KONG'S MATHEMATICS CURRICULUM

Wilfred W. F. Lau

1. INTRODUCTION

Mathematics is a key field of learning in almost every school system worldwide. The twenty-first century has seen new challenges to mathematics education due to rapid technological development such as how to integrate mathematics into science, technology, engineering, and mathematics (STEM) education (Gravemeijer, Stephan, Julie, Lin, & Ohtani, 2017). It is now time for educators and researchers to rethink how mathematics education should be delivered in schools. Thus, general reform in mathematics education is called for.

To cope with changing societal needs, mathematics curricula should be revised regularly. This chapter analyses updates to Hong Kong's mathematics curriculum implemented in 2017. Hong Kong is a cosmopolitan city in China whose students consistently rank highly in international comparative mathematics studies (Organization for Economic Co-operation and Development, 2018). This chapter first conceptualises curricula and traces international changes in mathematics curricula since the 1950s; it then delineates major mathematics curriculum reforms in Hong Kong since the turn of the millennium and analyses updates to the said curriculum by using the curricular spider web (van den Akker, 2003). Finally, the current chapter discusses the analysis findings and concludes with some recommendations for future research.

2. CONCEPTUALISING CURRICULA

Curriculum, which originates from the Latin word currere meaning 'to run/proceed', generally refers to

> *the sequences of courses that a student can take, the topics that are covered in a given grade, or the content, skills, competencies, and habits of mind that a person needs to acquire through schooling. (Mesa, Gómez, & Cheah, 2013, p. 863)*

A curriculum can be conceptualised as a tripartite model that includes the intended, implemented, and attained curricula (van den Akker, 2003). The intended curriculum denotes the vision and goals of education and the syllabi and standards described in the corresponding official documents. The implemented curriculum denotes the actual processes of teaching and learning implemented by teachers in classrooms. The attained curriculum denotes students' achieved learning experiences and outcomes.

A curriculum can be viewed as a product or a process (Cai & Howson, 2013). The product view regards a curriculum as a set of instructional materials and guidelines that enable students to acquire specific knowledge and skills. The process view emphasises interactions among teachers, students, and knowledge in authentic settings and in particular, the critical role of teachers in considering the teaching practices specified in a curriculum to enable learning to occur in classrooms.

3. INTERNATIONAL MATHEMATICS CURRICULUM CHANGES

Marked changes in the structure, content, and guiding principles of mathematics curricula have been observed in countries such as China, Japan, the Netherlands, and the United States since the middle of the twentieth century (Treacy, Faulkner, & Prendergast, 2016). Although the New Math movement, which emphasises abstract mathematics, had a profound influence on mathematics education in the United States in the 1950s and 1960s, it ultimately failed because of a lack of professional development training for teachers and its introduction at the elementary level (Schoenfeld, 2014).

In the 1980s, there was a call to de-emphasise skills and procedures in mathematics education in the aftermath of the New Math movement; consequently, problem solving and extensive use of calculators were advocated in the curriculum. In the late 1980s, the mathematics curriculum in the United States promoted student-centred, inquiry-based learning through daily life

problems. In East Asian countries such as China and Japan, problem solving began to play a key role in mathematics curricula owing to the influence of the mathematics education ideals in the West. For example, in 2001, China proposed new mathematics education standards that focussed on processes, methods, values, and attitudes in addition to knowledge and skills (Ni, Li, Zhou, & Li, 2014). This effort resulted in substantial changes in pedagogical practices in classrooms; instructional tasks with high cognitive demands, multiple representations, and multiple solution methods were designed and implemented.

The emphasis on problem solving and learning in authentic contexts can be attributed to the Realistic Mathematics Education approach advanced in the Netherlands in the 1970s (van den Heuvel-Panhuizen & Drijvers, 2014). Although this approach is largely unaffected by the New Math movement, it pays due attention to realistic situations that enable deep and meaningful learning to occur. These situations may originate from the real world, students' imaginations, or the formal mathematics world so long as they are perceived as real by students. In summary, enhancing 'student understanding of mathematical concepts with increased use of contexts and applications of mathematics in real world scenarios' (Treacy et al., 2016, p. 398) is increasingly crucial.

4. MAJOR MATHEMATICS CURRICULUM REFORMS IN HONG KONG SINCE THE TURN OF THE MILLENNIUM

Education in Hong Kong underwent significant changes under the 'Learning for Life, Learning through Life' reform proposals in 2000 (Education Commission, 2000). Lifelong learning and whole person development were selected as the two main themes of curriculum development in the twenty-first century (Curriculum Development Council, 2001). This vision requires students to not only master subject content knowledge but also become lifelong learners who learn how to learn. In addition to the cognitive development specified in the previous curriculum, the reformed curriculum proposed the development of nine generic skills for all key learning areas, including mathematics education. These skills were collaboration skills, communication skills, creativity, critical thinking skills, information technology skills, numeracy skills, problem-solving skills, self-management skills, and study skills. Another component of the reformed curriculum concerned values and attitudes towards mathematics.

Against this backdrop, a secondary mathematics curriculum originally published in 1985 was revised, and a new curriculum document was released

in 1999 (Curriculum Development Council, 1999); this new document emphasised the development of students' mathematical abilities, generic skills, and positive values and attitudes towards mathematics. The primary mathematics curriculum was revised in 2000 to keep abreast of the changes in society demands and technological development. Alongside the implementation of a new three-year senior secondary academic structure in 2009 in Hong Kong, a mathematics curriculum for Secondary 4 to 6 was designed based on the principles established in the Mathematics Education Key Learning Area Curriculum Guide (Primary 1 – Secondary 3) in 2002 (Curriculum Development Council, 2002). As a continuation of the junior secondary mathematics curriculum, the senior secondary mathematics curriculum aimed to

> *meet the challenges of the 21st century by developing students' ability to think critically and creatively, to inquire and reason mathematically, and to use mathematics to formulate and solve problems in daily life as well as in mathematical contexts.* *(Education and Manpower Bureau, 2007, p. 3)*

5. ANALYSIS OF THE UPDATED MATHEMATICS CURRICULUM IN HONG KONG

The primary and secondary mathematics curricula in Hong Kong were updated in 2017 to maintain pace with changing societal needs and scientific and technological development, to incorporate views from relevant stakeholders, and to align with the direction of the ongoing curriculum review (Curriculum Development Council, 2017a). The new curriculum was developed based on the recommendations made in the Mathematics Education Key Learning Area Curriculum Guide (Primary 1 – Secondary 3) (Curriculum Development Council, 2002), the Basic Education Curriculum Guide – To Sustain, Deepen and Focus on Learning to Learn (Primary 1 – 6) (Curriculum Development Council, 2014), and the Secondary Education Curriculum Guide (Curriculum Development Council, 2017b). In addition, new focal points were introduced, including STEM education, information technology in education, language across the curriculum, and generic skills and positive values and attitudes.

In this chapter, the intended updated Hong Kong's mathematics curriculum is analysed using the curricular spider web proposed by van den Akker (2003), which consists of 10 curriculum components, including the rationale behind the curriculum, aims and objectives, content, learning activities, teacher role, materials and resources, grouping, location, time, and assessment. The spider web revealed that these components are interconnected and thus mutually

influential. In addition, these components operate at the macro-, meso-, and micro-levels of the curriculum.

5.1. Rationale

Since 1997, most mathematics curriculum reforms have been triggered by major curriculum or education reforms such as the Learning to Learn Curriculum Reform in 2001 and the New Senior Secondary Academic Structure implemented in 2009. Fundamentally, the need to prepare students for effective participation in contemporary society appears to be the underlying driving force behind curriculum reforms. Therefore, curricula are regularly revised and updated in response to changing societal needs and economic, scientific, technological, and social development. This perspective suggests that learning mathematics is extrinsically rather than intrinsically motivated (Huckstep, 2000); however, this utilitarian view of mathematics education may run counter to curricular aims and objectives, which tend to be more discipline oriented as shown in the next subsection.

5.2. Aims and Objectives

The mathematics curriculum in Hong Kong aims to develop the following attributes in students: (a) critical and creative thinking, mathematical reasoning, and problem-solving abilities for use in everyday life as well as in mathematical and other contexts; (b) the ability to communicate clearly and logically with others by using mathematical language; (c) the ability to manipulate a variety of mathematical objects; (d) mathematical sense in different learning strands; and (e) a positive and appreciative attitude towards mathematics and mathematics learning (Curriculum Development Council, 2017a, p. 11). It is observed that the mathematics curriculum in Hong Kong tends to focus more on disciplinary aims and less on practical and cultural aims (Wong & Wong, 1997).

5.3. Content

The content of Hong Kong's mathematics curriculum includes subject knowledge organised in strands, generic skills, and values and attitudes (Curriculum Development Council, 2017a). Strands are meaningful categories of mathematical knowledge and concepts in the curriculum that help students to develop knowledge, generic skills, and positive values and attitudes in a

holistic manner. The curriculum contains three main strands, namely 'Number and Algebra', 'Measures, Shape and Space', and 'Data Handling'. These strands are further divided into five substrands at the primary level, namely 'Number', 'Algebra', 'Measures', 'Shape and Space', and 'Data Handling'. The learning targets and objectives are clearly specified across Key Stage 1 (Primary 1–3), Key Stage 2 (Primary 4–6), Key Stage 3 (Secondary 1–3), and Key Stage 4 (Secondary 4–6). Enrichment topics are found in the primary and junior secondary mathematics curricula. In addition, foundation and non-foundation topics are found in the junior secondary mathematics curriculum and the Compulsory Part of the senior secondary mathematics curriculum.

By contrast, the content of the Extended Part of the senior secondary mathematics curriculum is divided into four areas, namely 'Foundation Knowledge', 'Algebra', 'Calculus', and 'Statistics'. Module 1 of the Extended Part comprises 'Foundation Knowledge', 'Calculus', and 'Statistics', whereas Module 2 comprises 'Foundation Knowledge', 'Algebra', and 'Calculus'. Each strand or area contains learning units used to group similar content. A further learning unit is included to enable students to explore and integrate mathematical concepts in different strands and areas at each key stage.

Nine generic skills deemed crucial for learning in the twenty-first century are to be acquired through teaching and learning processes. These skills are collaboration skills, communication skills, creativity, critical thinking skills, information technology skills, mathematical skills, problem-solving skills, self-learning skills, and self-management skills and are divided into three groups of interrelated skills, namely basic skills, thinking skills, and personal and social skills. Seven prioritised values and attitudes are deemed crucial for students' whole person development and societal benefits. These values and attitudes are perseverance, respect for others, responsibility, national identity, commitment, integrity, and care for others. Similar to the generic skills, these values and attitudes are fostered through teaching and learning processes.

Overall, similar to the overseas curricula, Hong Kong's mathematics curriculum is centred on content and non-content specific strands intended to develop students' related knowledge and skills, respectively (Burke, n.d.). However, Hong Kong's mathematics curriculum is unique in terms of its promotion of values in education.

5.4. Learning Activities

Hong Kong's mathematics curriculum emphasises the arrangement of diversified learning activities at different levels, including hands-on exploratory

activities, projects, and mathematical reading activities. In addition, some activities such as STEM learning activities involve the integration of knowledge from other learning areas (Curriculum Development Council, 2017a). Generic skills and positive values and attitudes can be developed through such learning activities, suggesting that such activities align closely with the learning objectives and assessment tasks established in the curriculum to promote students' learning.

5.5. Teacher Role

Hong Kong's mathematics curriculum expects teachers to assist students in learning how to learn mathematics and in self-directed learning. Each teacher plays the role of a resource provider, student collaborator, and learning facilitator. In particular, teachers are responsible for

> *delivering clear explanation, designing and conducting exploratory activities in lessons, providing suitable hints and feedback, creating an open atmosphere for discussion and showing concern for students' progress through suitable assessment strategies.* *(Curriculum Development Council, 2017a, p. 59)*

These expectations define the teacher's role from a socio-constructivist perspective; a teacher is required to guide and support students in the construction of mathematical ideas and knowledge. Thus, teachers should design and assign tasks to stimulate students' thinking in a friendly environment and encourage students to discuss, consider, and understand these tasks (Wachira, Pourdavood, & Skitzki, 2013).

5.6. Materials and Resources

Teaching and learning resources are vital elements that enable teachers and students to interact with mathematics inside and outside the classrooms. Hong Kong's mathematics curriculum identifies textbooks as a primary resource for teaching and learning and provides guidelines for their selection. More important, the curriculum suggests some effective methods of using these resources for teaching and learning and how they can be appropriately managed. In conclusion, the curriculum emphasises interactions between teachers and resources to enable teachers to adapt and transform the said resources based on the learning context so that learning goals can be achieved (Pepin & Gueudet, 2014).

5.7. Grouping

Although students are primarily encouraged to learn independently, student grouping is proposed for streaming, inquiry and investigation, project work, and as a means of embracing learner diversity. Teachers should seize the opportunity to group students in order to promote cooperative learning, which occurs as students interact with one another in a group setting to achieve common learning goals (Johnson, Johnson, & Stanne, 2000). Grouping involves a well-organised teacher-oriented process where students divided into groups are motivated to collaborate and learn. In cooperative learning, students exchange their ideas and respond to those of others; the desired result is the generation of shared knowledge and shared understanding. Cooperative learning is considered a more effective learning approach than independent learning because it enables students to utilise the resources of their peers while working in groups.

5.8. Location

Hong Kong's mathematics curriculum offers some suggestions for how to study mathematics outside the classrooms. For example, life-wide learning through experiential methods provides a means of extending mathematics education beyond the classrooms. E-learning also enables students to interact and collaborate with one another beyond classroom boundaries. While such contributions of informal learning to formal learning should be acknowledged, notably, informal learning is usually made possible through social mediation and facilitation, and the educational paradigms of the two approaches are fundamentally different (Pattison, Rubin, & Wright, 2016).

5.9. Time

Schools in Hong Kong have suggested time allocations to implement curricula at the primary and secondary levels. Schools are encouraged to use lesson time flexibly to conduct inter-disciplinary activities and organise extracurricular learning experiences.

5.10. Assessment

Hong Kong's mathematics curriculum contains established guiding principles for the design of suitable assessment that enable (1) students to

understand their capabilities and improve their learning independently; (2) teachers to assess students' performance and the effectiveness of their pedagogies and provide appropriate help; and (3) parents to know students' performance and collaborate with teachers to support students' learning (Curriculum Development Council, 2017a). The curriculum also contains a clear assessment framework detailing the interrelationships among formative and summative assessment, teaching and learning processes, and internal and external assessment. Some alternative assessment methods such as peer assessment and self-assessment are recommended for assessment from various perspectives. The Education Bureau has developed the Learning Progression Framework and Student Assessment Repository to promote methods of assessment both for learning and as learning in schools. Generally, the assessment principles advocated in Hong Kong's mathematics curriculum are consistent with some key assessment concepts, including appropriacy, fairness and inclusiveness, and the relationship between pedagogical decisions and actions (Australian Association of Mathematics Teachers, 2017).

6. DISCUSSION AND CONCLUSION

The analysis detailed in this chapter demonstrates that curriculum development seems to be driven by extrinsic, utilitarian rather than intrinsic, disciplinary forces. Disciplinary aims outweigh practical and cultural aims. The content of Hong Kong's mathematics curriculum is well articulated with respect to content and non-content specific strands. Activities play a key role in facilitating learning of mathematics, as well as in the development of generic skills and positive values and attitudes. Teachers serve as learning facilitators to promote students' conceptual understanding and procedural fluency in mathematics. Furthermore, teachers use materials and resources in a manner that enables learning to occur. Both independent and cooperative learning activities are provided for students to optimise their learning. Studying mathematics both inside and outside of the classrooms is encouraged so that both formal and informal learning can be realised. Moreover, teachers should allocate lesson time flexibly to fulfil multiple learning needs. Finally, various forms of assessment should be designed and supported by a well-grounded framework to inform pedagogical decision making. Overall, the aforementioned findings are in line with the changing trends of international mathematics curricula (Treacy et al., 2016) and

highlight the ongoing needs to promote quality and equity in mathematics education.

Generally, mathematics curriculum development worldwide is influenced by globalisation and internationalisation (Cai & Howson, 2013). These two forces have informed our understanding of how different educational systems respond to similar problems and how educational stakeholders reflect on curricular and instructional issues from global perspectives to seek continual improvement. In addition to mathematical knowledge and skills, developing students' higher-order thinking skills is increasingly crucial. These skills include metacognitive skills for self-regulation of thinking processes.

For example, the updates made to Hong Kong's mathematics curriculum in 2017 comprise a focal point regarding STEM education, a key new global educational initiative. English (2016) discussed the role of mathematics in STEM education and argued that mathematical literacy provides a foundation for promoting learning across the STEM domains. Mathematical literacy develops students the skills necessary to deal with uncertainty and analyse data, skills that are essential for making evidence-based decisions involving ethical, economic, and environmental considerations. Furthermore, mathematical literacy enhances students' abilities to handle contradictory and potentially unreliable data found online; these abilities are critical in the light of the exponential increase in digital information in STEM. In addition, the aforementioned nine generic skills are transferable skills that students can learn in schools to prepare them for the challenges of the twenty-first century (Partnership for 21st Century Skills, 2015). These skills can be developed through teaching and learning activities designed to cover specific topics.

Future studies are recommended to compare the mathematics curriculum in Hong Kong with those in other parts of the world. Comparative studies of mathematics education generally fall under one of the two major categories: large-scale quantitative studies and small-scale qualitative studies (Andrews, 2007). Large-scale quantitative studies such as the Trends in International Mathematics and Science Studies compare the mathematical achievements of learners in one country with their counterparts in other countries. Such studies provide participants' information regarding their mathematical achievements in relation to those of others at the system level and with reference to previous cohorts. Small-scale qualitative studies aim to understand how mathematics is perceived by and presented to learners in different countries and strive to highlight the crucial role played by formal schooling in preparing young citizens for societal participation.

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5

DESIGN THINKING IN MANAGEMENT EDUCATION: CASE STUDIES FROM LESSONS

Elvira Strakhovich

INTRODUCTION

This chapter discusses examples and results of the use of Design Thinking in teaching management students. Initially, this method was developed and used for new product development and project management in the information technology (IT) industry. The sequence of steps of the Design Thinking method, namely empathy, definition, idea, prototype and test, is similar to the phases of project execution. Researchers in the field of education became interested in the opportunities of the method and recommended it for use primarily for studying project management disciplines in business schools. At the same time, since empathy is useful in studying the needs of consumers, the method has found application in the development of compendiums of academic disciplines.

According to United Nations Educational, Scientific and Cultural Organization (UNESCO) forecasts, the most in-demand competencies of employees in the twenty-first century are related to soft skills, such as creativity, critical thinking and teamwork. The possession of these competencies is especially important for managers. As managers, graduates of business schools should acquire not only knowledge and hard skills in the field of their subject (finance, marketing, etc.) but must also acquire soft skills in the field of management. The use of the Design Thinking method in the classroom involves teamwork

and collective participation in the creative processes and decision-making, as well as customer orientation and identification of his or her needs. These are the specific skills that business school's graduates should have, which explains the interest in Design Thinking.

Usually, discussions relevant to the use of Design Thinking in education are about compendium development, knowledge transfer, and organisation of the learning process. Thus, discussions are held from the teacher's point of view. However, there are at least two participants in the learning process: the teacher and the student. It is important to understand not only how to transfer knowledge to the student but also how he or she will grasp this knowledge. How the student masters the skills that the teacher seeks to develop is of significant importance.

Application of the method of Design Thinking in different disciplines at different levels of educational programmes in a business school will be examined. The teacher's assessment is given of how the understanding of the learned subject is improved by the students or how the knowledge of the learned subject is aligned in the group of students when applying Design Thinking. The analysis of students' own assessment of the influence of the method of Design Thinking on the development of soft skills is also given. The achieved results and opportunities for further development of the method are discussed.

DESIGN THINKING IN MANAGEMENT EDUCATION: CASE STUDIES FROM LESSONS

The task of Higher Educational Institutions is to prepare future specialists who are in demand in the labour market, who are confident leaders with knowledge and skills, able to quickly and efficiently adapt to changing circumstances and economic development. Future specialists need to possess not only the actual knowledge but also the skills and ability to learn, assess the situation, work in a team, and hear others, as well as the ability to defend one's point of view and be heard by others.

According to UNESCO forecasts (UNESCO, 2015), the most in-demand competencies of employees in the twenty-first century are related to soft skills, such as creativity, critical thinking and teamwork. The development of such competencies can be obtained only from the experience of working together or in a training situation in which everyone can win only by working as a team. This is especially important in business education, as it is necessary to take into account the interdisciplinary nature of future managerial professions (Çeviker-Çınar, Mura, & Demirbağ-Kaplan, 2017). As managers, graduates

of business schools should acquire not only knowledge and hard skills in the field of their occupation (finance, marketing, etc.) but must also acquire soft skills in the field of management, general decision-making, cooperation, etc.

Traditionally, the case method is used in the training of student-managers. Recently, however, the use of the Design Thinking method has become popular in training courses for student-managers, managers and executives. According to researchers in education, this method has been identified as making valuable contributions to business and management education (Matthews & Wrigley, 2017).

We used this method in business school lessons and evaluated the results from the point of view of both the teacher and the students.

Design Thinking Method in Education

Design Thinking was originally widely used in technical fields, then was successfully applied in the humanities, including education (Melles, Anderson, Barrett, & Thompson-Whiteside, 2015). Researchers in the field of education have proposed designing curricula on the basis of Design Thinking for all levels of education, such as secondary school, college, and so on. The Design Thinking method is actively promoted by universities and schools teaching this method, including Stanford d.school, Aalto University, and others. When researchers in the field of education became interested in the opportunities of the method, they recommended it for use primarily for studying project management disciplines in business schools. Using Design Thinking in business schools was also recommended based on the fact that students often study business cases in terms of their results; Design Thinking, on the other hand, is a process-oriented method that is also very important in management (Matthews & Wrigley, 2017). In addition, this method has been proposed for the development of training programmes, and it is also noted that the stages of the Design Thinking method are similar to the project management life cycle.

This chapter considers the Design Thinking method as outlined by Stanford University's design school (Stanford d.school, 2019) which defines the five steps in this method: empathise, define, ideate, prototype and test. These steps can be characterised as follows:

- 'Empathise' means to learn about the audience for whom a design will be performed.
- 'Define' means to construct a point of view that is based on a design user's needs and insights.

- 'Ideate' means to brainstorm creative solutions; at this stage, each of the proposed ideas is critically evaluated, and, if possible, all expressed ideas are taken into account in the common decision.
- 'Prototype' means building a representation of one or more of the design ideas to show to others.
- 'Test' means that the design needs to return to the original user group for a trial of the design ideas and feedback.

Each step except the first includes the possibility of a return to previous steps to clarify additional conditions for the design or to offer and evaluate new ideas for the solution. The method allows for as many iterations as necessary to make a decision that satisfies the target audience. This method focusses on studying and understanding the needs of the target audience and ensuring their satisfaction. Therefore, one of the main characteristics of this method is human-centred design.

Comparing the method of Design Thinking with other approaches to learning, we can highlight its proximity to problem-based learning. Problem-based learning assumes that there is a problem for which there are no ready-made solutions, and students must offer, implement and evaluate a solution. On the other hand, as noted above, the sequence of steps of the Design Thinking method is similar to the sequence of phases of the project life cycle, namely initiation, planning, execution and completion. This fact plays an important role in the recommendation to apply Design Thinking to education in the discipline of project management.

Design Thinking, as well as knowledge management, uses tools such as visualisation, brainstorming, polling, interviews and customer journey mapping. The role of visualisation is particularly important to finding new solutions through the association of visual images. At the same time, in the first steps of the Design Thinking method, students actively use analysis to determine the user's needs; then, at the stages of idea creation and prototype development, they actively use the synthesis method. Thus, the Design Thinking method combines elements of modern learning approaches.

Case Descriptions

The Design Thinking method was applied in three courses of IT disciplines at different levels and in the different programs of the Graduate School of Management at St Petersburg University. At this business school, students first study management disciplines and information technologies as tools in

managerial work. At the same time, students in both the bachelor's and the master's programmes have different levels of knowledge in the field of IT, which is essentially the user level. The method of Design Thinking was used with the aim of engaging a deeper level of involvement of students in the study of the courses and the formation of a more complete understanding of the tasks. It was not a study of the method as part of the courses; rather, it was the application of the method for completing tasks. Let's consider three cases from different disciplines.

Case 1: IT Project Management Course

Project management is a discipline included in every management education programme. Bachelor's students studying information management learn IT project management as well. The requirements collection is an important part of every project, especially an IT project, because the results of this procedure impact the project results. The first step before beginning the project is to determine the business case as the basis for determining the project business value. Students in the bachelor's programme have little development experience in IT, and need some additional clarification of the product specifics and project requirements for this area. At the same time, these students have studied various IT business systems and learned their functionalities. As mentioned above and according to project management processes (Project Management Institute, 2017), every project should start with a business case determination. The business case serves to confirm the necessity of the project, and the main functions and functionalities of the product are clarified based on the project business case. Therefore, it is important for defining the scope of work of the project. Prior to using the Design Thinking method in this course, students received a business case for a training project and collected requirements using one of the appropriate methods. Working on the proposed ready-made business case, students did not always fully understand its features; as a result, there was often a large gap between the proper requirements of the product and the collected ones. For the experiment using the Design Thinking approach to determine the business case, only the problem area for the development of an IT product was allocated, and the students were tasked with determining the type of IT product and business case for its use.

The students worked in groups of five to seven people. They were faced with the task of describing a business case of IT service for the students of the business school. Thus, the audience for which the business case was under development was the students themselves, and they well understood the audience needs. Therefore, they easily managed to complete the first step, empathising. The students in the group had different levels of IT knowledge, and

from time to time, while discussing ideas and prototypes, they exchanged information and learned new things from each other. They had enough knowledge and information to form ideas, develop a prototype, and test it, involving other students of the same school in the evaluation of the prototype.

A better understanding of the business case would be based on the previous practice and experience of the students (Wang & Wang, 2008), but the common teamwork and information exchange compensated for the lack of experience.

Case 2: IT in Human Resource Management

Another application of the Design Thinking method in the classroom is to collect the necessary features for a talent management tool, specifically for the motivation component. This exercise was performed by students studying IT for personnel management. The exercise was performed during the lesson, and students did not have the opportunity to find out the needs of the target audience – that is, human resource managers – so the scenario and goals of using such an IT system were described and explained to the students in the lesson. The empathy step was replaced with storytelling.

Case 3: IT in Public Administration

Case 3 took place in a course of IT discipline in public administration in the master's programme. Students enrolled in this course consciously chose this area of specialisation and had some experience in government and knowledge of the subject area. Some of the students also had IT knowledge. Developing a business case for the educational projects, students had an idea of what information technology is and how it can be used in the urban environment and in social projects. The examples of the student projects can be found in Fig. 1. In this case, students as urban residents and society members were part of the target audience for which the projects were intended. Work on the creation of a business case was conducted in groups of five to seven people. The most heated discussions took place at the first stage, empathy, when it was necessary to narrow the area of project development and decide which needs of the target audience would be considered. Since students were part of the target audience of the project, and during prototyping there were constant discussions, this case can be considered as multiple iterations of prototype testing.

Information systems are important tools for a modern manager, and determining their functionality, of course, is the manager's task. A specific aspect of the execution of these educational projects was the international composition of educational groups and the various social experiences of students. On the other hand, working on joint projects allowed the students to exchange

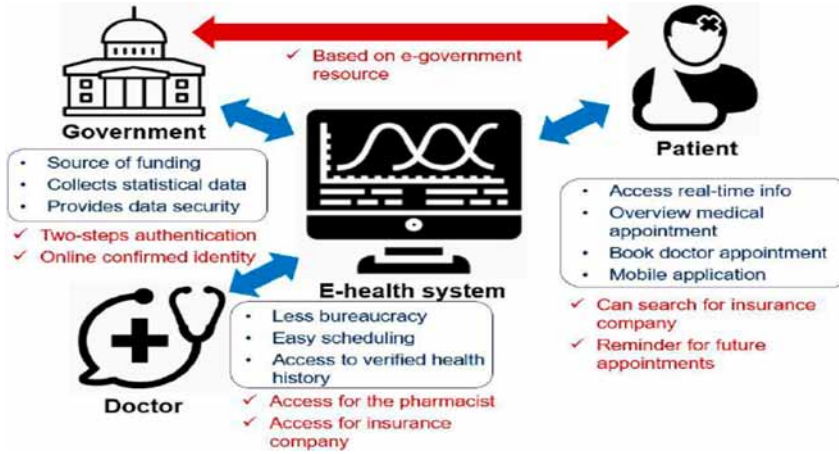

Fig. 1. An example of a business case description for a student project.

experiences and expand the proposed project solutions. Each project team chose its own project topic.

Several options for choosing a business idea were considered. First, it was an opportunity to continue the project, which was already started as a year-long project, but the work had stopped due to a lack of understanding of how to continue developing the project. Second, there were projects that had been realised in other countries, and students proposed adapting the project idea for another country, taking into account its features. Finally, some project proposals involved developing a new idea.

In all of the cases considered, the project results were evaluated, and each student's evaluation of the completed project depended on the overall result; that is, each project participant was interested in its success. After each project group presented the results of their work, the student group discussed, evaluated, and ranked the project in relation to other completed projects.

DISCUSSION

In the considered cases, student project groups were formed at will, and the working atmosphere in each group was different. In groups where students continued to work on a year-long or graduate project, students were already working together in a group, and there was a serious, businesslike atmosphere. Participants of newly created project teams at the beginning built relationships, became acquainted with each other, and formed a team. This fact demonstrates that the students acquired development skills.

One of the groups, formed by students who knew each other and already had a strong leader, ignored the steps of the method, forced the development of the project, and immediately offered a description of the business case. Unfortunately, the project result was weak; it did not take into account the needs of the target audience, and the students themselves recognised this fact. Performing the method step by step allows the participants to think deeply about the solution and to consider and critically evaluate the possible options.

Some researchers propose that it is better to not implement the entire Design Thinking cycle into the learning process but to include just some of the steps, arguing that this also benefits the development of soft skills (Ewin, Luck, Chugh, & Jarvis, 2017). Due to circumstances such as time constraints, some steps of the Design Thinking method were excluded in academic disciplines; the results are summarised in Table 1.

In the case when the first step, empathy, was skipped and students were given instructions with the description of the business case and scenario of its usage and they were tasked with determining the necessary functionality, the proposed solution turned out to be limited in comparison with other possible solutions. The questions to the potential users of the system were non-specific and did not reflect the features of the business case. In the case when the empathy step was included, but the testing step was skipped, the proposed business cases were diverse in topics and functions. Thus, based on this observation, it can be summarised that the inclusion of the empathy step opens up opportunities for a creative approach to problem solving and allows for the most interesting cases.

From the teacher's point of view, the use of the Design Thinking method in groups helps to involve students in the learning process (Ching, 2019), to organise the exchange of information and knowledge in groups, apply analysis

Table 1. The Importance of Empathise Phase Was Confirmed in Practice.

Phase \ Project	IT-project	IT in Public Administration	IT in HRM
Empathize	Done	Done	Skipped
Define	Done	Done	Done
Ideate	Done	Done	Done
Prototype	Done	Done	Done
Test	Done	Skipped	Done
Results:	Many-side solution, original suggestions	Many-side solution, original suggestions	Limited proposed solutions

to study and evaluate the project environment, and synthesise the solution. By applying critical thinking and teamwork in the group, a symbiosis of knowledge and soft skills is formed. The practical application and development of the method in educational projects gives a result that will be useful in future management work. At the same time, there are at least two participants in the learning process: the teacher and the student. It is important to understand not only how to transfer knowledge to the student but also how he or she will grasp this knowledge. In other words, how does the student master the skills that the teacher seeks to develop?

A survey was conducted to collect student assessments of the use of the Design Thinking method in the classroom and evaluate its results. Thirteen students took part in the survey. The survey results are presented in Fig. 2. All students noted the focus of the method on the development of soft skills such as collaboration (31% of survey participants 'strongly agree' and 69% 'agree'), teamworking (61% 'strongly agree' or 'agree' and 31% were 'neutral' and one person was 'disagreed'), integrative thinking (100% of respondents 'strongly agree' or 'agree'). Most participants noted characteristics such as the ability to listen to each other (54% 'strongly agree' or 'agree', while 46% were 'neutral') and opportunities for creative search for solutions (85% respondents replied 'strongly agree' and 'agree', while 15% were 'neutral').

We can summarise the advantages of using the Design Thinking method in the training project as follows:

- Student involvement in the learning process increases, their interest in the results of the work grow through participation in the process of creating this result, and they take an active approach to learning.
- Students working on the business case understood the essence of the planned system and well formulated and understood the functional requirements of the system.
- Collaboration for the task execution and human-centred orientation following the Design Thinking method allowed students to develop soft skills.
- Given the different levels of the students' familiarity with information systems, the joint work required students to exchange knowledge and to learn from each other.
- A clear understanding of the problem area and the business case allowed students to better execute subsequent tasks for the training project.
- Working on the business case, the students study the Design Thinking method, which has become increasingly popular in the field of business.

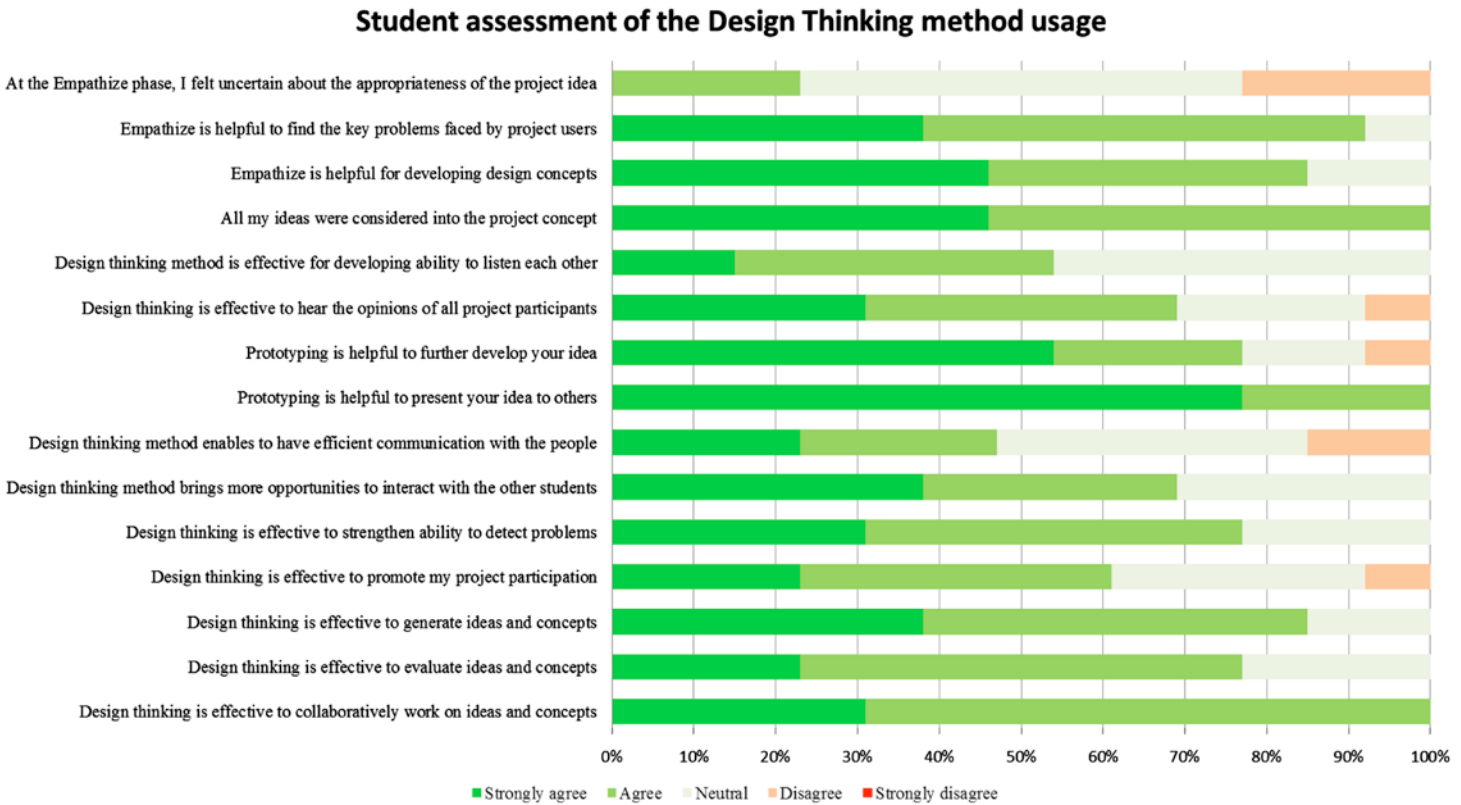

Fig. 2. Survey results.

CONCLUSION

Based on our experience, we can state the positive results of the application of the Design Thinking method in teaching. The involvement of students in the educational process, the creation of new common knowledge in the course of work, the development of integrative and critical thinking skills, and the development of soft skills will create a positive impact on the future professional work of modern students. A positive assessment by students of the process and the results of the application of the Design Thinking method in teaching confirms the usefulness of its implementation in the classroom.

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6

STUDENT ENGAGEMENT THROUGH COLLABORATIVE CONSTRUCTION OF KNOWLEDGE IN MAKERSPACES

Ellen Taricani

INTRODUCTION

When completing specific tasks, groups will often reflect on the impact of constructing and designing a group project while multiple individual models and backgrounds are combined in a type of social influence. Students are often expected to establish connections and share knowledge in group collaborative work. Many times, groups gather and discuss ideas without really making connections with each other's ideas. They are more focussed on the completion of a task than the process of completing it.

Finding ways to enhance social construction is important towards total participation. Objects can provide an atmosphere of sharing as well as an introduction to these new ideas. Collaboration tools can be used to help ensure that each member contributes using various objects found in a maker common area. This community building process and adaptation will increase group formation and clarification.

There are two major types of constructivism in the classroom: cognitive or individual constructivism and social constructivism. Similarities in these include the manner in which a student inquires and explores a topic. Each student learns to create concepts built on existing knowledge that are relevant and meaningful. Individuals have very different backgrounds but are able to draw from their past learning experiences. Social constructivism can occur as

students begin to interact and discuss ideas. In social constructivism, ideas are constructed through interaction with the teacher and other students. Schemas are constructed through the process of assimilation and accommodation, when going through four different stages of development (Wadsworth, 2004). Each student brings ideas both new and old to the project. A series of both individual and group processes bring the group together to a point of reflection. Reality is constructed through human activity and process.

Working with makerspaces is built upon many basics of constructionism and provides students with space to be creative and explore. The background of these ideas comes from 'the philosophy of hands-on learning through building things' (Kurti et al., 2014). The builders will learn and teach others while the actual 'teacher' provides guidance and suggestions for what is being built. Ideally, the line between learner and instructor becomes blurred. The teacher is not the only one teaching to the students, soon they should be teaching each other and learning from one another. This is all part of learning to work as a team.

Students process together and produce a final product that is demonstrated in a video or PowerPoint presentation to reveal the steps and the final product. Makerspaces are built to do all that is needed for specific tasks while being able to change or adapt to generation of new ideas. The students learn and unknowingly teach each other as they move through the construction of their ideas.

BACKGROUND

The initial study was conducted with 24 first-year students in a class dealing with cyber-culture and social media. One of the goals in class was to learn about relationships and online communities. Each member was expected to participate and contribute to the group work. Overall, each member of the four-person group was an equal part of providing input to the group goal. Fundamentally, the theory of this learning is defined as social epistemology. The group knowledge that is developed becomes a collective achievement. Individuals generate personal opinions from their own perspectives, but they do so, on the basis of cultural knowledge, shared language and learned representations. These beliefs become shared knowledge through social interaction, communication, discussion, clarification and negotiation. Knowledge and knowledge representation will become a socially mediated product. The students can also assist each other in the interpretation of the assignment and instructions. Maker objects were created based on readings from the textbook and lectures dealing with the concepts of community.

Each group consisted of four people randomly assigned. They have some training the first day to learn about the littleBit objects and how they worked. They are also presented with bins filled with various Lego parts. The second and third day were spent in design of the communities. They could use any objects and create any kind of community. The communities consisted of ideas that they generated and were interested in forming. The fourth day, the students took time to make a video of their work that was to include text and narration of how the community functioned. LittleBits and Legos can provide a natural environment for students to practice collaboration, critical thinking, communication, and creative design.

Students were asked to use concepts from a chapter in the textbook to simulate these in a form of community. They were given freedom to consider what type of community and how it functioned. Each group had the option of using many parts from littleBits as well as Legos or other artefacts that they could make or use in the lab area.

The text from the book included four main concepts: Identity, Reciprocity or recognition, Commonality, and Bonding. Other factors to consider and represent in the creation of the community included these:

- Virtual community
- Community and technology
- Subjectivity
- Modes of social explanation(knowledge)
- Modes of social organisation (within time and space)
- Modes of presence(embodiment)
- Ethical concerns
- Bonding connection
- Reciprocity and recognition
- Commonality
- Identity
- Structures of community.

OVERVIEW

Working with makerspaces is built upon the foundation of constructionism and provides students with space to be creative. It is a space that enables students to

create freely and without boundaries or limitations. It is an open constructivist learning environment without limits. The only limit is the class time that ended at a certain time. The environment presents a selection of materials that can be used in a variety of ways apart from any specific rules or expectations. A key to the success of the Maker Movement in education is the shift away from ready-made knowledge to a classroom environment ripe for exploration, creativity, innovation and collaboration. (Schrock, 2014). It is a desired method of learning as students are asked to create meaning. The background of most of the ideas originates from the philosophy of hands-on learning through building things. The builders are supposed to learn and teach each other while the actual 'teacher' provides the tools for the work to be built. Theoretically, the line between learner and instructor becomes blurred as the teacher is only a guide and not the enforcer of methods to be used. The learning becomes more of a mix of aspects from each other and reminders from the teacher.

Most classrooms are set up with a series of rows with chairs and each seat has a student sitting taking notes and listening. This is the shape of most college classrooms. This raises the question of why continue to implement instruction the same way. Most universities desire to see more diversity, creativity, and innovation, yet they continue to teach the same way. This has led to the new concept of makerspaces which are innovating ways to design classrooms to better fit the learning that is going on. Makerspace is more than a space itself, it is a mindset that can and should be taught (Gerstein, 2014). It is more than just an experience out of the classroom, but one that should be the classroom. One of the main points of a makerspace is to encompass things that naturally happen in various learning environments

Makerspaces are built to do all that is needed for a specific task while being able to change or adapt to new ideas. Oliver (2016) says that 'makerspace professional development should give educators an opportunity to discuss and resolve these questions for their space.' When referring to these questions, Oliver (2016) is talking about a list of questions of how, what, and why to use makerspaces. It can be very useful in professional development. Makerspaces are becoming more common in schools and school libraries, showing teachers how their content can be applied in maker projects may help to promote value to the users. These spaces have the potential to improve creative engagement with the task and also enhance students' motivation as they use their minds to make connections and create meaning. Research point towards the idea that students are engaged if given the opportunity to collaborate with others.

This type of teaching and learning and it is critical for innovators to understand as we develop frameworks that move away from consumption, towards creation in our educational settings (Fullan, 2013). It is important to develop

measures for both deep learning outcomes and for the new pedagogies and learning environments that can support the new techniques. New methods of measuring diverse elements of the learning process and environment are important to explore both the various roles that members take on and the interactive relationships. The new learning task and designs need to be clear prior to engagement. Measures of inputs, outputs and outcomes should all be a part of a holistic and aligned system of measures that can support deep learning (Fullan & Langworthy, 2013).

A makerspace is about 'turning knowledge into action' (Flemming, 2015), and allows for a true opportunity to support personalised learning (Martinez & Stager, 2013). Technology is quickly becoming ubiquitous in learning environments – from personal devices to the education cloud to digital learning resources. Projects like this focuses on the 'pedagogical innovations that will allow technology to achieve its potential to impact learning' (Fullan & Langworthy, 2013). New types of partnerships emerge from a set of roles for both teachers and students different to the ones found in many classrooms. These will challenge thinking and processing.

The goal is to critically review existing work, often rigorously, and to generate new ideas that build further and create something better (Taricani, 2017). Groups have been noted to perform better when taking this very interactive approach on projects where teamwork is not only important, but essential. In discussing educational spaces, Kurit et al. (2014) explain several aspects of makerspaces being, the ideology and the feel and guiding principles. 'The maker movement in education is built upon the foundation of constructionism, which is the philosophy of hands-on learning through building things'. Included in the models of constructing objects, there is also the concept beyond construction when makerspaces can involve deconstruction as well using general tools. It can be considered an ideal activity that should occur in such in education. Often taking apart objects assists in understanding and continued reflection.

The builders are supposed to learn and teach each other while the actual 'teacher' gives the tool for the work to be built. Ideally, 'the line between learner and instructor becomes blurred'. The teacher is not the only one teaching to the students, in a short time they will be teaching each other and learning from one another. In this makerspace, the students learn as they attempt to create their projects. For the feel of a makerspace, it is important to 'invite curiosity', 'inspire wonder' and 'encourage playfulness'. Kurit et al. (2014) found 'inquiry-based learning to occur, students must be attracted to the space and be inspired to use it'. Students are mostly accustomed to traditional classrooms where they listen to lectures and take exams. They may have mixed

emotions about a makerspace as trying something new can be confusing and intimidating or simply exciting for some. Inquiry-based learning focusses on investigating an open question or problem.

Students are mostly accustomed to traditional classrooms where they listen to lectures and take exams. They may have mixed emotions about a makerspace as trying something new can be confusing and intimidating or simply exciting for some. Getting the students interested in the space will make a very successful learning environment. The principles of the space are that 'it's ok to fail', 'breaking things is not a cardinal sin' and to 'collaborate, collaborate, collaborate!' People tend to want to do things right the first time and sometimes independently but when it is something new it may not happen as such so encouragement is vital. In addition, everyone can learn from one another versus just an instructor so working together brings the space alive. It is the students' job to take control of their learning experience.

The time to change education is needed now more than ever. We are facing an educational system in crisis and a global economy feeling the ripple effect of this failure (Wagner & Compton, 2012). Wagner captured the voice of business leaders describing the need for students to graduate with the skills of creativity and innovation, and that our educational institutions are failing to meet this mark (2012).

> *There are essential elements of educating young people to become innovators: the value of hands-on projects where students have to solve a real world problem and demonstrate mastery; the importance of learning to draw on academic content from multiple disciplines to solve a problem; learning to work in teams. (Wagner & Compton, 2012, p. 52)*

This description can be found at the heart of the maker movement manifesto; imploring individuals, community centres and schools to allow people to make, share, give, learn, tool up, play, participate, support and change (Hatch, 2013).

PROJECT GOALS AND IMPLICATIONS

Part of the process involves providing a space for students to explore the concepts with objects and construct meaningful representation of the concepts using Legos and littleBits. In the theory of constructivism, knowledge is constructed based on personal experiences and hypotheses of the environment. Learners are to attempt to test these hypotheses through social negotiation

in their groups. Each person has a different interpretation and construction of knowledge process, but the process develops their learning and thought processes as they work together. If you were to observe the groups, you could almost see the thoughts forming in the air. Students can learn from one another, via observation, imitation and modelling. They can learn observationally through modelling. This process of continuous reciprocal interaction between cognitive, behavioural and environmental influences will eventually build a team and a product.

Each team built many different environments that included the main concepts of team building from the book. The makerspace afforded opportunities for many sparks of creative thinking.

Students provided feedback as they discussed what did they thought about the exercise. Here are a few thoughts:

- some were confused and not sure what to do
- had to think outside the box
- freedom to create absolutely anything
- ideas were pitched and thrown away until people could agree on something
- the assignment was challenging

GOALS OF THE SESSION AND THIS RESEARCH

Each team was expected to work on their own after some brief instructions from the instructor. Teams need more direct input from the instructor to help scaffold the project. The objects are not always interpreted in the manner that they were presented. More reinforcing assists in directing the group and the work (LeDoux et al., 2012). Frequent feedback on their performance assists in overcoming issues and questions. Students were asked to evaluate their group as it formed and made decisions. Some of the questions for them to consider included self-reflection and well as group reflection of the phases of their own group development. Questions include a discussion of the technologies and the interactions.

Refection guide provided to the students:

Student Goals: group reflection on impact of building a group project through multiple individual models and background

Two impacts: social influence and social construction

Take time to discuss and write up the following:

1. Discuss your work and influence on final decisions both individual and group.
2. How many ideas did each of you have when you first started discussing community ideas? List them.
3. How did you decide on which one to do? Was it unanimous?
4. How did you decide what objects to use?

Group reflection includes an initial step of self-reflection and consideration. Each student needs to be prepared to add to the overall discussion and include some key points and issues. The metacognitive strategies selected in the chart below (Fig. 1) demonstrates the power of an effective group being able to blend both individual and group ideas into a concept design and implementation. Without the process of each person contributing, the end result would not be as complete.

In each class, a set of questions and points were purposely asked to engage the group in some metacognitive processes. Below are some of the main points:

- When it comes to forming a new community from scratch, there are many aspects that need to be understood and considered. Community is not a flat concept. It is necessary for all aspects to sustain the environment. **What are some of the development aspects as a community develops?**
- Bonding is experiencing membership as well as sharing something in common. **What is being shared?**

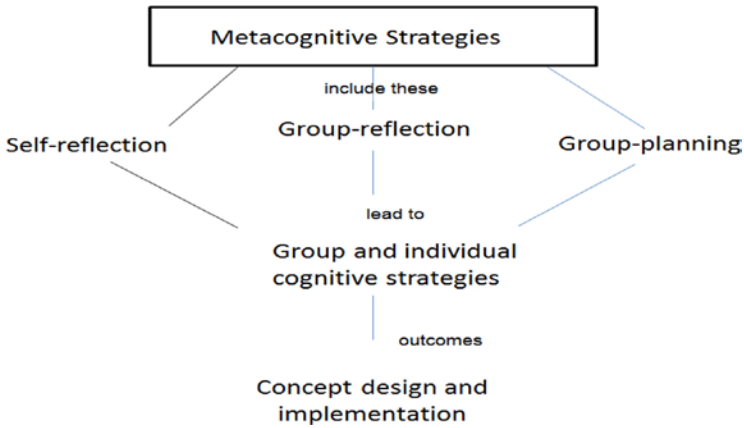

Fig. 1. Metacognitive Strategies.

- The cognitive element plays a role as all the members acknowledge that hard work everyone does and the sacrifices that are made in order to be a member are recognised. **How do the members get recognised?**
- Represent the concepts of bonding, commonality and reciprocity in your group. **How does this community sustain itself?**

Students begin the process by looking over their notes and considering the exercise. Each attempt to pull out the important aspects of the work in order to proceed.

The first session started with some training on how to use the littleBits. This was provided by the lab staff in the Maker Commons. Students were divided into groups of three and were encouraged to have full participation in the exercises. The second session started with a brief questionnaire and a guide sheet to start the project. Many groups seemed to try to jump in without much thought, but more thought was developed as the time went on. In other words, trial and error seemed to be the predominate method of processing. Each group was in a separate space in the commons area so that they could work more privately on their prototype. The groups were able to store their structures for later work, so they didn't have to start from scratch each time. This was very helpful. On the third day, it seemed so much more started working together both in the team work and the ideas. The instructor would go from group to group to ask questions and make sure they were on track. The communities were starting to actually look like a community and have more functionality. The last day in the lab was to finish up the project and make a movie that described what they did and demonstrate the principle concepts in the book. Each group was to make the video and include each person in the video in some manner. The video was only two to two- and one-half minutes and uploaded to YouTube so others could see. Along with a video, the students were asked to write a short paper discussing what they did and their ideas. The video was presented to the rest of the class along with a short presentation.

Some student feedback:

- some were confused and not sure what to do
- had to think outside the box
- freedom to create absolutely anything
- ideas were pitched and thrown away until people could agree on something
- the assignment was challenging
- how to work together cohesively or in teamwork

- need for each other to complete it
- forced them to rely on one another as well as do self-thinking
- answer could not be found online or on a text book for memorisation
- groups can build and alter the concepts and make changes to each as the production continues
- great teamwork and chemistry
- creative environments
- extensive ice breaker
- teamwork really makes the dream work.

Final thoughts from the students:

- 'I became more familiar with aspects of community'
- 'The assignment really sparked everyone's creativity'
- 'There were endless amounts of interactions within a community'
- 'Students can work together and use other's ideas to create one big community'
- 'Each aspect connects or is affected by another aspect of the community'
- 'People form relationships if they respond and reciprocate back'.
- 'Through trial and error, we came up with our final idea. This allowed us to come up with our best and final idea'.
- 'It really showed us how the elements of community are connected and work together'.
- It was interesting to be able to link the different elements such as bonding, reciprocity, recognition and identity to our communities.

CONCLUSION

In addition, this as a useful learning tool, group work can also serve as a key assessment tool that, when used in conjunction with education standards, can provide educators with an authentic assessment of how students understand and perform on key indicators. Overall, the process of reflective thinking and

social cognition were major factors in making successful groups. Constructivism is founded on the idea that learning: is an active process of exploration from multiple perspectives; results in knowledge being constructed from a personal interpretation of the experience; causes the student to learn to operate at a higher cognitive level; can use technology should be used to encourage individuals to learn 'with' rather than 'through' technology.

The maker spaces are focussed on student-centered inquiry. It is not the project being completed at the *end* of a unit of learning, but the actual vehicle and purpose of the learning. Innovation in teaching may or may not produce better learning but it does provide a time to reflect on what is important and provides a conduit for group buy-in and considerations. Problem solving is a powerful engagement tool that allows high achieving students to extend the ideas involved and to challenge their greater knowledge and understanding as they add to the group work.

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7

THE INNOVATION OF PEDAGOGY: TOWARDS A SYSTEMATIC APPROACH FOR TEACHING IN HIGHER EDUCATION

Ellen Th. W. Bastiaens and Theo J. Bastiaens

INTRODUCTION

In this chapter, we are looking at higher education in a changing society. There is a need for an evolution of existing higher educational models. From our experiences, we describe two case studies and we look towards a modern pedagogy for higher education. It involves a pedagogy that has a focus on real world problems and sees transfer of learning as utterly important. Finally, we discuss the implementation of educational innovation, in which we have to look closely to the need of the users (students and teaching staff) and the significance to use a systematic approach.

HIGHER EDUCATION IN A CHANGING SOCIETY

The need for change in HEIs and the way they organise their education to address these changes have been made abundantly clear in numerous publications (e.g. Barber, Donnelly, & Rizvy, 2013; Christensen & Eyring, 2011; Machin & Van Reenen, 1998; The 50+20 Agenda, n.d.). In general, the challenges address globalisation, technology, accountability and requirements regarding lifelong learning development due to the changing work-environment. Technological development driven by global competition continuously increases the complexity of work and the related skill demands, whereas the

educational sector should meet these demands by preparing and upgrading the skill level of the working population. Globalisation and technology change the way students get access to information and teachers' knowledge: search technologies such as Google, EBSCO, ISI-Web of Knowledge and e-journals are 24/7 available for students, open online courses (e.g. MOOCs) too. The impact of Artificial Intelligence and Learning Analytics will be severe; the effects cannot be overseen yet at this moment. Technology goes far beyond another way of offering information; it allows students to work with advanced simulations and games in numerous disciplines. In addition, it supports students to develop a better understanding of the complexity of the workplace, to experience hybrid learning situations (blending face-to-face and online learning), and to work and learn in distributed groups working at multiple locations. Technology has changed the profile of our current and prospective students. One of first notions about this changing profile was with the introduction of the concept of the Digital Native by Marc Prensky (2001a, 2001b). Prensky elaborates on generational differences regarding technology, making a difference between those born in the digital era, called digital natives, and those learning to adopt to the digital era, called digital immigrants. Since then, many reflections on further elaborations on the impact of digitisation have been published (e.g. Kesharwani, 2019; Prensky 2009) and the way students of today and tomorrow are accustomed to technology. Regardless of these reflections and the presumed effectiveness or non-effectiveness, this is, according to us, the wrong discussion. The digital era is here and will not go away anymore. The discussion should be how to make an impact with technology and how to influence and affect new generations of learners positively for the years to come.

Accountability is another challenge with far-stretching consequences. Society, in the majority of the HEIs the financer, expects from HEIs that students get well prepared for the labour market resulting in high employment rates of graduates. Education not only needs to prepare graduates for their chosen profession, but also to equip them with transferable and generic competencies allowing them to work closely together with other professions and disciplines. The impact of increased autonomy of educational institutes, the significance of (inter)national accreditation, performance indicators, ranking lists and the role of alumni, all demonstrate the growing pressure to increase added value for society. This has led to a debate whether education that strives to perform well on these indicators also implies a better education.

The uncertain future of jobs and job roles and significant societal challenges (inequality, climate change and migration) combined with global ambitions (Sustainable Development Goals, SDGs) call for twenty-first century competences, including fusion skills and competences that are (still) distinctly

human like creativity, collaboration and self-regulation. Graduates would have to become creative system thinkers with distinct social emotional qualities like empathy, openness and courage. HEIs begin to add character outcomes to their lists of intended learning outcomes and look for pedagogies that instil these qualities in their students and have become capable of preparing students for dealing with these kind of developments and for jobs of the future that are yet not defined/known. Educational institutes are accountable for offering effective educational programmes providing optimal matching with previous and successive education, creating a continuous and flawless curriculum, realising high efficiency during the study for the HE itself, whilst addressing the needs and choices of students in a more and more personalised and flexible way. Awareness is growing that assessment is more useful as a mirror to trigger further learning than as a tool only used for evaluation purposes.

Given these changes, HEIs have to find answers that fit their own context and pedagogy. The way forward is finding a balance between serving large populations in a standardised manner in education, while at the same time creating possibilities for customisation to support students in getting the most out of their education, either for the next learning phase or for their professional development. The way forward is also found in the way universities will commit to innovation and to changing their DNA. The challenge is relying on achievements and building upon these achievements while at the same time have a strong look and action towards the future (Christensen & Eyring, 2011). The challenge is to improve the quality of education rather than the quantity. The ability of HEIs in preparing students for the continuously changing skill demands in the knowledge society, calls for a better understanding of how students can be educated to be successful in following levels of education and eventually the labour market and other spheres of life. We are not training students for a 'well-defined workplace', but many of them will end up in workplaces, which are continuously 'under construction' or for jobs that currently not exist.

MODERN PEDAGOGY IN HIGHER EDUCATION: THE NEED FOR AN EVOLUTION OF EXISTING EDUCATIONAL MODELS

New societal challenges put a lot of stress on education in general and educational models specific. In a retrospective, we cannot say that pedagogical models in higher education have changed a lot over the last 50 years. In many cases, the focus is still on a professor sending information and knowledge to students who act like receivers. Definitely, there have been many experiments,

also at our institutions. We have tried to make education less passive for students by using for example Problem-based Learning (PBL) as a scenario at Maastricht University (UM) or by focussing heavily on new technology in Distance Education (DE) at the Open Universiteit (OU).

CASE STUDY: MAASTRICHT UNIVERSITY

Introduction

PBL has been developed at McMasters in the late sixties as an answer to a need of a different kind of education in medicine. The answer was found in what became to be called PBL (van Berkel, Scherpbier, Hillen, & Van der Vleuten 2010). UM was one of the earliest adopters of PBL in the world and the first university in the Netherlands to implement a new educational pedagogy in the early seventies. UM started the eight medicine faculty in the Netherlands, even before UM was officially a university. This required pioneering in every sense of the word by the first staff members, the first students and the first programmes (Klijn, 2016).

In the following 45 years, UM has grown into a university with more than 17,000 students in both undergraduate and graduate programs. PBL has been further developed and enrolled in all our academic programmes, which make PBL a pedagogy that is truly part of our DNA. Our whole infrastructure is structured around PBL for instance with study facilities and teaching rooms for small-scale education. Furthermore, PBL is part of every communique about UM and PBL is of course part of our training programmes for staff and students.

Already in the early nineties, UM decided to create a more international profile by offering programmes in a bi-lingual modus (Dutch and English), and increasingly offering English programmes. This has led to an international classroom with a great diversity of students and academic staff from many different nationalities, enriching our education and research to a large extend, also leading to new challenges for PBL.

Problem-based Learning: A Short Description

PBL is an educational philosophy that emphasises that learning should be constructive, taking place in a context, in collaboration with others and driven by self-direction (Van Berkel et al., 2010). We also refer to this as the CCCS-principles. Constructive refers to learning as an active process of constructing learning building their own knowledge. Learning in a context brings more

meaning to the learning process, thus facilitating transfer. In PBL, students are confronted with authentic problems that are often highly relevant for their future professional practice. Learning in collaboration with others aims to maximise student learning and retention in long-term memory. With collaborative learning, learners are stimulated to collaborate and interact with each other because this has a positive effect on their learning. Self-directed learning means that learners play an active role in planning, monitoring and evaluating their own learning process (Van Berkel et al., 2010). The basic approach for PBL is built around tutorial meeting with 12–15 students, self-study and lectures. Every course comprises two tutorial sessions per week, for a period of 6–8 weeks. During every tutorial, one (or two problems) are addressed and discussed. To steer and facilitate the learning process in the tutorial meetings, UM has developed an approach, called the seven-step model. These seven steps are designed in such a way that it supports students in the process of problem solving (van Berkel et al., 2010). The steps are (1) Clarifying unfamiliar terms; (2) Problem definition, (3) Brain storming, (4) Analysing the problem, (5) Formulating learning goals, (6) Self-study and (7) Reporting. In a traditional design of PBL-seven steps, these steps are followed every week addressing one or more problems.

Evidence About PBL

In the early days, PBL was perceived with scepticism (van Berkel et al., 2010); many studies have been conducted to provide evidence with the effectiveness of PBL in the past 50 years. Hung, Dolmans, & van Merrienboer (in press) have executed a review study of review studies, thus revealing three large trends in PBL-research. The first wave of research up to mid-2000 focussing on the question 'does PBL work?'; a second wave up to mid-2010 with the leading question 'how does PBL work?'; and a third wave focussing on the question 'how does PBL work in different specific contexts?' starting as of mid-2010. A first and consistent finding is that students and teachers are positive about the way of learning cq teaching. Several studies have shown positive effects of group learning. Still, evidence and insight into the mechanisms or active ingredients of small group learning is needed. Furthermore, students considered themselves to be better prepared than their colleagues regarding collaboration skills, problem solving skills, skills to run meetings and the ability to work independently (van Berkel et al., 2010; Hung et al., in press).

In 2017, UM investigated the status of PBL at our own university, called EDview. In this study, more than 1,700 students and staff members participated via interviews, questionnaires and focus groups, leading to a comprehensive and

complete picture of the status of PBL. The overall reflection on the practice of PBL was one of PBL as similar to the seven-step model, while at the same time staff are creative and have applied many different models in their education while still addressing the four CCCS principles (CCCS stands for Collaborative, Constructive, Contextual, and Self-directed). A majority of the respondents asked for more creativity and flexibility about how to implement PBL in the future (Frambach, 2018). Two major challenges for the future that became clear via EDview are the use of technology in the context of PBL and the need/demand for more flexibility. Both developments, also mentioned in the introduction, create an apparent tension with PBL as the leading pedagogy at UM. UM is currently in the process of defining a vision on both technology and flexibility in the leading pedagogy PBL via a large implementation project, also called EDview.

CASE STUDY: OPEN UNIVERSITEIT

Introduction

The introduction of new technology has been disruptive for education. Especially in the field of DE, the impact has been large. DE started more than 40 years ago with mainly a postal correspondence model (sending textbooks and assignments to students' homes). Followed by a phase with new possibilities of mass media of TV and radio. Nowadays, DE embraces the internet and mobile devices as well, making especially interaction and two-way communication with their students (often in remote locations) easy and convenient. One can say that the technical possibilities in DE have grown over time, making in the field of pedagogy of DE more and more teaching and learning designs possible (for a detailed and extended overview, we refer to the work of Anderson & Dron, 2011).

The Dutch OU is a distance teaching university for the Netherlands, the Dutch Caribbean and the Flemish part of Belgium. For 35 years, they have offered their 15,000 students' academic programmes in seven fields. The general pedagogical DE model is focussed on online learning with optional parts of face-to-face education.

Activating Online Learning: A Short Description

The academic year of the OU exists of four equal parts of each 10 weeks (with an exam in week 11). Every programme is built of separate courses with a

minimum of five European Credit Transfer and Accumulation System (ECTS). ECTS credits are a standard means for comparing the volume of learning. The course is the building block of a Bachelor or Master programme. Students earn a certificate for every course, meaning that every course can also be studied separately. The curriculum of the programmes exists of fixed courses (with a fixed start date) and variable courses (no fixed start date, students can enrol at any given moment). The nominal study load is 30 EC per year (the total of an academic master is 60 EC; an academic Bachelor is 180 EC). Offering flexibility to their (adult) students is a key. OU understands the pedagogy of flexibility and knows that their students are lifelong learners that study under sometimes difficult study circumstances (at the workplace, at home) with many distractions.

The pedagogical model focusses on learning by internalising. This means, the students get continuously assignments and self-assessments to actively engage with the course content. Students are no passive consumer of the subject matter, but construct new knowledge themselves by working on 'real world' problems. Educational activities in the courses focus on small-scale group activities and make use of the work/personal context of the students. Next to subject specific content, skills and knowledge, a focus is on general academic research skills development. All educational programmes are well balanced in a, so-called, didactical triangle of the professor, the student and the learning material. The professor activates, encourages and monitors students and their activities. Education is a social process in which the instruction (online or face-to-face) is done by professors. Learning material is well made and includes guidance and learning support. Students work together in study groups with a maximum size of 15 persons. The examination of every course follows the principle of 'constructive alignment'. Educational research shows that tests steer student learning. So, the examinations have to fit the educational purpose of the course and have to build a logical oneness with all other learning activities.

YOUlearn

The Open Universities' core heart for education is their own learning platform YOUlearn. All 15,000 students go there to arrange their learning. The university employs a blended approach for teaching. It is a mix of synchronous and asynchronous activities in an online learning platform, face-to-face activities in their 17 local campuses and a small part of self-study materials.

Evidence About Learning in a Digital Environment

Learning with technology has been researched intensively since the early days of abacus and writing slates. But especially since personal computers entered the classroom researchers became heavily interested whether these new teaching tools were more effective, efficient and better than traditional classroom teaching and the teacher. Thousands of quasi-experimental studies have been done comparing traditional face-to-face education with variations of learning with new technology. Most of the time the conclusions of the educational researchers were… 'there is no significant difference' (for a more for a detailed and extended overview, we refer to the work of Nguyen, 2015). Although there is no constant effect that shows that the effectiveness of learning with new technology is better, we definitely can draw the conclusion that learning in a digital environment is the future of higher education. First of all, societal life becomes more and more digital. New generations of students expect their experiences to be digital, also when it comes to learning. Secondly, artificial intelligence, robots, etc. make the workplace more technological. The gap between expectations for employees and the actual competencies of graduates of higher education is already huge. Society demands for new technology. Finally yet importantly, research shows that learning with technology is no worse than classroom education.

Since the OU uses a media mix of learning with technology, self-study materials and face-to-face learning it is interesting to look at finding of blended learning. One of the latest meta-studies in the comparison of blended learning with traditional classroom instruction (Vo, Zhu, & Diep, 2017) on the academic achievement of students shows also no significant differences regarding of end-of-course assessment methods. However, their findings confirm that blended learning is significantly associated with greater learning performance of STEM disciplined students with traditional classroom practice. In general, their conclusion is that blended learning can result in better learning outcomes for students.

KEY FEATURES FOR EDUCATIONAL SOLUTIONS

To find solutions in HEI addressing the changes and to foresee in educational pedagogies that fit the student of tomorrow, from our two cases above, we can distinguish the following four guiding principles:

1. Learning is context-related

We have to connect knowledge to a concrete context in order to make learning meaningful and transfer of learning to the workplace better. This can

be realised via, for instance, the usage of real problems in our education. This brings the context of the world of today closer to our education and encourages real involvement. Students have to find answers for these problems connecting to earlier acquired knowledge and via effective search approaches in literature. Via creating context to learning, transfer of learning to society and workplace will be eased.

In both of the case studies, this is common practice. Presenting a problem to students is the starting point of the learning process at UM. The same applies for the OU where content is ideally offered around real-life problems.

As an example, UM has developed different honours programmes where students work on a complex authentic problem from a client outside of UM. They collaborate with students from other disciplines, meanwhile receiving coaching on the development of competencies. The OU as DE university makes for example use of virtuality using serious games and started experimenting with augmented reality cases.

2. We have to create a variety of learning tasks facilitating students to learn in different settings and ways

Variation of learning tasks encourages motivation and improves transfer because students will be able to recognise more situations in real life. The variability principle refers to the fact that learning tasks must be sufficient different from each other to allow for the construction of general abstract schemata that make transfer of learning possible. Ideally learning tasks should differ on all dimensions that also exist in the real world with a high contextual interference (Van Merriënboer & Kester, 2005, p. 80).

Personal learning paths can play an important role in enhancing learning. And although it has shown to be difficult to implement personal learning paths in higher education due to the fact that (especially in undergraduate teaching) one has to deal with large groups, it should at least be possible to differentiate to a certain extend. When we look into the very interesting work in the field of learning patterns (Vermunt & Donche, 2017), we can conclude that a lot of progression is made the last 20 years, but still no agreement on how students learn (or learn best). Besides that, they come to a rather obvious conclusion that personal learning paths change over lifetime. A more helpful approach could be the use of a taxonomy of teaching approaches and/or didactical patterns. Especially the work of German researcher Karl-Heinz Flechsig who started a catalogue of instructional models is very helpful (Flechsig, 1996). If we can develop paths that lead to a learning goal and combine different blended learning activities that suite the occasion it would mean a great progress in many curricula. It must be possible to select at least

'three different' paths in each learning situation to show students 'their way to Rome'. Flechsig differentiates 20 different models, examples are activity method, case method, and teacher directed learning, programmed instruction, educational dialogue.

An example of blending the instructional model 'debate' with technology and create a 'Twitter debate' is shown in Fig. 1. This instructional model creates two groups of students (preferably both on a different end of the discussion) who debate a certain complex problem in their field of study. Normally in a classroom one could debate is for the length of the course or the instruction. In an online debate with Twitter, one could do it for as long as necessary and also 24 hours a day.

Group A could use the tools as shown in Fig. 1. The students could prepare themselves for the debate in their schools ELO. Using a mind-mapping tool, they could show relations in definitions and wording. By using the Twitter tool on their phone, opinions can be exchanged. Finally, at the end of the debate, they use a tool to evaluate (or vote) which of the two groups has the

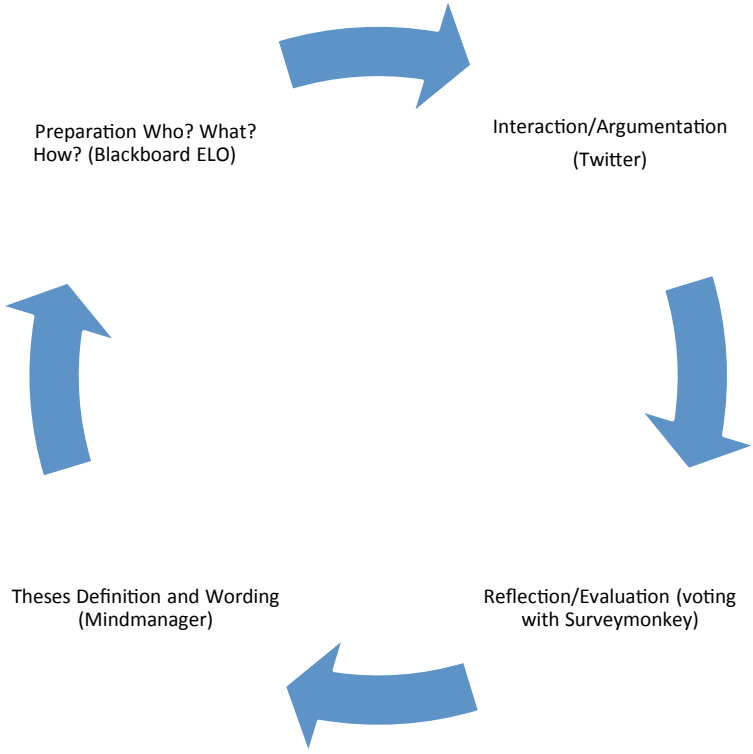


Fig. 1. Blending the Instructional Model Debate with Technology.

best arguments. The huge benefit would be that this blended approach reaches further than only formal teaching time.

To conclude, a path of learning tasks can make learning more personal. Include fixed courses (with fixed start date) at the beginning of the academic year with variable courses (start at any given time).

3. Smart use of technology

We have to acknowledge that technology is available. Our current and definitely our prospective students are accustomed to having technology available 24/7. This makes the necessity for an adequate digital proficiency of students essential. We believe universities have a responsibility in this because technology will be part of modern workplaces. Using technology creates ample new opportunities for new educational approaches, for both large groups of students, small groups, but also to support individual studying. One big advantage is that technology makes flexibility possible. Other advantages are easing the process of cooperation and collaboration, even at remote locations or students working together whilst not physically in the same room. Another example is that technology offers possibilities for experimentation and simulation.

4. Learning is transfer focussed meaning that learning has to make sense to students

Especially in academic education, much content is still in a curriculum for historical reason. Many teachers teach in the same old way as they did many years ago. Two big questions nowadays are: Is the content still necessary to be part of the curriculum? and Should I educate this in the same old way I am used to? Information is available for students, so teachers could concentrate more on supporting students in evaluating and assessing the information, and in connecting the information to knowledge the students already have stored, thus building a better-connected and richer knowledge base. Knowledge that needs to be shared as part of the curriculum can be shared in many different ways.

In short, learning is a balance between old and new models/paradigms. Learning and teaching must be a good mix of proven (evidence based) approaches with new ideas although evidence may not always be available yet. Since technology is around us, 24/7, we have look for opportunities/possibilities to integrate this in our learning and teaching and we have to finds a pedagogy that makes technology effective. Furthermore, use of technology can make learning more motivational, for instance via gamification. Using technology can also be driven by communicational reasons or to just make the standard approach a little different.

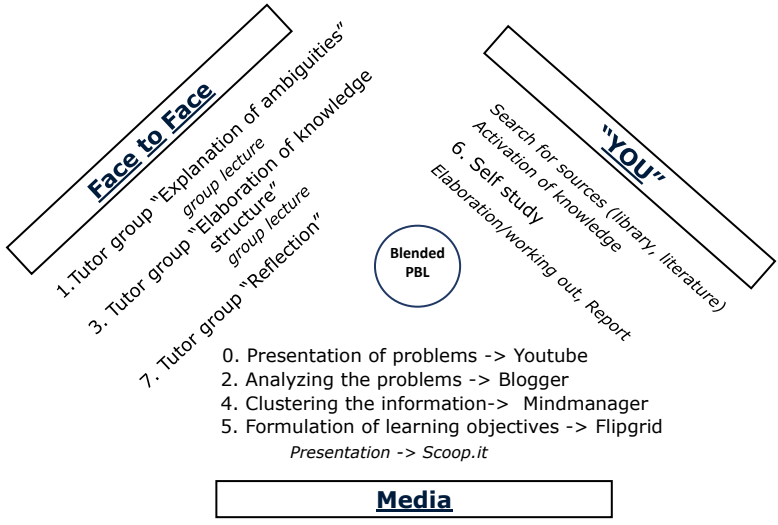
In the following example (Box 1), we have tried to integrate both university approaches into one model, where we believe the best of both worlds meets.

BOX 1. A PEDAGOGY WHERE THE BEST OF BOTH WORLDS MEET.

The original seven-step PBL model of UM is used as an example, although we are well aware that this seven-step model has undergone many alternations and adjustments already (Frambach, 2018). In this chapter, we call our approach blended PBL. In our opinion, the strengths of the four key principles for PBL, Constructive, Collaborative, Contextual, and Self-directed are integrated and even reinforced with the use of technology to create an enriching and meaningful pedagogy. Technology is not leading in this pedagogy; it merely supports, enriches and eases the learning process. And, using technology is to a large extent also the students' own choice.

In blended PBL, we define three actors: the student or 'YOU', the group or 'Face to Face' and 'Media'. All three actors have different responsibilities in different steps of the seven-step model. In the figure the cohesion between these actors during the seven step model is represented. It starts with step 0. Presenting the problem, in more traditional designs of the tutorial meetings, this is done at the beginning of the meeting. Using technology, the problem can be presented in many different ways to students, thus also saving time for the collaborative part of learning during the tutorial meeting. The tutorial meeting 'Face to Face' starts with clarifying unfamiliar terms that are part of the problem (step 1). After this, the student 'YOU' searches for sources by using various sources from literature, online and in the library, and digital platforms like Wikipedia. In this process, digital proficiency and learning how to judge the information found in the sources is a key to an effective learning process. During the phase of analysing the problem (step 2), students can use a variety of technology-based support 'Media', such as mind mapping and blogs. During colleges, 'Face to Face' additional knowledge can be shared with the students. Even in the colleges, technology can be used, for example voting tools such as Kahoot and Woodclap, which create more interaction in a large group setting. The student 'YOU' processes the knowledge and activates previously acquired knowledge. During this process, students can make use of digital support 'Media'; again, programmes for mind mapping and blogs are suitable examples. Brainstorming about or elaboration of the knowledge structure (step 3) is a group process 'Face to Face'. During this step, the problem will be

analysed in more depth and looked at from different perspectives and angles (step 4). When formulating learning goals (step 5) 'Media' comes in place again; for instance, a programme like Flipgrid can offer support and creating and interactive setting around learning goals. Finally, the student 'YOU' continues with self-study (step 6), resulting in reporting about is learning in the tutorial meeting 'Face to Face', where also reflection (step 7) is organised and facilitated.



In this section, just as a mind play, we have integrated the possibilities of two pedagogies of two different universities. This new pedagogy, introduced as blended PBL shows possible benefits how PBL can incorporate technology without compromising to the key principles of Constructive, Collaborative, Contextual, and Self-directed, but also shows that pedagogy must always be in lead. In our opinion, these mind plays are important to advance education to a next level. The next step would be to pilot the model and seriously evaluate the outcomes.

IMPLEMENTATION OF EDUCATIONAL INNOVATION: A SYSTEMATIC APPROACH

Adopting innovations is a challenging process in general. We believe this is even more the case if you aspire innovation of education in HEIs. After all, you have to deal with professionals that are active as teachers and believe

they are experts themselves in teaching and innovating teaching (e.g. Tagg, 2012; Wagner, 2001). However, the model presented by Rogers in Diffusion of Innovations (Rogers, 2003) offers guiding principles that will make the adoption of the innovation more acceptable. Rogers (2003) defines adoption as a decision of 'full use of an innovation as the best course of action available' (p. 177). For Rogers (2003), the innovation-decision process involves five steps: (1) knowledge, (2) persuasion, (3) decision, (4) implementation and (5) confirmation. These stages typically follow each other in a time-ordered manner. In the knowledge stage, individuals learn about the existence of an innovation and seek information about the innovation. According to Rogers, the questions form three types of knowledge: awareness-knowledge, how-to-knowledge and principles-knowledge. During the persuasion stage, the individual forms an opinion about the innovation at hand. One is more sensitively involved with the innovation in this stage. During a decision stage, one either rejects or adopts the innovation. During the implementation stage, an innovation is put into practice. In the confirmation stage, the innovation is at place, but one still looks for confirmation making the right choice.

Besides the five stages of adopting an innovation, Rogers also distinguishes five characteristics of innovation: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability and (5) observability. According to Rogers (2003), the rate of adoption of innovation can be estimated based on the perception of individuals regarding these characteristics. Relative advantage refers to the degree to which an innovation is perceived as being better than the idea or method it will replace. The compatibility attribute is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters (p. 15). The more an innovation is compatible with an individual's needs, the more uncertainty will decrease leading to an increase of the adoption of the innovation. A third attribute is complexity, which is as simple as how easy or difficult is the innovation to understand and use. Trialability refers to the opportunity for the individual to explore and experiment with the innovation. It also provides valuable insights to improve the innovation. It is important that the use of an innovation will be visible to others, referring to the fifth characteristic 'observability'.

Given these five characteristics that are all personal attributes, the question arises how these characteristics can be addressed in such a way it eases the process of adoption of the innovation. We believe Design Thinking can bring us additional insights and techniques to enhance a better adoption and implementation. Design thinking is about how people think, see the world and work together (a). One of the best-known value propositions of design

thinking is that it supports the creation of more value by including the needs of the user in the design of the innovation. One of the most powerful elements of design thinking is that it taps into the mostly unused right side of the brain, unlocking human capabilities. Design thinking can support in crossing bridges between people from different departments and on different levels because a design or a prototype 'speaks' to everybody because it visualises the product and/or makes this product tangible (to play around with). By creating a prototype (design), it forces individuals to become concrete in the thinking process and in the innovation. The design process itself is iterative, co-creative and user-centered. Moving from one iteration to the next is a journey through the problem-solution space. When people start prototyping, they see that they can attack a complex problem systematically. Generally, the design process is non-linear and iterative. It contains analytical and synthetic elements in both theoretical and practical settings (Owen, 1998). The main steps in this iterative process are finding, discovery, invention and making. Using these steps in a structured and coordinated manner, with a clear focus on and involvement of the user will increase the acceptance of the innovation.

Learning from design thinking, with its explicit focus on the user, we believe that user-centered innovation will positively affect all five attributes of innovation as mentioned by Rogers. Translating Design Thinking to the context of education, the focus is primarily on the student, then on the teaching staff and supporting staff. Inviting teachers and students to the design table of the innovation, increases the clarification of the advantages (characteristic 1). Teachers and students have a strong say in defining the necessary requirements of the innovation, with which they can also have a firm say in the complexity (characteristic 3). Working with prototypes and thus making the innovation visible and/or tangible, creates opportunity for compatibility (characteristic 2) and triability (characteristic 4). Working with design teams with an active role for teaching staff and students supports the observability (characteristic 5); individuals get inspired by others in the team and feel more safety to use the innovation because others do so too.

We believe that Design Thinking, if implemented in a systematic way, can contribute to the success of innovation in HEIs. Design Thinking is a way of thinking and working with a constant eye on the user, the technological possibilities and the economic viability. However, Design Thinking in not yet often applied in HEIs. Here lies a challenge for HEIs to approach their need for innovation as stressed in our introduction to apply Design Thinking. In the past years, we have adopted Design Thinking in various projects at our own universities; the innovations have been successfully implemented, created value for the user.

FINAL THOUGHTS

In this chapter, we have given some ideas to bring HE pedagogy further. In our field of Educational Technology and at our universities, we see a lot of good practices and examples.

We think that a pedagogy for HE in the future will involve many technologies. We also believe that only pedagogy can be leading.

In general, we also see many different approaches and experiments in the field of education. Successful attempts and maybe not so successful attempts. We think that the pedagogical approach of a university in the future has to become more standardised and more systematically implemented (if only alone for the high costs of technology). The work of Rogers, although around for many years now, can be a huge help. We also can profit from design thinking, which is one of the approaches to think systematically of the need of the users. Our future students have to work in a different world then today. Globalisation, insecurity, change and flexibility are keywords for them to deal with. It would be good if the university would create a first environment for them to get accustomed to that. An environment to experiment with it and to learn the competencies needed for their future jobs.

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AFTERWORD: CONSIDERATIONS ON PEDAGOGICAL APPROACHES IN EDUCATION AND DESIGN THINKING

Xun Ge

This book consists of seven chapters discussing educators' pursuit for innovative practices in higher education. These are just some examples of many 'best' educational practices. Various pedagogical methods or approaches, such as digital storytelling, design thinking, makerspace learning and problem-based learning, have been explored and implemented in higher education setting to improve learners' experience and performance. This collection of scholarly work indicates educators' aspiration for better solutions and tools to improve learners' educational experience in order to meet the challenges of the twenty-first century.

While exploring various innovative means of pedagogical approaches in education, we need to deliberate upon the following questions: Why do we need to seek innovative educational practice? What learning outcomes do we intend to achieve through innovative approaches in education? Clearly, twenty-first century presents new demands for workforce education and new challenges for the digital society. The twenty-first century skills, as identified by Partnership for 21st Century Skills (Partnership for 21st Century Skills, 2009) that consists of educators, business leaders, academic and governmental agencies, include not only core subject areas, but also learning and thinking skills, problem-solving skills, communication skills collaboration skills, information and communication technologies literacy. Chapter 2 deals with the issue on how to develop learners' information and technology literacy, which is one of the important twenty-first century skills. The twenty-first century skills are expected to be integrated into the teaching of the core academic subjects in this new digital age.

The contributors of the chapters are encouraged to further their research by carrying out design research and assessing learner outcomes

focussing on the twenty-first century skills resulting from the innovative pedagogical approaches. It is hoped that the assessment results will provide feedback to educators who implement innovative approaches in their instruction so that they can make revisions and improvement in the next iteration of the new innovation methods or models. Most importantly, the assessment results can provide administrators and educators with evidence demonstrating the impact of the innovation and convince them to support innovation effort in higher education at the institution level.

Implementing innovative pedagogical approaches is a cultural change in education to some extent. This change requires a totally different philosophical and epistemological perspective towards knowledge, learning and instruction. How learners view knowledge, learning and instruction determines the success of the implementation of innovative instruction and learners experience with the new pedagogy (Hofer & Pintrich, 1997; Mellat & Lavasani, 2011; Pintrich, 2002). In addition, how teachers and other stakeholders (e.g. administrators and parents) view knowledge, learning and instruction may also affect learners' perception of the innovative instructional approaches. In addition, it is important to consider how the stakeholders' perceptions can possibly bring changes towards the implementation of educational methods.

According to Baxter-Magolda (1987), the levels of epistemological reflection progress from *absolute knowing*, where knowledge is fixed and obtained from authorities, to *transitional knowing*, where knowledge is partially fixed and needs understanding through research, reasoning, and deliberation, to *independent knowing*, where knowledge is not fixed and requires independent thinking, and to the final stage, *contextual knowing*, where knowledge is contextualised. Many of the innovative instructional approaches, as discussed in various chapters of this book, require learners' understanding and ability to move from the stage of absolute knowing to the stage of contextual knowing. Likewise, innovation in education also requires educators to change their epistemological views and mindset in correspondence with the innovative learning environments. As a result, they will be able to motivate their students and engage them in the innovative learning environments. One of the effective approaches to influence learners' change of their epistemological belief is to situate learners in a culturally-rich real-world problem-solving environment, in which learners identify themselves with a professional community and perceive themselves as problem solvers who are committed to making contributions to the society and making this world a better place.

Some of the chapters addressed issues and challenges in technology-supported learning environments, such as how to deal with plagiarism. If their epistemological beliefs about learning and instruction are aligned

with the twenty-first century skills, learners will be motivated and engaged in their learning process in an innovative learning environment. They will become active and self-direct learners and take ownership and responsibility of their learning (Pintrich, 2002). Consequently, plagiarism can be minimised and would not be a major concern. In addition, developing learners with information and technology literacy (part of the twenty-first century skills) will help learners develop skills to use, synthesise and cite resources appropriately.

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CONCLUSION

Ellen Taricani

Throughout the book, you have experienced some creative pedagogy from around the world. The goal is to experiment and implement innovative techniques to assist in framing and developing global leaders. The cultures and cross-cultural functionality bring awareness of opportunities that can provide expansive value to the learner.

The chapters included in this book are certainly not the end of a great discussion, but rather the beginning of an evolving conversation that goes beyond innovation of pedagogical approaches, methods, models or practices, to the underlying epistemological views and the core values and purpose of innovation in education. This book has definitely provided a platform for that constructive conversation. It is essential that future research on innovative methods and approaches in higher education be grounded in learning theories, supported by empirical evidence, and generate useful data-based findings to inform educational practice. Research results on educational innovation practices are often confounding because it is often not clear what learning outcomes are assessed. Therefore, it is important that research specifies learning outcomes that are assessed, specifically focussing on twenty-first century skills and those that are predicted for future employees.

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Note: Page numbers followed by "*n*" indicate endnotes.