ICEduTech 2013

international conference on educational technologies

Kuala Lumpur, Malaysia 29 Nov - 1 Dec

Proceedings

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international association for development of the information society

INTERNATIONAL CONFERENCE
on
Educational Technologies 2013
(ICEduTech 2013)

PROCEEDINGS OF THE
INTERNATIONAL CONFERENCE
on
Educational Technologies 2013
(ICEduTech 2013)

KUALA LUMPUR, MALAYSIA

29 NOVEMBER - 1 DECEMBER, 2013

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FOREWORD

These proceedings contain the papers of the International Conference on Educational Technologies 2013 (ICEduTech 2013), which has been organised by the International Association for Development of the Information Society and co-organised by the Faculty of Computer Science & Information Technology, Universiti Putra Malaysia, Kuala Lumpur, Malaysia, 29 November - 1 December 2013.

ICEduTech is the scientific conference addressing the real topics as seen by teachers, students, parents and school leaders. Scientists, professionals and institutional leaders are invited to be informed by experts, sharpen the understanding what education needs and how to achieve it.

Topics for the ICEduTech Conference:

- Education in Context: Education in the Network Society, Educational Games, Social Media in Education, Home Schooling, Students' Rights, Parents' Rights, Teachers' Rights, Student-Safe Searching, School Violence, Education and Tolerance for Peace and Education in Developing Countries.
- Education as Professional Field: Teacher Education, Teachers' Professional Development, Teachers' Workload, Teacher Support for Grading, Time Tabling, Grading, Learning Tools, and Online Learning Software, Teachers' learning in Communities of Practice, Web-based Communities for Teacher Support, Teachers' Career Planning, Legal and Financial Issues, Conflict Resolution and Mediation, Governance and Servant Leadership and Educational Policies.
- Curricular Evolution: Problem-based Learning, Critical Thinking Skills, Creativity Skills, Learning Citizenship, Global Education, Media Literacy / Pedagogy, Multicultural Education and Alternative Assessment Methods.
- Learner Orientation: Student-Oriented Learning, Peer- and Collaborative Learning, Learning Strategies: Learn how to Learn, Motivating Students, Recognizing Students' Learning Styles and Special Education.
- Integrating Educational Technologies: Social Media and Social Networking, The Semantic Web 3.0, Podcasting for Broadcasting Video Lectures, Podcasting feedback to students, Wiki and blogs in Higher Education, Mobile, Virtual and Vicarious Learning and Simulations and Modeling.
- International Higher Education: Marketing Higher Education as a Business Case, Pitfalls and Solutions in Joint and Double Degree Programs, Enculturation and International Teacher Accreditation, Web-based, Mobile, Virtual Presence and Social Media to Overcome Student Mobility, Blended Learning and Student Assessment at a Distance, Student Mobility and Distance Education, New-Emerging Standards and Benchmarks for Higher Education, Education, Research, Exchange an Capacity Building, 21st Century Academic and Industrial Brain Exchange, Academic Salaries, Faculty Contracts, Residence Permits and Legal Issues, International Student Exchange Funding Programs: Erasmus Mundus,

the U.S. Council on International Educational Student Exchange, and the Euro-American "Atlantis" program, Networks for International Higher Education in the Pacific, Australia, Europe, Asian and European countries and Higher Education, Cultural Diversity, Tolerance and Political Conflict.

The International Conference on Educational Technologies 2013 (ICEduTech 2013) received 76 submissions from more than 22 countries. Each submission was reviewed in a double-blind review process by an average of four independent reviewers to ensure quality and maintain high standards. Out of the papers submitted, 13 got blind referee ratings that published them as full papers, which means that the acceptance rate was 17%. Some other submissions were published as short papers, reflection paper and poster/demonstration.

Best paper authors from the ICEduTech 2013 conference will be asked to extend their papers for possible inclusion in a special issue of IJICT - International Journal of Information and Communication Technology, indexed by Scopus and Compendex, among other indexes and in other selected publications.

In addition to the presentation of full papers, short papers, reflection paper and poster/demonstration, the conference also includes two keynote presentations from internationally distinguished researchers. We would therefore like to express our gratitude to Prof. Piet Kommers, University of Twente, The Netherlands and Assoc. Prof. Dr. Sakina Baharom, Director of Centre for Learning Innovation and Excellence (CLIEx), UNITAR International University, Malaysia.

A successful conference requires the effort of many individuals. We would like to thank the members of the Program Committee for their hard work in reviewing and selecting the papers that appear in this book. We are especially grateful to the authors who submitted their papers to this conference and to the presenters who provided the substance of the meeting. We wish to thank all members of our organizing committee.

Last but not least, we hope that participants enjoyed Kuala Lumpur and their time with colleagues from all over the world.

Piet Kommers, University of Twente, The Netherlands
Tomayess Issa, Curtin University, Perth, Australia
Conference Co-Chairs

Nurfadhlina Mohd Sharef, Universiti Putra Malaysia, Malaysia
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Kuala Lumpur, Malaysia
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KEYNOTE LECTURES

LEARNING IN THE NETWORKED SOCIETY

By Professor Piet Kommers
University of Twente, The Netherlands

Abstract

This keynote addresses the growing impact of societal factors like the notion of "Networked Society" in the further evolution of education. So far the role of technology in education has been marginal as it was limited to emulate and virtualize traditional face-to-face teacher/student interactions. Now when societal transformations become visible, it is inevitable that education shifts its accent from the transfer- into the development of new expertise for instance via problem-based learning. The method for making rather accurate extrapolations of current trends into to-morrow's practice is to re-interpret the recent educational transformations. As exemplar the potential impact of social media on education will be elaborated.

STUDENT-CENTRED LEARNING ENVIRONMENT FOR HE DIGITAL LEARNERS

By Assoc. Prof. Dr. Sakina Baharom,
Director of Centre for Learning Innovation and Excellence (CLIEx),
UNITAR International University, Malaysia

Abstract

There are claims made that the new generation of students entering higher education institutions (HEIs) is much more comfortable using ICT as part of their lives as compared to previous students. Terms such as 'millenials', 'digital natives', 'Google generation', 'net generation' and 'I-Generation' indicate that this new generation are familiar with anything digital and internet-related are using such tools widely. These terms provide the impression that higher education (HE) students are synonymous with technology and use technology ubiquitously in their lives. This presentation explores student-centred learning environment (SCLE) concept to address the needs of the current type of leaners we have amongst our HEI today. However, SCLE are usually personalized learning and could only happen in small classes. How can this be implemented HEI wide? The presentation discusses a HEI whole organization approach to implementing SCLE by using technology as a means to deliver the initiative.

Keynote Paper

LEARNING IN THE NETWORKED SOCIETY

Piet Kommers
University of Twente, The Netherlands

ABSTRACT

This keynote addresses the growing impact of societal factors like the notion of "Networked Society" in the further evolution of education. So far the role of technology in education has been marginal as it was limited to emulate and virtualize traditional face-to-face teacher/student interactions. Now when societal transformations become visible, it is inevitable that education shifts its accent from the transfer- into the development of new expertise for instance via problem-based learning. The method for making rather accurate extrapolations of current trends into to-morrow's practice is to re-interpret the recent educational transformations. As exemplar the potential impact of social media on education will be elaborated.

1. SOCIAL RELEVANCE IN EDUCATION

Western cultures have relied heavily on institutional bases the last two centuries. Sociology recently made us aware that corporate autonomies need to be questioned and revisited; Kaplan, 2005). The notion of the Network Society offers new opportunities but threats as well. Social Media have the recent reputation to make management models volatile en subject to rather quick evolutions nowadays. One of the reasons is that communication patterns change due to mediated communities like shown in marketing, education and health care; Eyrich, Padman & Sweetser, 2008). The other reason is that the new social media may help enterprises to conquer a positive presence and reputation by means of networking platforms like Yelp and Foursquare. This lecture provides you with the recent findings in social media effects and the way management can accommodate or even anticipate to it. The tools will be provided like network analysis and sociometric representations.

2. EDUCATION AND SHARED KNOWLEDGE

This lecture demonstrates the new options for social dynamics between learners. differently from the traditional method called "collaborative learning" where students are encouraged to learn together but still facing an individual assessment. The essential pivot for educational reform is not so much the didactic or instructional design; it is the question whether we allow learners to be sensitive to the agenda of those who already master the topic, or to become fundamentally open to one's personal cognitive needs at that very moment. In terms of "learning as an existential need" it is clear that learners have only a limited view on what is needed to accommodate future demands.

Teachers at least can extrapolate the disciplines built before. In this sense there is not necessarily a polarity between instructivism and constructivism; both need each other. However from a pedagogical perspective it is vital that the learner is seen as a person with a growing awareness on the final goals in life, and should thus be taken seriously if it comes to the question: Who is the owner of the learning process? Beyond the paradigmatic issues this workshop opens the question we expect mobility and virtuality to land in real learning settings soon? Social media prompt youngsters need for "social presence" even when there is a lack of time and even if there is a need for convergence in terms of attention and mental focus. In recent projects we have observed how learners, teachers and parents struggled with the rather drastic reorientation that mobile learning may trigger; Learners were quite happy with "learning by heart". It allows them to keep their mind in a most versatile position; no fixations to the limited span of working memory. Learners typically choose dynamic situations with diverse modalities and information channels: TV, telephone, books and …. Food. An easy way to label such situations is that learners want to keep their mind in an "everyday-

life" condition. Instead of reducing cognitive overload by limiting social "noise", young learners tend to build upon routine mentality: watching many kind of social signs and keep free to express any kind of feelings as long as possible. For many of the teachers it was much more the issue how to keep learners tightened to the prescribed topic. Mobile phone were not seen as counterproductive to learning, as long as they were programmed to narrow the learners' attention and increase feedback for right/wrong answers. Parents were typically concerned on maximizing the "time on task"; as they observed their children often on the borderline of what they called "learning" versus "playing", it was their prime worry that the mobile phone would distract learners' attention to functional strands like MSN, twittering and Facebook. These tools were seen as "opposite" to learning, by the parents. In this lecture and workshop we will open the examples given by recent projects and try to derive the best rules of thumb on how to combine the alternative cognitive load theory and the more pragmatic tactics that teachers already have. The final goal is to formulate policy rules on how to make both teachers and students more creative in finding out how social media help various stages of learning best at various ages.

3. LEARNING AT THE SCALE OF ICT AND INTERNATIONAL ENDEAVOUR

This lecture challenges both your memory and your imagination, by asking who of you had estimated the web to become so vital? Interesting enough we also need to admit that as now information access is that immense; Which direction do we take in order to make learning even better and more efficient? Indeed, we hardly mention the long debates from the years '70 and '80 on student modelling, programmed instruction and mixed initiative dialogues. What are the key discussions at the moment?

1. Fortunately the essence of PBL (Problem-based Learning) is back on the agenda: Working, playing and learning at a distance. In order to mitigate sceptic feelings, we carefully mention "serious" gaming in order to avoid connotations of "playing".
2. Through openness for PBL we also meet an open mind for students' problem solving and creative design. Are authentic solutions by the student more welcome than the anticipated once by the teacher? Have we squeezed out the juice of improvisation by the teacher as we now have saturated curricula, tuned to the test to be expected?
3. TRIZ as materialized Altshuller's Theory of Inventive Problem Solving is being (re)discovered by Secondary- and Higher Education to make students aware of how to remove built-in contradictions
4. Teams for collaborative problem solving via synchronous media have been accepted recently when solutions by expert teams became even better when few novices became member of such team
5. Social media so far have helped to articulate awareness on relational networks among students. The question now is if and how social media can help teachers to learn from each other and build upon each other work and experience?
6. The question on if and how international student exchange is going to contribute to students' learning attitude? So far we see that universities start having international campuses, with only very tiny interactions between the international- and the local students. This is an unsatisfactory situation, as it prevents the real synergy among guests and the local population.

This keynote lecture will highlight the new plans for a teacher Master Degree on the integration of ICT in didactic contexts. UNESCO's IITE institute in Moscow is working out the plans for such an extra degree in the hope that it will stimulate school leaders and national authorities to reward extra efforts for innovation more vigorously.

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Full Papers

MEDIATING AUTHENTIC LEARNING: THE USE OF WIKI'S AND BLOGS IN AN UNDERGRADUATE CURRICULUM IN SOUTH AFRICA

Simone Titus
University of the Western Cape, South Africa

ABSTRACT

Over the past few years, the virtual landscape of South African higher education institutions has changed as a result of ubiquitous and ever-present technological initiatives that can potentially provide students with a flexible learning space. Within these learning spaces, Web 2.0 tools have transformed educators' pedagogical approaches to teaching and learning and its impact on students. To this end, emerging technologies tools such as wiki's and blogs provide a powerful opportunity to increase collaboration, and enhance student engagement. These educational technology tools has the potential to provide students who are located in resource poor institutions, the much needed digital literary skills required for the 21st century workplace. Hence, the pedagogical value of wiki's and blogs is worth further scrutiny. For the purpose of this study, a wiki task was designed to include the nine elements of authentic learning in order to improve collaboration and engagement. Alongside this, students used a blog as a reflective tool in order to document their experiences using emerging technologies in the classroom. Reflective practices in education have in many ways shown to have value and therefore blog posts were used to allow students to reflect on their learning experiences as well as a discussion forum within a blended learning environment. Therefore the aim of this exploratory study was to investigate how emerging technologies mediate authentic learning in sport science education. Participants for this study were conveniently selected from a group of students (N=88) in their second year of study towards a sport science degree which is located within a health sciences discipline. This paper drew on the students' reflective experiences after an authentic wiki-based task where a total of 67 reflective blog post summaries were analysed using a qualitative methodological approach. A thematic content analysis was conducted on the written blog reflections using the nine elements of authentic learning as an analytical framework. This paper proposes that educators be mindful of authentic learning principles when designing learning activities aimed at increasing collaboration and engagement. This paper concludes that educational technology tools transformed students' learning experiences and mediated learning, engagement and collaboration in a meaningful way.

1. INTRODUCTION

Universities in South Africa recruit students from diverse cultural and historical backgrounds (Strydom et al, 2010a; Scott et al, 2007) whose academic needs are fulfilled through the provision of mostly didactic lectures throughout the academic year. However, despite students attending lectures, there still seems to be a problem with regard to student engagement with course content (Strydom et al, 2010b). A variety of reasons could account for this, including; lack of critical thinking abilities due to under preparedness from the schooling system as highlighted by Hardman and Ng'ambi (2003) or diversity within the classroom setting as highlighted by Strydom et al (2010b). Thus, if this problem continues to exist, then Universities will never adequately equip students with the attributes required to fully function in working society after they graduate. One way this problem may be addressed is through the use educational technologies as it allows for active participation, collaboration and engagement (Gachago et al, 2013; Beldarrain, 2006). This bodes well for sport science students as they require much more flexibility in their programme as many of them are still active/professional sport participants. In addition to this, the practical nature of various sport science curricula at various institutions, locally and globally, will lend itself well to flexible learning. However, designing authentic learning activities in sport science education may be difficult to conceptualize within the classroom.

Technological applications such as the use of Web 2.0, wikis and blogs have the potential to transform the learning experience of students worldwide (Hazari et al, 2009; Siemans & Tittenberger 2009). Web 2.0 tools such as a wiki is an online authoring tool that is developed collaboratively by a group / community of users and can be used by all to publish new content or edit existing content (Hutchison & Colwell, 2012; Jobling & Moni 2004). Blogs, also Web 2.0 tools, are web sharing information technologies that often function as an online journal, but may be used for knowledge sharing or reflection (Boulos et al, 2006). These tools have become popular because of their wide scope for interactivity (Williams & Jacobs 2004). It is therefore particularly appealing because of its provision of instant, any time and any place access to a dynamic and ever building digital repository of user-specified knowledge (Wheeler et al, 2008). As an emerging technology in South African education, blogs can be valuable reflective tools in which students share or provide information about their experiences. These tools aid student engagement in much the same way as authentic learning tasks facilitates student engagement and educational outcomes (Herrington 2006). Therefore, wiki's and blogs provide a valuable space for students to engage in reflective practices whilst learning is supported by emerging technologies. Reflective practices are therefore seen as a learning strategy whereby professionals become aware of their implicit knowledge base (Herrington et al, 2010; Schön 1983). These practices in education have value in their potential to develop self-confident learners because they provide an opportunity to mirror student experiences. Reflective practices also facilitate self-examination by allowing students to look back over what has happened in practice and consider their professional growth.

Wikis and blogs are effective in fostering student engagement which is one of the elements of authentic learning (Bozalek et al, 2013). However, there is a paucity of research of wikis and blogs in sports science education globally. With regard to engagement, South African studies have shown that student engagement has been identified as an important indicator of student success and is useful in understanding students' perspective of their learning experiences in higher education settings (Council for Higher Education, 2010). To this end, student engagement is defined as the 'time and energy students devote to educationally purposive activities and the extent institutions employ effective education practices to induce students to do the right thing' (Strydom et al, 2010c:10). By increasing student engagement, there is a likelihood of minimizing apathy in the classroom and thereby improving learning and academic performance (Aronson et al, 2012). Furthermore, engagement is an aspect of teaching, learning and discovery in a way that enhances learning through its focus on knowledge enterprise. Engagement is of utmost importance as it, amongst other things, enriches students' learning experiences, broadens academic thinking and improves student development (Fitzgerald et al, 2012). In addition Angelino and Natvig (2009) indicated that engagement may be one strategy that could be used to address retention in higher education institutions. Although strategies to improve retention, academic thinking, student development and student learning create a good learning environment, it does not guarantee success and throughput. Since student engagement is central to the success of students in higher education settings, an integrated pedagogical approach that offers students the opportunity to participate in activities that allow for collaborative engagement may create a space that is more conducive for the improvement of throughput rates. However, due to the dual facet of student engagement, little research has been done on student engagement in South Africa (Warwrzynski et al, 2012).

Authentic learning is a developing strategy used in a variety of higher education programs. The tasks of this type of learning reflect the kind of activities that people do in the real world (Herrington & Kervin 2007) and it requires a classroom context that is purposeful, motivational and practical (Jobling & Moni 2004). Nine elements have been offered as guidelines for authentic learning in education: 1) Provide an authentic context that reflects the way the knowledge will be used in real-life, 2) Provide authentic activities, 3) Provide access to expert performances and the modeling of processes, 4) Provide multiple roles and perspectives, 5) Support collaborative construction of knowledge, 6) Promote reflection, 7) Promote articulation, 8) Provide coaching and scaffolding and 9) Provide for authentic assessment of learning within the tasks (Herrington, Reeves & Oliver 2010). Given the current availability of technological and electronic media advances, these elements can be fused with student-centered technological approaches that are meaningful and conducive to the ways in which today's learners engage with life-world environments (Bozalek et al, 2013; Wankel & Blessinger, 2013; Herrington & Kervin, 2007).

It is therefore important to determine the pedagogical value of emerging technologies and the impact it has on student engagement though the completion of an authentically designed wiki-based task within the South African higher education context. This paper documents a qualitative exploratory educational exercise on the use of educational technologies, using the framework of authentic learning. Therefore, the aim of this paper is to report on the extent to which emerging technologies can mediate authentic learning is sport science education.

1.1 Methodology

This pedagogical exercise was evaluated using a qualitative methodological approach. Qualitative methods typically follow a path of aggregating the words or images into categories of information and presenting a diversity of ideas gathered during data collection (Creswell, 2009).

1.1.1 Authentic Task

An authentically designed wiki task was designed for a sport psychology module. Students were required to: 1) interview a peer, in their class, who was a student-athlete to determine the psychological tools their peer would use whilst participating in sport; 2) Find relevant literature to contextualize or support their findings based on their interview, 3) based on their findings, they had to develop or recommend an activity to enhance sporting performance. The student-athlete profile was constructed on a wiki using the open access Wikispaces platform. Whilst completing the wiki, three randomly assigned class members reviewed, and gave constructive feedback on one of their colleagues' wiki page. This was done for the purposes of improving each wiki page. After completion, each student's wiki page was anonymously peer reviewed by another class member. Alongside the wiki, a class blog was available for use as a forum for discussion. The discussion forum page was used to support the blended learning environment where class discussions about topics that were not completed in the classroom, was taken up on the blog discussion forum. This also allowed the researcher to ascertain whether there were areas students may require further learning. The other purpose of the blog was for students to post their reflective experiences of engaging with the educational technologies in the classroom. To this end, students were encouraged to contribute a five-hundred (500) word reflective summary about their experiences using educational technologies in the classroom for the first time.

1.1.2 Procedure

Participants for this study were conveniently selected. A sample of eighty-eight (88) students in their second year of study towards a sport science degree at a higher education institution in the Western Cape, South Africa was invited to participate. The university is considered a resource poor institution. An e-mail was sent to all students to request permission to use their five-hundred (500) word reflective summaries as part of this study. Students, who granted permission to use their reflective summaries, did so privately via e-mail or via a Google doc's information sheet. This ensured that correct data was collected and that the participants did not feel intimidated by the researcher asking in person. Sixty-seven (67) of the 88 students agreed to participate. With respect to ethical considerations, permission to conduct this research was obtained from the Senate Research Grants Committee and the Ethics Committee at the University of the Western Cape. All information was treated with the strictest confidentiality in so far as pseudonyms were used to protect the anonymity of the participants

1.1.3 Data Collection and Analysis

Data was extracted from the class blog, captured, coded and prepared for analysis using a thematic analysis. The text in this study was coded by placing words or phrases, which are related the nine elements of authentic learning, which was used as an analytical framework. Similar or related ideas were grouped together in thematic categories that represented authentic learning activity indicators. The thematic categories were then synthesized into a narrative summary that highlighted how the elements of authentic learning were manifested in the students' responses. This narrative summary aimed at reflecting the experiences of the participants regarding their use of emerging technologies in the classroom.

2. RESULTS AND DISCUSSION

This section represents the findings of the thematic content analysis. The discussion below starts with an outline of the results. Pseudonyms have been used to protect the identity of the research participants.

2.1 Results

Reflective summaries were extracted from the class blog which documented students' experiences of using wiki's and blogs to support learning in the classroom. Themes from the 67 reflective blog posts are summarized below:

2.1.1 Authentic Context

In order to create an authentic context within a sport psychology module offered to sport science students, a flexible learning environment utilizing wikis (Wikispaces) and blogs (Blogspot) was created. Both the physical and the virtual environment reflect the way in which knowledge is co-constructed and shared.

I enjoyed that we were given a topic that allowed us to be flexible and use plenty of content such as information, pictures, video content and links to other websites (Nicky)

It is a way to train us and get us ready for the outside world when we actually start working and nowadays everything is done on the internet, so all of this is quite helpful in a way (John)

The above quotes indicate that students were able to recognize the task was flexible, and that it had a real life connotation using a medium that they would in the workplace.

2.1.2 Authentic Activity

The activity had real life relevance since students had to interview real athletes (who happened to be classmates) in order to build a psychological profile, just as they would if they were in the real world. Information was systematically gathered across an 8 week period and integrated in the subject area

The wiki assignment… I felt the assignment had real life connotation and gave us an opportunity to improve on specific skills involving the psychological tools necessary to improve sporting performance (Jamie)

The time for the assignment was long enough I think we were given two months before the due date, so anytime I had a chance I had to write some few lines (Samantha)

The above indicates that the task was authentic enough because it depicted real life scenarios. Students also report that the length of time they were given to complete the task was over a sustained period of time.

2.1.3 Expert Performance

Access to experts in the field was challenging as sport psychology is not a recognized profession in South Africa. To this end, students were able to access global experts work online and view YouTube clips. Each student was required to share their story, and for this assignment, their peers became the experts. Therefore, three peers had to comment on each student's wiki and give input based on their understanding of the content. The researcher was available to facilitate this process.

Using Wikispaces, BlogSpot, and Edmodo was fun, and it made it easier for us students to communicate with each other and with the lecturer. .. These websites provided a platform for us to interact with each other and the lecture (Bronwynne)

My favourite thing about wikispaces itself was that we could view everyone's page. Reading about everyone in class, was very interesting and informative (James)

The above quote exemplifies that the sharing of stories in an online space provided an opportunity for students to access other 'professional' opinions. Furthermore, students enjoyed the ability to interact and communicate with peers as well as the educator.

2.1.4 Multiple Roles and Perspectives

There was a cross pollination of learning as students were exposed to other areas of sport science (such as sports injuries) as a result of the activity. Students were allowed to express their viewpoints with regard to the subject area which led to deeper investigation in this and other subject areas

Seeing the different views and opinions of different students and being able to challenge what each other says made it worth blogging (Amanda)

[It] Was also a very interactive assignment made it more interesting because for once we would get to use other people's views and perspectives that we would incorporate in our assignment, other than our own (Andrew)

One assignment I read over had a video which explained how rotator cuff operations (Cory)

Students valued the idea that they were able to not only express their own views, and view those of other classmates. They were also keen to blog about their views and challenge viewpoints of their peers. Furthermore, this task allowed students to engage with content they would use for another module in the following semester.

2.1.5 Collaborative Construction of Knowledge

In order to do this assignment, students had organized themselves in pairs in order to do the interview. In addition, three different students were randomly assigned to comment and give input into their peers' blogs. There were incentives for peer group assessments as extra grades were awarded for group input and constructive comments.

I actually came into contact with people in class that I normally wouldn't be in contact with (David)

It was very interesting to engage with a fellow classmate, working together on the information and actually applying everything that we have done in class so far to a real case (Bongani)

Through this assignment, students were able to collaborate with peers they would not normally communicate with inside or outside the classroom. They valued that they were able to learn from their peers.

2.1.6 Promote Reflection

Students were given an opportunity to use blog to reflect on their learning experience. Ease of access was granted as students could access both educational technology tools via their mobile devices. Free wireless internet access was also made available on campus.

It also gave us a chance to revise our work in an actual living environment, which makes our understanding of psychology so much better (Peter)

I think having the blog is a very good idea to get us all involved in various discussions and reflections about the subject and work (Linda)

The blog provided students with an opportunity to go through the discussion forums to revise work, but also reflect on their own learning.

2.1.7 Promote Articulation

The task required students to articulate what their classmate had shared with them. Therefore, the need for scientific writing was crucial as students had to blend formal and informal spaces, yet keep their writing style succinct and academic.

Having someone interview me and ask me about the way I prepared myself, actually got me thinking and helped me to gain knowledge about other ways in which I can prepare myself (Frank)

I really enjoyed writing about the person I interviewed and it was great learning more about the person's sporting background (Jane)

Students found that articulating their story to peers required some finesse, but within the articulation they were learning new ways of improving performance as an athlete by writing someone else's story.

2.1.8 Coaching and Scaffolding

Since students were given nine weeks to complete the assignment, assistance was available for the duration of the activity. Furthermore, more knowledgeable peers served as coaches in their collaborative groups as well as in the classroom.

Lecturer was also a star in helping us with what to do and made the instructions reasonably clear on what she wanted. We were always free to go ask her questions (Thandi)

One of my classmates started to show me some of the stuff it was really nice and fun to play with the wiki (Alan)

Students were satisfied that there was assistance to do this task by not only the educator, but also from their peers.

2.1.9 Authentic Assessment of Learning

Peer comments were permitted in order for students to refine their final product before it underwent an anonymous peer evaluation process. A peer evaluation component was built into the assignment. One peer who had no interaction on another peers wiki had to anonymously assess the wiki in its complete state using a rubric.

The peer assessment was also a good part of the assignment as it allowed me to see how other members of the class approached the task and it gave me the opportunity to compare it with mine (Gary)

The assignments give me an opportunity to reflect and comment on 3 students which were part of the assignment showing my own view (Lloyd)

Students reported the value of having peers comment on their wiki as it gave them an opportunity to refine it before finally submitting it.

2.2 Discussion

The purpose of this paper was to explore how educational technologies, such as wikis and blogs can be used as mediating tools to support authentic learning in sport science education

With regard to the *authentic context*; students reported that the flexibility of doing an assignment in online spaces was valuable and at the same time they were able to learn about other classmates, and not only the one that they had to interview. Results show that the students were of the opinion that the *[authentic] activity* had real-life relevance and that it could prepare them for the working world. Students felt that the time allocated for the assignment was long enough [eight weeks] and they could use a variety of resources to complete the task. In addition, students felt that they were able to link their task to other disciplines and broaden their knowledge, more specifically to sports injuries. Sport science students would enjoy this flexibility because the nature of sport science programmes includes practical aspects that require them to be outside of the traditional classroom (McMullen et al, 2013). Much of was reported is consistent with Herrington et al's (2010) elements of authentic learning . By affording students an opportunity to engage is a real-world activity allowed them to make learning more meaningful and relevant for what they would be required to do outside of the learning environment. It appears that by appropriately structuring an authentic task, students are able to decontextualize formal learning (Hannafin, 1991) by dividing the activity into manageable tasks across an 8 week period.

Students reported that they felt comfortable expressing their opinions and share their stories and interact with fellow classmates on the blog as well as the wiki. This could be attributed to the fact that the tools were only accessible to their classmates in a closed wiki. Although students did not have access to *expert opinions* directly, they were able to access other 'professional' wiki, you-tube videos posted by experts as well as the wiki provided to model what was required. Students were however allowed to share their wiki stories with the entire class through sharing; they became experts in and amongst themselves. Students also reported that they were able to express their opinions, share their stories and interact with fellow classmates through the technology tools. This further supported *expert performance* on the authentic learning continuum. In relation to *promoting reflection* students were permitted to choose anyone in their class they wished to interview. They had an opportunity to decide the format of their wiki within the conventions of the assignment task. Students appreciated the ease of access since both Wikispaces as well as the Blogspot tool was open access and easily available on their mobile devices and they had free wireless access on campus. Students were allowed to compare their work to those of their classmates and felt that they were allowed a space to discuss subject matters with peers. This also allowed them to enter and revisit the learning spaces as they deemed fit as highlighted by Williams and Jacobs (2004)

Students in this module appreciated the fact that they were able to express their views, but more so, they appreciated the fact that classmates could give feedback on wiki's that they were able to take into account when completing their task. Students were able to use learning resources for other disciplines such as sports injuries and this allowed the task to take on a dual or *multiple roles* in that it provided an opportunity to crisscross learning environments. In addition, the blending of formal and non-formal learning spaces also assisted with this particular element. With regard to *collaborative construction of knowledge,* students were of the opinion that the interaction on the blog and wiki provided a rich opportunity for students to learn from one another. Whilst students claimed to enjoy the interaction and engagement in some elements, they also reported in other areas of the authentic elements that they've learnt from one another. When students are allowed to work in groups, they are better able to *articulate* their [learning] progress throughout completing the authentic task (Herrington & Kervin 2007). Furthermore, the engagement this task allowed students is valuable since student engagement has been documented to be critical to success (Strydom, Mentz & Kuh 2010). This assignment hinged not only on the co-operation of their colleagues, but the collaboration on the ICT tools. For this reason students appreciated the support they received from the lecturer and peers

[*coaching and scaffolding*]. This showed that this task allowed for meaningful engagement in the sharing of knowledge across the classroom. To this end, the ICT tools used in this study provided an open space for meaningful engagement and interaction. This meant that the interaction on the blog and wiki provided a rich opportunity for students to learn from one another. This study demonstrated that through active engagement and interaction, students were able to learn from one another through meaningful collaboration and in doing so constructed knowledge by learning from one another in an open space. This further demonstrates that ICT tools are extremely valuable to support learning in an authentic context within a social-constructivist learning paradigm.

3. CONCLUSION

This study was limited to one of the twenty-four higher education institutions in South Africa. One main limitation of this study is that the perceptions of students from a conveniently selected sample were used and only positive experiences as expressed by student were discussed in this paper. Although only reporting on one case, findings from this contextual data shows how the use of education technology / learning tools transformed students' learning experiences and levels of engagement within the classroom. Thus, the outcome of this pedagogical exercise has offered new insights into our pedagogical approach to teaching sport science programmes and how these tools can mediate learning and foster engagement in the classroom. With regard to mediating authentic learning in sport science education, not many academics within this discipline use emerging technologies, or authentic learning. This goes a long way to inform our teaching and learning practices using emerging and educational technologies as mediating tools, in a way that enhances student engagement and facilitates collaborative construction of knowledge in a constructive manner. By affording students an opportunity to engage is a real-world activity allows them to make learning more meaningful and relevant for what they would be required to do outside of the learning environment as it transforms their learning experience in a more tangible way. With regard to wikis and blogs as mediating tools for authentic learning, when these tools are combined, they provide valuable support for the nine elements of authentic leaning.

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14

PROFESSIONAL LEARNING TO NURTURE ADAPTIVE TEACHERS

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ABSTRACT

This paper presents the findings of a study conducted in China to identify the potential benefits of incorporating robotics as an educational tool for 100 primary and 320 secondary school teachers of general technology. The Professional Learning Program was conducted from 2010-2013 in China. The major focus of the program was on the development within the teacher participants of knowledge, attitudes, habits-of-mind, skills and confidence necessary for the successful enactment of the curriculum reforms. It aimed to facilitate the development of *adaptive expertise* in using technology to facilitate innovative teaching and learning in Chinese classrooms. The study found that teachers made substantial progress towards the development of adaptive expertise as manifested not only by advances in the teachers' repertoires of pedagogical content knowledge but also in changes to their levels of confidence and identities as teachers. Although the study occurred in China, many of the issues with respect to professional learning by teachers are not unique to China. Thus many of the key issues identified in this study have wider implications for professional learning programs in other countries introducing student-oriented reforms in schools.

1. INTRODUCTION

In promoting a new culture of learning Thomas and Brown (2011) emphasised that teachers need to realise that 'to learn means to embrace what we don't know, come up with better questions about it, and continue asking questions in order to learn more, both incrementally and exponentially. This means that teachers are in fact giving less to students but expecting them to think more and construct their own knowledge'. This philosophy formed the basis for the design of a Professional Learning Program that was conducted with 420 Chinese teachers to successfully cultivate their skills to creatively solve problems, enhance creativity levels in students, and allow teachers to be comfortable in sharing this expertise with their peers. When teachers in China are given this opportunity for professional learning, they are introduced to new technologies and tools for teaching and learning that can subsequently support a significant change in teaching practices and facilitate a change in teacher mindset.

In July 2010, China announced the "National Plan for Medium and Long-term Education Reform and Development (2010-2020)" (PRC, 2010). The Plan calls for a thorough overhaul of the way education is delivered, examined and administered. It stated that the general education system would:

- be an integrated development where everyone can become a talent;
- combine learning and thinking;
- unify knowledge and practice;
- allow teachers to teach according to individuals' needs; and
- reform education quality evaluation and personnel evaluation systems focusing on performance including character, knowledge, ability and other factors.

In order to achieve a successful enactment of the curriculum reforms mentioned above, the major focus of the Professional Learning Program (PLP) was to develop and nurture within the teacher participants their knowledge, attitudes, habits-of-mind, skills and confidence to allow them to implement change within their own schools.

2. CONTEXT OF THE STUDY

Research increasingly has shown that the continued professional development of teachers is the key to improving the quality of education. Experience in many countries strongly indicates that many educational reforms rely on teacher learning and improved pedagogical practices in class to enhance student learning (Borko, 2004). Numerous studies and reports have recommended changes to teacher education to better prepare them to cope with 21st Century students (Kalantzsis & Cope, 2008). Due to recent New Curriculum reforms in China, in-service teachers urgently need to engage in an "effective" kind of professional learning, if the newly introduced educational reforms are to have an impact on student learning. Lawless and Pellegrino (2007) argue that introducing teachers to new technologies for teaching and learning can support a change in teaching practices. The Professional Learning Program (PLP) demonstrated not only how to use technology, but also showed the teacher participants how technologies can support instructional goals implicit in the current curriculum reforms. The PLP sets out to achieve a degree of change in teacher mindset and habits-of-mind. The activities involved the use of LEGO® educational toolsets. However, no previous familiarity with LEGO® robotics or terminology was assumed.

LEGO® educational toolsets were used because research studies have shown that robotics can have inter-disciplinary potential to enhance cognition in a range of ways. Research on the cognitive skills development associated with technology has established that use of robotics helps improve students' problem solving skills, critical thinking, collaboration and communication (Barker & Ansorge, 2007). Maud (2009) discovered through extensive use of robotics-based lessons that students were simultaneously developing knowledge in mathematics and science and being required to vocalise problems and solutions. Working with technology-based processes of design also encouraged peer-tutoring, self-reflection and self-directed learning.

The activities within the PLP encouraged a culture of knowledge-building, collaboration and teamwork. The activities pushed teachers 'out of their comfort zone' to facilitate their development as 'adaptive experts' actively engaged in hands-on activities focusing on the development of problem-solving skills. When teachers acquire adaptive expertise, they also possess both the expert knowledge that is necessary for high-quality performance and the ability to be flexible and inventive in the face of non-routine situations. They possess not only conceptual understandings, but also have procedural competencies, models of practice, and ways of monitoring their own development (University of Minnesota, 2010).

Teachers with adaptive expertise also exhibit the disposition of reciprocity; they are more able to move beyond their identities as science, technology, engineering or mathematics teachers and be buoyed by a sense of discovery and enjoyment at interacting with others who come from a different perspective (Hardy, Howes, Spendlove & Wake, 2008). These teachers also display a willingness to go outside of their own discipline area and engage in joint learning tasks with teachers from other disciplines, express uncertainties and ask questions, take a variety of roles in joint learning enterprises and take others' purposes and perspectives into account. This teacher attribute probably is a necessary condition for the successful implementation of trans-disciplinary 'intellectually messy' learning situations (Lantz, 2009).

2.1 Theoretical Framework for the PLP Design

The design of the PLP adopted the key principles as proposed by Desimone (2009). She contends that these principles are characteristics of professional development which play a critical part in increasing teacher knowledge and skills, in improving their practice, and, which hold promise for increasing student achievement. The principles included the following.

- *Content focus*: the most influential feature – the PLP focused on the GT syllabus for this project
- *Active learning*: opportunities for teachers to engage – throughout the PLP, GT teachers had ample opportunity to engage whereby they designed challenges, discussed, evaluated, reflected and shared their knowledge online.
- *Coherence*: the consistency of school, district and state reforms and policies with what is taught in the PLP – this project was sponsored by the Ministry of Education with industry support and policy messages to teachers were consistent throughout.

- *Duration*: PD activities require sufficient time and had to span over a semester – the PLP was conducted intensively over five days, followed by implementation in schools and follow-up workshops after twelve months.
- *Collective participation*: participation of teachers from the same school or department – in the PLP teachers were grouped according to provinces and engaged in multiple forms of interaction and discourse including extensive group work and online discussion forums.

In addition, four pedagogical approaches (Goldman, Eguchi & Sklar, 2004) were adopted. Firstly, the program was underpinned by the theory of constructivism where human learning is constructed. Learners build new knowledge upon the foundation of previous ones. No matter if they are correct or incorrect, despite having the same learning experience with somebody else, each learner constructs individual meanings. Secondly, the notion of Papert's (1980) constructionism – learning by doing -- was incorporated. The learner in a constructionist environment builds things on their own, preferably a tangible object that they can both touch and find meaningful. Thirdly, learning by design facilitated collaborative learning in teams whereby students engage to design activities and reflect on their experiences. Fourthly, cooperative inquiry, which involves -- contextual inquiry, participatory design and technology immersion – allowed for teacher exposure to LEGO® robotics which for many teachers in China was their first experience. The PLP placed heavy emphasis on pedagogy. It was not sufficient for teachers to merely engage in exciting activities, work with well-developed curricular materials, and interact with one another in constructive and positive ways. The PLP aimed to have teachers return to their classrooms with clear teaching methods and means to assess their students' learning processes.

2.2 The Three Phases of PLP Implementation

The three phases (Table 1) of implementation were:

Phase 1: Three and a half days face-to-face training: teachers participated in hands-on workshops focusing on inquiry and project-based learning using LEGO® robotics and the 4Cs approach – Connect, Construct, Contemplate, Continue - (the socio-constructivist 4Cs model which is the philosophy behind LEGO® Education tools). At the end of the PLP, each teacher was required to design at least three more lessons, which they will try out once they have returned to their own schools. These lesson plans together with teacher self-reflections and notes for improvement were uploaded online for sharing.

Phase 2: Twelve months of lesson implementation in schools and continual reflection: teachers implemented their ideas in their classrooms, using some of the strategies derived in Phase 1.

Phase 3: Two-day follow-up workshop focusing on reflection and sharing. Teachers reflected and shared their experiences, ideas, lesson plans and resources face-to-face and online. An electronic repository was set up to provide access to all lessons developed by the teachers.

Table 1. The three phases of the PLP

Phase	Name of Phase	Period	Activities	Focus
1	Initial Training	3.5 days	▪ Lectures/Presentations and Open Forums (Plenary Group of teachers) ▪ Workshop and Reflection Sessions (Four Workshop Groups split into teams of 3-4 teachers from same region) ▪ On-line Moodle® discourse	▪ Inquiry and project-based learning with LEGO® Education Toolsets (4Cs approach) ▪ Establishment of knowledge-building professional learning community
2	Implementation	1 School Year	▪ Application in schools ▪ On-line reflections and discourse	▪ Determining how inquiry and project-based learning can be implemented in Chinese schools.
3	Sharing/Reflection	2.5 days	▪ Presentations: ⊕ Seminars ⊕ Workshops	

The teachers were expected to think technologically (using LEGO® robotics across subject areas) to investigate, design, produce, evaluate and reflect on their design challenges. They engaged continuously in discussions both in class and online which focussed on the interplay between materials, systems and information in the tasks which they carried out in teams of four or five. By the third day teachers were required to design their own lessons within their teams. These lessons were then presented to the group and tried out in class. At the end of the professional learning program, each teacher was required to design at least three more lessons, which they would try out once they returned to their own schools.

3. FINDINGS

3.1 Impact on Teachers

The analysis of data revealed that during the implementation phase of the PLP, the teacher participants had consolidated and in most cases advanced to their levels of adaptive expertise as indicated below:

Pedagogical Content Knowledge: The analysis of data clearly indicated that the socio-constructivist 4Cs model (philosophy behind LEGO® Education tools) had become a central component of most of the teacher participants' pedagogical knowledge.

Habits-of-mind and Attitude: The analysis of data from the Reflection/Sharing Phase of the professional learning programs indicated that the teacher participants had adopted habits-of-mind and attitudes about teaching, learning and assessment consistent with the LEGO® 4Cs approach and those implicit in the National Plan (PRC, 2010).

3.2 Impact on Teaching Methods/Approaches

All of the teacher participants interviewed indicated that since their participation in Phase 1 of the PLP, they had made significant changes to their teaching methods & approaches when they returned to their own schools. These major changes were detected. Firstly, teachers introduced group work and group exploration for students. Secondly, teachers adopted problem-solving approaches based on the 4Cs' concept for their lessons. Thirdly, teachers increasingly adopted and adapted interactive teaching/learning strategies hitherto not frequently utilised in their classrooms such as open-ended focus questions, discussions about how and what had been learnt, and reflection on how the process and product could be improved and assessed.

3.3 Impact on Teacher Vision

During the interviews, most of the teacher participants from the PLP indicated that they felt that a major impact of the programs that had been reinforced during the one school year period of the implementation phase had been changes to their vision as a teacher. This vision tended to focus on the educational significance of the LEGO® 4Cs approach and the vision of a teacher being a nurturer of student creativity.

3.4 Impact on Other Teachers and Educational Administrators

The impact of the PLP on teachers was amplified by the 420 teacher participants in the professional learning programs engaging in the professional development of other teachers in their schools and/or teachers from other schools in their city/region. Thus, in many cases the application of LEGO® Education Toolkits often went beyond the subject areas of the teacher participants.

3.5 Impact on Students

Despite the constraints that the teachers had to work with in their local situation, the findings strongly indicated that the PLP had a flow-on effect to students in the classroom. The analysis of data indicated that the teacher participants felt that the introduction of the student-oriented LEGO® design challenges and the

implementation of the teaching/learning strategies they had acquired from their participation in the professional learning program into their schools had had the following six positive effects on their students:

- Arousal of interest;
- Recognition and utilisation of individual students' abilities;
- Increased innovative and divergent thinking;
- Increased risk-taking and perseverance;
- Enhanced teamwork and life skills; and
- More active learning.

The above effects were clearly evident in the responses from the perspective of teacher participants during interviews.

3.6 Issues and Problems

Two types of issues and problems faced the teacher participants during the implementation phases of each of the PLP. A minority of teacher participants indicated that they were still under pressure from parents and administrators to cover content while trying at the same time to implement socio-constructivist teaching/learning practices in their classrooms. However, pragmatic issues and problems such as:

- logistical problems – insufficient LEGO® Kits, no replacement parts
- class sizes; and
- administration shortcomings - procurement problems, timetabling, school policies, disparity

between affluent and less affluent remote schools were perceived by most of the teacher participants as being the major impediments to the successful implementation and further advancement of the teaching/learning reforms in their classrooms. The set of recommendations presented in the following section addresses most of these conceptual and pragmatic issues and problems.

4.   RECOMMENDATIONS AND FUTURE DIRECTIONS

Two sets of recommendations will now be presented. The first set of recommendations focuses on what needs to be done by the government authorities at the national level and what needs to be done at the local level by regional administrators, principals and subject coordinators to reinforce, extend and amplify the beneficial outcomes from the professional learning programs. The second set of points focuses on the design and implementation of future professional learning programs and possible future research.

4.1 Building upon Outcomes of the PLP

Many teacher participants in the PLP reported that the major impediments to the full and successful implementation of the socio-constructivist teaching and learning practices were due to pragmatic issues and problems. In order to address these pragmatic issues and problems, the following recommendations are made:

Recommendation 1: That teachers who have participated in the professional learning programs be strongly supported in their schools by the provision of school policy, procedures and timetabling that support the implementation of the reforms.

Recommendation 2: That schools empower their teachers to lead and drive change, and create opportunities for their students to learn in new ways to meet their individual needs. Classrooms should support new approaches to learning, not only through the use of LEGO® Education Toolkits but also through changes in the culture of the school. For these practices to be championed in schools, all stakeholders need to work together to progress the school reform agenda.

Recommendation 3: That all levels of administration (school, region, and central government authorities) ensure that each classroom is provided with ample number of LEGO® Education Toolkits to enable teachers to establish collaborative learning groups of 2-4 students within their LEGO® design challenge lessons.

Recommendation 4: That the government authorities enable schools to purchase at reasonable cost replacement parts for LEGO® Education Toolkits lost through wear-and-tear, breakages or theft. The process of procuring these replacement parts should be made easily available online and when immediately needed by the teachers.

Recommendation 5: That ongoing professional learning be provided. The completion by teachers of the professional learning programs should be accompanied by continued and renewed efforts to strengthen and reform how lessons are taught in schools in China and in particular how technology is integrated across the curriculum to achieve enhanced outcomes for student learning. Failure to provide follow-up on the professional learning programs is a false economy that will significantly minimise the sustainability of the curriculum and teaching/learning reforms ushered in by the professional learning programs.

Recommendation 6: That the authorities establish an online platform to encourage teachers to engage, collaborate and share their teaching and learning beyond school level (e.g., to local provincial level or national level) to ensure that ongoing/sustainable professional learning occurs.

4.2 Future Directions and Conclusions

A number of important implications for the design and implementation of future teacher professional learning programs in China has emerged during the course of the four professional learning programs in this project. The points to note for future programs are:

Point 1: Professional Learning Programs need to be carefully designed and customised for local conditions. This is to ensure that "cultural synergy" (Jin & Contazzi, 2001) occurs during the course of the professional learning programs. With cultural synergy, there is mutual effort from teachers and facilitators from different cultural backgrounds to learn about, understand and appreciate others' culture and their interpretations of learning and to learn reciprocally with and from others.

Point 2: Professional Learning Programs need strong conceptual and theoretical frameworks otherwise they are in danger of becoming a 'one-shot' fix and their outcomes and impact will not be sustainable in schools.

Point 3: Participant group size: the optimal group size for future professional learning programs should be set at maximum of 28 participants to allow for meaningful group work and group dynamics during discussions and reflection sessions. It is not about economy but quality of the professional learning. A particular strength of the PLP was getting all the teachers (from 32 provinces) to come to one venue in one city and engaging them in a highly focused PLP.

Point 4: Selection of teachers: teachers need to be fully informed about why they are attending and not simply sent by the school or at the direction of the authorities without any background knowledge. (Facilitators need to know the teaching backgrounds of teachers well in advance).

Point 5: Careful selection of participants by school principals of teachers with the attributes (status with teaching peers, experience, openness of mind, school "gate-keepers") necessary to not only understand and take on the reforms in lesson design and implementation presented in the professional learning programs but also to enthusiastically facilitate the adoption of these reforms by other teachers in their schools and regions.

Point 6: Senior administration needs to be involved and preferably participate in the professional learning programs. If this is not possible, half-day training sessions for senior school administrators on the theoretical underpinnings of the professional learning programs is recommended. Another necessary condition is for senior administrator "buy in" too.

Although the project occurred in China, many of the issues with respect to professional learning by teachers identified during the course of the PLP are not unique to China. Many other countries (e.g., other Asia-Pacific rim nations such as Singapore, Korea, Vietnam, Malaysia, and Japan) are currently engaged in reforms similar to those in China (Drori, 2000; Los Angeles Times, 2012; Tan & Gopinathan, 2000) in order to cope with the effects of globalisation. A review of the literature indicates that these countries are experiencing problems similar to those being experienced in China (see Coll & Taylor, 2008; Poisson, 2000). Thus, many of the key issues identified and reported in this project have implications for professional learning programs in other countries engaged in the process of introducing into their schools "student-oriented" reforms in science and technology education.

We hope that the set recommendations and point to note presented in this paper will provide strategies that can be implemented in future to improve the level of integration of LEGO® toolkits across curriculum areas in Chinese classrooms and perhaps in many other countries as well. These findings also lay the foundation for future research on PLPs conducted in similar settings.

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UNDERSTANDING TPACK IN PRACTICE: PRAXIS THROUGH TECHNOLOGICAL PEDAGOGICAL REASONING

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ABSTRACT

Reflective, intelligent, professional teachers research their own practice to inform future improvements. However, the demands upon teacher graduates and early career teachers do not enable the space and time to engage effectively in 'praxis' (Freire, 1970) which involves "highly developed educational practice that consciously articulates the theory on which it is based, and, in turn, generates new theory" (O'Toole & Beckett, 2013). Freire (1970) articulates the term 'limit situations' which can enable teacher voice to portray experience and reflection which might differ from those around them. This paper is situated within an understanding of the complexities of the contexts for graduate and early career teachers to develop Technological Pedagogical Content Knowledge (TPACK) (Mishra & Koehler, 2006) to have the confidence and capabilities to use technologies to support their teaching and to support student learning. This paper provides an Australian early career teacher's story through praxis by drawing upon the TPACK conceptualisation and recent attempts to explore teachers' Technological Pedagogical Reasoning (TPR) (Smart et al., 2013). The praxis is also considered in relation to the expectations of the *Australian Professional Standards for Teachers* (AITSL, 2011a), and the *ICT Elaborations* (AITSL, 2011b) which complement those standards. The authors suggest that this approach can significantly contribute to the TPACK literature to inform what TPACK looks like in practice through the experiences and reflections of teachers and explore the 'black box of technology integration' (Tondeur et al. 2013) through teacher perspectives.

KEYWORDS

TPACK, Classroom Practice, Professional Standards, ICT, eLearning

1. INTRODUCTION – TPACK RESEARCH, POLICY, AND PRACTICE

The authors have a passion for investigating how new and emerging technologies might be used to enhance learning and teaching. However, as teachers and researchers, we also agree with and adopt Mishra and Koehler's perspective that teaching with technologies is a 'wicked problem', whereby 'wicked problems' are characterised as being incomplete, contradictory, changing, and occurring in complex and unique social contexts. As Mishra and Koehler (2008) indicate, solutions are often unable to be 'right' or 'wrong', and involve engaging "expert knowledge to design solutions that honor the complexities of the situations and the contexts presented by learners and classrooms" (p. 2).

Both authors undertook pre-service teacher education programs which were designed to develop their professional knowledge and professional practice so that they had strong content knowledge and pedagogical knowledge. Throughout those pre-service programs we developed understandings of Shulman's theorising of pedagogical content knowledge (PCK) (Shulman, 1986; 1987) and his Model of Pedagogical Reasoning and Action (MRPA).

Throughout the various stages of our professional careers, we have also understood the importance of 'praxis' (Freire, 1970) which involves "highly developed educational practice that consciously articulates the theory on which it is based, and, in turn, generates new theory" (O'Toole & Beckett, 2013, p. 34). We believe that the emergence of Technological Pedagogical Content Knowledge (TPCK), now known as TPACK, (Koehler & Mishra, 2005; Mishra & Koehler, 2006; 2008) which builds upon Shulman's PCK might enable us to more adequately understand how technological knowledge (TK) might intersect with content knowledge (CK) and pedagogical knowledge (PK).

Therefore, this paper is situated within an understanding of the complexities of the contexts for teachers to develop TPACK capabilities to use technologies to support their teaching and to support student learning. This paper provides an Australian early career teacher's story through praxis by drawing upon the TPACK conceptualisation and recent attempts to explore teachers' Technological Pedagogical Reasoning (TPR) (Smart et al., 2013). The praxis is also considered in relation to the expectations of the *Australian Professional Standards for Teachers* (AITSL, 2011a) and the *ICT Elaborations* (AITSL, 2011b) which complement those standards. The authors suggest that this approach can significantly contribute to the TPACK literature to inform what TPACK looks like in practice through the experiences and reflections of teachers and explore the 'black box of technology integration' (Tondeur et al., 2013) through teacher perspectives.

From the summary of relevant literature relating to TPACK presented in the following section, there is an identification of emerging teacher stories which are now providing insights into what TPACK looks like in practice. The *Australian Professional Standards for Teachers* and the *ICT Elaborations* (AITSL, 2011b) are also discussed in the following section to illustrate that TPACK capabilities are inherent in these expectations for Graduate teachers. Subsequently, the research methodology is briefly outlined, and this is followed by the teacher's story of TPACK in practice and interpretations employing TPR are provided.

2. EMERGING TEACHER STORIES ABOUT TPACK IN PRACTICE AND THE AUSTRALIAN PROFESSIONAL STANDARDS FOR TEACHERS

The TPACK conceptualisation (Mishra & Koehler 2006; 2008) has been a catalyst for teacher education research in recent times. For example, Voogt et al. (2013) provides a review of TPACK literature through the examination of 55 peer-reviewed publications between 2005 and 2011. The review determined that there were different understandings of TPACK, and that teacher knowledge (TPACK) and teachers' beliefs about pedagogy and technology determined whether or not a teacher might teach with technology.

Since 2011, the quantity of published TPACK research has substantially increased, with more than 230 papers published in 2012-2013, as identified through a search of the Association for the Advancement of Computing in Education (AACE) EdITLib publications, using 'TPACK' as the search term. This provides evidence of an expanding body of TPACK research which is making a significant contribution to informing pre-service teacher education and the professional learning of practising teachers.

In Australia, the *Teaching Teachers for the Future (TTF) Project* was guided by the TPACK conceptualisation. The TTF Project involved all 39 Australian Higher Education ITE providers, with the lead agency being Education Services Australia (ESA) and partners being the Australian Council of Deans of Education (ACDE), the Australian Institute for Teaching and School Leadership (AITSL), and the Australian Council for Computers in Education (ACCE). Further details about the project are available elsewhere (AITSL, 2013 – see http://www.aitsl.edu.au/teachers/ttf/ttf-project.html) and a summary of the findings are provided elsewhere (see Finger et al., 2013). At the 3rd TTF National Support Network meeting attended by Punya Mishra and Matthew Koehler, they referred to the international TPACK initiatives and networks and Mishra indicated that the TTF Project 'dwarfed' anything occurring internationally.

The TTF Project research and evaluation included three major research and evaluation strategies; namely, (1) the development and administration of a *TTF TPACK Online Survey* (see Jamieson-Proctor et al., 2013), (2) the implementation of Most Significant Change (MSC) methodology, and (3) the facilitation of and opportunities for institution-initiated TTF research and evaluation projects. The findings from the *TTF TPACK Online survey* administered at the beginning of the project and toward the conclusion of the project showed measurable improvements in the confidence of pre-service teachers in using ICT, as future teachers, to support teaching and to support student learning (see Finger et al., 2013). In addition, Heck and Sweeney (2013) describe the MSC approach which involved collecting stories to establish the impact of the project. These MSC stories articulated change across three domains, namely, course development, ICT capacity of teacher educators, and the ICT capacity of pre-service teachers.

Among the TTF Project outcomes and deliverables was the development of AITSL's *ICT Elaborations for Graduate Teachers* (AITSL, 2011b) to complement the *Australian Professional Standards for Teachers* (AITSL, 2011a). It is important to note that, prior to the TTF Project and the development of the ICT Elaborations, it would be possible to read the Focus Area and the Descriptor of each standard and, in most instances, employ only PCK as ICT or technologies are not explicitly mentioned. A close examination of the standards, focus areas and descriptors revealed that ICT was stated in only 3 of the 26 Focus Areas as shown in Table 1 below.

Table 1. Identification of ICT referred to in the Australian Professional Standards for Teachers Focus Areas and Descriptors

STANDARD 2 Know the content and how to teach it		
FOCUS AREA		**DESCRIPTOR**
2.6	Information and Communication Technology (ICT)	Implement teaching strategies for using ICT to expand curriculum learning opportunities for students.
STANDARD 3 Plan for and implement effective teaching and learning		
FOCUS AREA		**DESCRIPTOR**
3.4	Select and use resources	Demonstrate knowledge of a range of resources, including ICT, that engage students in their learning.
STANDARD 4 Create and maintain supportive and safe learning environments		
FOCUS AREA		**DESCRIPTOR**
4.5	Use ICT safely, responsibly and ethically	Demonstrate an understanding of the relevant issues and the strategies available to support the safe, responsible and ethical use of ICT in learning and teaching.

These standards, which shape the teaching profession in Australia, do not refer to TPACK explicitly. Therefore, the TTF Project in assisting in the development of the *ICT Elaborations* (AITSL, 2011b) makes a significant contribution to making TPACK and TPR more explicit. To illustrate, Table 2 displays an example of the ICT elaborations developed for Professional Standard 3 – Plan for an implement effective teaching and learning – expected of Graduate Teachers. Made explicit in each of these elaborations is the intersection of technological knowledge (TK), content knowledge (CK) and pedagogical knowledge (PK), while the Focus Area and Descriptors themselves, with the exception of the Descriptor for Focus Area 3.4, do not explicitly refer to ICT whatsoever.

Table 2. ICT Elaborations for the Australian Professional Standards for Teachers - Standard 3 Plan for and implement effective teaching and learning
(see http://acce.edu.au/national-professional-standards-teachers-ict-elaborations-graduate-teachers)

STANDARD 3 Plan for and implement effective teaching and learning			
FOCUS AREA		**DESCRIPTOR**	**ICT ELABORATION**
3.1	Establish challenging learning goals	Set learning goals that provide achievable challenges for students of varying abilities and characteristics.	Demonstrate knowledge and understanding of how the use of digital resources and tools can support approaches to teaching that enable all students to pursue their individual curiosity, set their own educational goals, manage their own learning, choose the way they respond to tasks and challenges and assess their own progress.
3.2	Plan, structure and sequence learning programs	Plan lesson sequences using knowledge of student learning, content and effective teaching strategies.	Select and sequence digital resources and tools in ways that demonstrate knowledge and understanding of how these can support deep learning of the content of specific teaching areas and effective teaching strategies.
3.3	Use teaching strategies	Include a range of teaching strategies.	Demonstrate knowledge and understanding of how to support teaching strategies through the use of digital resources and tools in ways that facilitate accelerated and deep learning, promote creative and innovative thinking and inventiveness, engage students in exploring real world issues and solving authentic problems, promote student reflection and promote collaborative knowledge construction.
3.4	Select and use resources	Demonstrate knowledge of a range of resources, including ICT, that engage students in their learning.	Demonstrate knowledge of the use of digital resources and tools to support students in locating, analysing, evaluating and processing information when engaged in learning.
3.5	Use effective classroom communication	Demonstrate a range of verbal and non-verbal communication strategies to support student engagement.	Use a range of digital resources and tools to support effective communication of relevant information and ideas, taking into account individual students' learning needs and backgrounds, the learning context, and teaching area content.
3.6	Evaluate and improve teaching programs	Demonstrate broad knowledge of strategies that can be used to evaluate teaching programs to improve student learning.	Demonstrate the capacity to assess the impact of digital resources and tools on students' engagement and learning when adapting and modifying teaching programs.
3.7	Engage parents/carers in the educative process	Describe a broad range of strategies for involving parents/carers in the educative process.	Describe how digital resources and tools can support innovative ways of communicating and collaborating with parents/carers to engage them in their children's learning.

The important work of Shulman (1987) in theorising MPRA provides potential for deepening our examination and understandings of these professional standards and ICT elaborations. In encouraging praxis, we suggest that an implication from the TPACK literature is to research whether or not teachers adopt TPR. MPRA involves six processes to develop the knowledge base for teaching: Comprehension; Transformation; Instruction; Evaluation; Reflection; and New Comprehension. This model was further developed and confirmed by Wilson, Shulman and Richert (1987) through studying preservice teachers making the transition into classrooms. More recently, Smart et al. (2013), in an award winning *Society for Information Technology and Teacher Education (SITE) Conference 2013* paper, through examining the use of digital portfolios of four experienced teachers, propose that teachers might develop TPR throughout their career. Smart et al. (2013) suggest that, as ICT did not exist when Shulman developed MRPA, further research involving TPR and TPACK through teacher voice and stories should be undertaken. For example, should MRPA with technology be replaced with a Model of Technological Pedagogical Reasoning and Action (MTPRA), as they develop and demonstrate TPACK rather than PCK?

3. RESEARCH DESIGN AND METHODOLOGY: AN EARLY CAREER TEACHER'S STORY

As O'Toole and Beckett (2013) indicate, "Good teachers…are automatically researchers. They are researchers in the sense of being those who examine what they do in order…to improve teaching practice" (p. 34). However, they warn that, while it is a short step to formalise praxis, most practitioners don't think of themselves as researchers. They suggest that graduate and early career teachers do not have time to engage in formal research. They are faced with numerous challenges and demands, and, more broadly, "the false dichotomy between 'practice' and 'research' that still influences our education systems and structures can discourage many of us from attempting to formalise praxis…" (p. 34). At the same time, as outlined in the review of the literature, the expanding TPACK research requires more teacher-focused research which provides insights into what TPACK looks like in practice.

The research design adopted an interpretivist approach which privileged the teacher's stories shared through planning documents, online and digital artefacts, and reflections on the teacher's journey as an early career teacher building TPACK confidence and capabilities. To assist in the interpretation of the professional journey, the expectations provided by the *Australian Professional Standards for Teachers* (AITSL, 2011a) and the *ICT Elaborations* (AITSL, 2011b) were drawn upon while using the TPACK conceptualisation. In addition, implications related to TPR (Smart et al., 2013) are suggested.

The authors acknowledge that, as no research is values-free and neutral, there might be other possible interpretations. By disclosing their disposition being driven by a passion for investigating technologies for enhancing teaching and learning, the authors identify their position in relation to the research and explicitly engage with deep thinking and reflection to examine what Tondeur et al. (2013) describes as the 'black box of technology integration'. For Tondeur et al., this means that we need to "look at what's actually going on in the classroom, to collect more in-depth information on why teachers integrate technology in education and to describe the interrelated aspects contributing to their practices" (p.435).

4. AN EARLY CAREER TEACHER'S STORY OF TPACK IN PRACTICE

4.1 Portrait of the Teacher

The teacher, for the purposes of this paper, is referred to as Mark (not his real name), is a male teacher, in his 5th year of teaching, and can be considered to be in his earlier years as a teacher. This is his 1st year in the current school, located in Queensland, Australia, and he is teaching Year 4 students.

He graduated from a four year preservice teacher education Bachelor of Education (Primary) program, achieving a very high Grade Point Average and receiving awards for academic excellence based upon that Grade Point Average. His very strong academic achievements at University were consistent with his very high achievements in Secondary School, where he obtained an Overall Performance (OP) Score of 2. When

he completed Year 12 in 2004, there were 27 235 OP-eligible students consisting of 15049 female students and 12186 male students. The cumulative percentage of students achieving an OP 1 (N= 636) and an OP 2 (N=726) represented the top 5% of Year 12 students (Source: Queensland Studies Authority, 2007). He has always had a passion for learning as a student, with a 'love' of Mathematics and was the Dux of Mathematics B, Information Technology Systems, and Home Economics at the Independent Secondary School in which he studied.

Mark sees himself as an aspiring teaching professional who already understands TPACK and expresses a desire to add value to the students he teaches, add value to the school and education system in which he teaches, and to engage in productive, respectful relationships with parents/carers and the community to enact quality teaching. Mark believes that, while he is still an early career teacher, there are aspects of his demonstrated professional knowledge, professional practice and professional engagement which align with the expectations of a *Proficient Teacher* stage of development (see AITSL, 2012a). For example, Mark has identified that descriptors for the *Graduate* expectations (AITSL, 2011a) and the *ICT Elaborations* (AITSL, 2011b) which complement the *Graduate* Professional Standards (AITSL, 2011a), are constructed largely in terms of 'know and understand', and that he 'demonstrates' achievement of the seven Standards which is expected at the *Proficient* level.

He aspires to gain acknowledgement within his new school to develop evidence and contribute to the expectations expected of a *Highly Accomplished Teacher* (AITSL, 2012b), who "are recognised as highly effective, skilled classroom practitioners and routinely work independently and collaboratively to improve their own practice and the practice of colleagues" (AITSL, 2012b). At this stage, he believes that he needs more time to gain acceptance and acknowledgement of his professional knowledge and practice, as well as needing more time to gain credibility with peers and adjust to the new educational context in which he is located.

4.2 Portrait of the School and the Classroom

The school in which the teacher is located is a primary P-7 school in Queensland in Australia. It is a relatively new school, in only its third year of operation, having opened in January 2011. Its architecture is attractive and modern, and its website outlines that classrooms are digitally rich learning environments that act as a portal to the world. Furthermore, the school conveys a vision that students will be able to utilise digital devices in all classrooms. Each classroom is equipped with Interactive Whiteboards and data projectors, wireless connectivity, and students will use iPads and laptop computers and have access to digital cameras.

Thus, the classroom is situated within a modern school with a vision for technological innovation. Students can opt to be in a Bring Your Own Device (BYOD) classroom, with students in Years 1to 3 having access to iPads, while students in Years 4-7 have access to MacBooks. Students who opt to be in a more traditional classroom have access to school provided iPads and MacBooks. This addresses equity considerations, while also enabling access to digital devices for learning and teaching. All students in this class need Internet access at home to be able to engage with the online materials at home.

The focus classroom of this paper is a Year 4 BYOD classroom and it is well equipped with those digital technologies evident. Students each have their own laptop – MacBooks - for use at school and at home, have wireless connectivity, and their parents are encouraged to connect online. The school uses the infrastructure platform and learning management system provided by the education system.

4.3 TPACK in Practice

4.3.1 iLearn@eLearn

The following provides insights into the design, planning, implementation, and ongoing reflection undertaken by Mark resulting in the iLearn@eLearn approach. He is very inclusive in his use of technologies to connect parents/carers and students. In a recent presentation to parents, Mark outlined his iLearn@eLearn information. He discussed with parents/carers responses to the following questions - What is 21st Century Learning? How does this look in this class?

Mark explained to parents/carers that blended learning is adopted as it combines pedagogical best practice, with a focus on the purposeful and deliberate use of digital technologies. His justification for a blended learning approach is that digital technologies enable:

- Learning opportunities that could not exist without the technology;
- 24/7 learning that allows students to access important learning information anywhere, anytime;
- Explicit teaching experiences that use a variety of resources including MacBooks, interactive whiteboard, hands on materials, pencil and paper workbooks and teacher support;
- A Virtual Classroom that students can use to access learning information online; and
- iLearn@eLearn is the centre of what we do in this class.

Subsequently, Mark reflected upon the iLearn@eLearn journey so far in terms of 3 phases; namely,

Phase 1 achievements:
- Establish skills for working on MacBooks
- Digital Citizenship
- Accessing learning materials online (TaskCentre, Homework)

Phase 2 initiatives now underway:
- Online Journals
- myGrades

Phase 3 future directions:
- To be designed through reflection and feedback to inform improvements
- To be designed through exploring new technologies and functionalities

In relation to TPACK, Mark believes that he designs and implements a seamless approach using technology for all curriculum learning areas, and incorporates a range of best practice blended learning pedagogical approaches.

4.3.2 Digital Expectations

As shown in Figure 1, clear expectations about the use of digital devices are communicated to and shared with students and their parents/carers. Mark explicitly plans for the digital devices to be pervasively used in all learning areas. Students are expected to care for their MacBooks and to have a sense of personal, self-directed agency in using them for learning through engaging online.
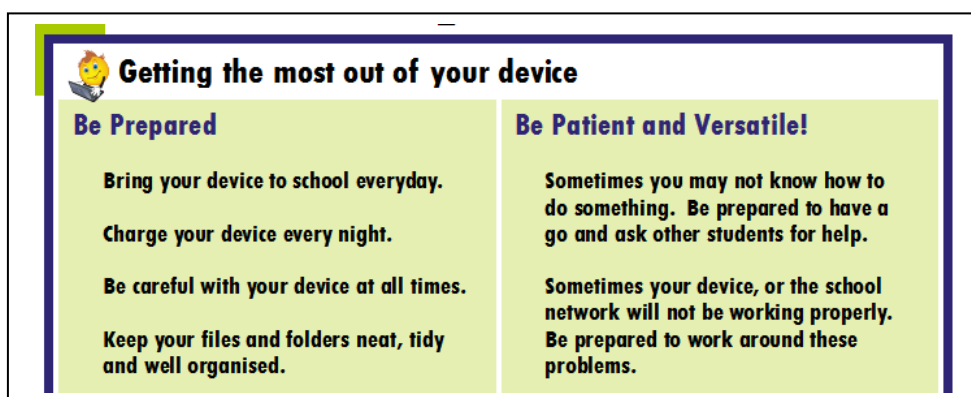
Figure 1. Digital Expectations – Screen shot of information for students and their parents/carers

In this class, homework has become redefined through an approach which uses the digital technologies and the learning management system to enable students and their parents to strengthen the home-school nexus. Mark's approach to this aligns with the concept of a networked school community (Lee & Finger, 2010). The device for achieving this is Marks' well designed 'Virtual Classroom' developed using the BlackBoard Learning Management System. Mark explains that students can access materials online by clicking on the Homework link. Each week, his students complete their homework online, including their writing tasks, spelling activities, Mathematics ongoing practice task, Mathletics, and Literacy Planet activities. Parents/carers have access to this online environment, so that communication and connection is seamlessly connected.

4.3.3 iLearn@eLearn Design Feature Examples – TaskCentre, Assessment, myJournals, and myGrades

The design features include a menu which is easily understood and accessed by students and their parents/carers. For example, the TaskCentre houses all of the planned learning experiences for the week. Students use the TaskCentre to work through activities for the day, see the WALT and WILF statements for each lesson, and to access important online learning materials. The TaskCentre screenshot example, shown in Figure 2, includes links to a range of instructional resources, including video clips, activities and supporting resources.

The Assessment section contains all of the assessment tasks students will undertake throughout the semester, and include the Task Description, the Guide to Making Teacher Judgements, and the Due Date. myJournals enables students to access online journals which are the primary method for students to submit work online, as well as edit and complete work either at home or in school. Mark has designed the following key features of the journals:

- Journals are private, which means students only monitor their own work and assessment feedback;
- Journals can be created using features similar to Microsoft Word;
- Students can copy and paste text and tables from Microsoft Word directly in a Journal to submit work;
- Students can review their online journals or make corrections to respond to feedback; and
- Teachers can efficiently mark journal entries and provide feedback to students online.
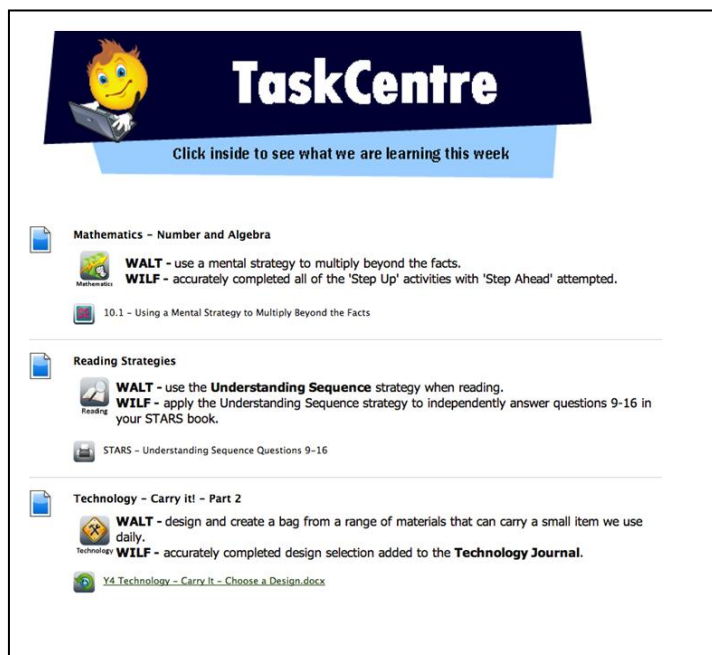
Figure 2. TaskCentre Example Screen Shot

Using myGrades, students can access feedback and ongoing academic results and Mark has designed the following key features and purposes of myGrades, with an example screenshot displayed in Figure 3:

- Student privacy is protected with Grades and comments being accessed only by the student;
- Student privacy also promotes an ipsative assessment model;
- Students can clearly see results for all assessment tasks including comments for both assessment *for* learning (formative) and assessment *of* learning (summative) purposes; and
- The Description button allows students to see what the assessment task involves.
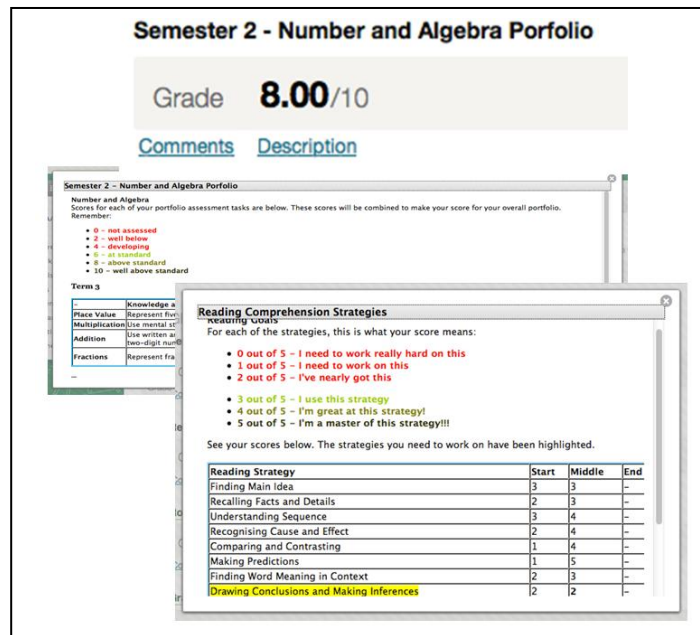
Figure 3. myGrades Example Screen Shot

Mark is excited by his design and use of myGrades, and reports positive parent appreciation of his efforts and effective communication to parents/carers and students using myGrades. Mark relates that positive outcomes have been that students consistently monitor and track their own results through myGrades, and students have a clear, transparent understanding of their level of achievement and have access to learning materials which enable them to move to the next level. This personalises their learning and guides them through their personalised learning journeys. In relation to student outcomes, Mark provided evidence to show that several students who have consistently achieved below standard prior to this year have responded positively to this environment and approach, and they are improving their results over time.

5. TPACK REFLECTIONS

5.1 TPACK and the Australian Professional Standards

Mark believes that, being a recent graduate, he has a contemporary understanding of the importance and the implications of technological innovation and the implications for teaching and learning. He believes that TPACK is becoming more widely understood throughout the profession, and some professional development about TPACK has taken place with staff at his school. Furthermore, he said that there is also now more widespread discourse in the profession about the *Australian Professional Standards for Teachers* (AITSL, 2011a). At his school, matrices which align with the *Australian Professional Standards for Teachers* are being developed for teachers to use when observing other teachers and as a basis to guide the provision of feedback.

When he undertook his pre-service teacher education, the program was designed to meet the requirements of the Queensland College of Teachers standards published in 2007, and have since been superseded by introduction of the national standards. Mark is developing an increased awareness of the change through identifying the similarities and the differences – for example, there were 10 QCT Standards, while AITSL provides 7 Standards. He was unaware of the *ICT Elaborations* (AITSL, 2011b) and, as he wasn't a student teacher during the TTF Project, he was unaware of this significant initial teacher education project. With his perception that there are generally low levels of awareness of TPACK, and of the *Australian Professional Standards for Teachers* and the *ICT Elaborations*, Mark questions whether or not many teachers, at this

stage, are engaging in praxis which is informed by these. He suspects that in examining the 'black box of technology integration', increasing awareness of TPACK, the *Australian Professional Standards for Teachers* and, in particular, and engaging in rich conversations about the *ICT Elaborations* can provide very useful conceptualisations for teachers to inform their praxis.

As discussed earlier, Mark believes that he has moved beyond the expectations of the Graduate level, as outlined in the *Australian Professional Standards for Teachers* (AITSL, 2011a) and the *ICT Elaborations* (2011b). Mark has deconstructed these and determined that they refer largely to 'demonstrate knowledge' or 'demonstrate understanding'. For example, in the Professional Standard 3 Focus Area – Engage parents/carers in the educative process - the ICT Elaboration states "Describe how digital resources and tools can support innovative ways of communicating and collaborating with parents/carers to engage them in their children's learning". Mark provides compelling evidence that he has moved well beyond 'describing' to designing, implementing, reviewing and improving communication and collaborating with parents/carers.

Similarly, using the ICT Elaboration for Professional Standard 3 Focus Area – select and use resources – the ICT Elaboration states that teachers are expected to "Demonstrate knowledge of the use of digital resources and tools to support students in locating, analysing, evaluating and processing information when engaged in learning". Mark's stories about iLearn@eLearn and the design features outlined in the previous section of this paper, are situated well beyond 'demonstrating knowledge' as he is designing and transacting through praxis and TPR how this is being enacted and can be improved. His students' use of MacBooks and the online Virtual Classroom for their learning in all curriculum learning areas reflects that he has courage to explore and engage with Mishra and Koehler's articulation of teaching with technology as a 'wicked problem' which requires "expert knowledge to design solutions that honor the complexities of the situations and the contexts presented by learners and classrooms" (p. 2).

5.2 Praxis and Mtpra

Shulman's Model of Pedagogical Reasoning and Action (MPRA) involves six processes to develop the knowledge base for teaching: Comprehension; Transformation; Instruction; Evaluation; Reflection; and New Comprehension. More recently, Smart et al. (2013) explored four teachers' digital portfolios to investigate if teachers now undertake TPR. Smart et al. (2013) found that there was evidence of Shulman's MPRA as the teachers' digital portfolio could be mapped to MPRA, and they provide a comprehensive mapping of teacher reasoning against the elements of MPRA. As the focus of the digital portfolios was on the teachers use of ICT for the requirements of achieving a *Smart Classrooms Professional Development Framework Digital Pedagogical Licence - Advanced*, Smart et al. pose the question - could this be termed TPR?

Consequently, from the early career teacher's story presented in this paper, the authors of this paper ask – should MPRA with technology be redefined as a Model of Technological Pedagogical Reasoning and Action (MTPRA)? Given the expanding TPACK literature base and its influence in informing teacher education and professional learning, it is worthwhile considering whether or not TPACK and MTPRA complement each other and add to the shift from PCK to TPACK, by suggesting a shift from MPRA to MTPRA.

The praxis emerging from the teacher's story presented in this paper can be considered in terms of MRPA through identification of the teacher's comprehension, transformation, instruction, evaluation, reflection and new comprehension. However, when discussing MPRA, Mark indicated that technology was now integral to his planning and implementation, and that TPACK was the conceptualisation which most appropriately reflected his use of technological knowledge, content knowledge, and pedagogical knowledge.

He illustrated with an interesting example of praxis and TPR in relation to the use of digital technologies and the virtual classroom in the pedagogy, assessment and feedback process with students and parents/carers. Both Mark and Julie (not her real name), the teacher in the next classroom, used a very similar assessment and feedback model. This process involved a process of assessing for diagnostic purposes, teaching and instruction, using ongoing assessment, providing feedback, and allowing students to target areas of concern and enacting learning improvements. Students then submit their summative assessment item, and feedback is again provided, giving students an opportunity to improve on areas of concern, and/or aim for a higher result based on the explicit feedback provided.

While Mark used technological affordances, Julie is in a traditional classroom. They compared their reflections after their classes had both completed a recent assessment item. Mark's students used the online journals, while Julie's students used a print resource to write their responses and findings. When comparing

the final submissions of students from both classes through moderation processes, it was evident that both sets of students demonstrated similar levels of knowledge and understanding. However, it was also evident through discussions, evaluation and reflection, that the use of the virtual classroom streamlined the feedback process and students found it considerably easier to go back and make adjustments to their responses. Students also found it considerably easier to access the feedback online. As this process was simplified for students through the virtual classroom, they were more likely to make these adjustments and make more effective adjustments, in comparison to students working from the traditional, print resource classroom. These findings are now being used to inform future actions. Julie is examining introducing the use of MacBooks and iPads, which she has access to, with the intent of developing a similar online model. This assists with constructive and effective alignment of curriculum intention, pedagogy, assessment and the use of technology, reflecting TPR.

Mark estimates that he engages as a professional well beyond the hours which would be reasonably expected of a teacher. Mark believes that this is due to his commitment as a professional, and is largely due to implementing an online approach which requires substantial work intensification beyond face-to-face teaching, through, for example, communications with parents/carers which, in a paper-based, more traditional form of schooling was not possible or expected. Mark has also found throughout his almost 5 years of teaching that he personally selects, develops, creates, and acquires resources, often at his own personal expense. He views his investment in both time and money as necessary ingredients in providing a best practice blended learning approach. He understands that teaching, prior to using the technologies we have today, it might have been sufficient to develop PCK and employ MPRA. However, he is excited by the environment and possibilities now available for teaching and learning, not possible in earlier times. Through the transaction which occurred in the conversations undertaken to gain his story, Mark believes that TPACK and MTPR makes sense to him through adding new dimensions of technological knowledge (TK) and TPR, as these help to frame his story.

6. CONCLUSION

This paper established that there is a significantly expanding TPACK literature base, and argued for research which acknowledges the importance of teacher stories to assist in our understanding of what TPACK looks like in practice. The Australian early career teacher's story presented in this paper provided interesting insights in the ways in which the teacher drew upon technological knowledge as being integral to his pedagogical approach to teaching and learning in all of the learning areas which his students undertake.

Relationships between TPACK, the *Australian Professional Standards for Teachers*, and the *ICT Elaborations* developed through the TTF Project were examined and discussed. By drawing upon the recent work by Smart et al. (2013), and reflecting upon the teacher stories presented, it was suggested that TPACK which builds upon Shulman's PCK, might be assisted by the conceptualisation of a Model of Technological Pedagogical Reasoning and Action (MPRA) to accommodate the importance and influence of the technological changes since Shulman theorised a Model of Pedagogical Reasoning and Action (MPRA).

To conclude, the authors encourage the reader to engage in praxis, to draw upon the TPACK conceptualisation and convey their stories of praxis, and their stories of challenges, solutions and initiatives to improve learning and teaching in the complex educational contexts in which they teach.

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A COMPARISON OF LOW PERFORMING STUDENTS' ACHIEVEMENTS IN FACTORING CUBIC POLYNOMIALS USING THREE DIFFERENT STRATEGIES

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ABSTRACT

In this study, repeated measures design was employed to compare low performing students' achievements in factoring cubic polynomials using three strategies. Twenty-five low-performing Grade 12 students from a secondary school in Limpopo province took part in the study. Data was collected using achievement test and was analysed using repeated measures analysis of variance. Findings indicated significant differences in students' mean scores due to the strategy used. On average, students achieved better scores with the synthetic division strategy than with long division and equating coefficients strategies. The study recommends that students should be offered opportunities to try out a variety of mathematical solution strategies rather than confine them to only strategies in their prescribed textbooks.

KEYWORDS

Cubic Polynomials, equating coefficients, long division, low performing students, Synthetic division

1. INTRODUCTION

Cubic polynomials are functions of the form $y = Ax^3 + Bx^2 + Cx + D$, where the highest exponent on the variable is three, A, B, C and D are known coefficients and $A \neq 0$. Factoring cubic polynomials helps to determine the zeros (solutions) of the function. However, the procedure can be more tedious and difficult for students of low-mathematical ability especially in cases where strategies such as grouping and/or factoring the greatest common factor (GCF) are inapplicable.

Questions that require students to factorise cubic functions are common in the South African Grade 12 (senior certificate) Mathematics Examination. Our experiences show that many students find it difficult to factor cubic polynomials. Discussions with mathematics teachers and analyses of examiners' reports confirm that many South African Grade 12 students have difficulties in factoring cubic polynomials. The problem could be as a result of the way teachers expose the students to mathematical idea. Due to limited mathematical knowledge, many teachers tend to stick to teaching only what is in the prescribed textbooks, rushing through topics to cover the syllabus and avoiding the topics that they are not competent to handle (Cai et al, 2005).

In many classrooms, mathematics teaching and learning is confined to strategies that are in the prescribed textbooks and students who do not understand the solution are regarded as beyond redemption (Elmore, 2002). Yet, the growing demand for scientists and engineers in South Africa demands renaissance of mathematics teaching (McCrocklin & Stern, 2006).

Research on best practices of teaching some important mathematical aspect can help improve students' achievement in mathematics. Naroth (2010) asserts that the role of the mathematics teacher is to create an environment in which students explore multiple strategies of solving mathematical problems. Such exposures will likely help the students understand how and why certain strategies work (Naroth, 2010). Donovan and Bransford (2005) report that this serves as a scaffold to help students move from their own conceptual understanding to more abstract approaches of doing mathematics which involve their own reasoning and strategy development. However, some teachers do argue that exposing students to multiple strategies and

heuristics will confuse the students (Naroth, 2010). The findings of this study could be drawn upon to assess such views.

A number of articles bemoan the poor achievement of South African students in matriculation examinations and international benchmark studies (for example, Howie, 2004; Mji & Makgato, 2006; Pourdavood et al, 2009). However, little is known about how teachers may address the plight of low-performing mathematics students.

This study seeks to compare low performing students' achievements in factoring cubic polynomials using three strategies and hopes to make a contribution towards addressing the plight of low-performing mathematics students in this mathematical aspect.

1.1 Strategies of Factoring Cubic Polynomials

The three strategies of factoring cubic polynomials students may use in cases where grouping and factoring the greatest common factor is inapplicable are equating coefficients, long division and synthetic division.

1.1.1 Equating Coefficients

Let us consider the function: $f(x) = x^3 - 6x^2 + 11x - 6$. To factorise this cubic function, we first find one factor by inspection. Now $(x+c)$ can only be a factor of $f(x)$ if c is a factor of the constant term $(- 6)$. Hence the only possible factors of $f(x)$ are: $x \pm 1$; $x \pm 2$; $x \pm 3$; $x \pm 6$. Let $f(x) = x^3 - 6x^2 + 11x - 6$. Then, by trial and error, $f(1) = 0$. Thus, by the factor theorem of algebra, $(x-1)$ is a factor of $f(x)$. The strategy of equating coefficients is then set out as follows:

$$
\begin{aligned}
x^3 - 6x^2 + 11x - 6 \quad &= \quad (x - 1)(Ax^2 + Bx + C) \\
&= \quad Ax^3 + Bx^2 + Cx - Ax^2 - Bx - C \\
\therefore x^3 - 6x^2 + 11x - 6 \quad &= \quad Ax^3 + (B - A)x^2 + (C - B)x - C
\end{aligned}
$$

Equating coefficients:

$A = 1$ ------ (i)
$B - A = - 6$ ------ (ii)
$C - B = 11$ ------ (iii)
From (i) and (ii) $B = - 5$
$C = 6$ (Equating constants)

$\therefore x^3 - 6x^2 + 11x - 6 = (x - 1)(x^2 - 5x + 6) = (x - 1)(x - 3)(x - 2)$

Students' success in using the strategy depends on their ability to simplify brackets and group like terms. Understanding the meaning of the term *coefficient* is equally important and the strategy also requires students to formulate and solve linear equations.

1.1.2 Long Division

Consider $f(x) = x^3 - 6x^2 + 11x - 6$. Then, $f(1) = 0$. Thus, by the factor theorem of algebra, $(x-1)$ is a factor of $f(x)$. Having identified one factor by inspection (as explained above), the long division procedure is then set out as shown below:

$$
\begin{array}{r}
x^2 - 5x + 6 \\
(x-1) \overline{\smash{\big)}\ x^3 - 6x^2 + 11x - 6} \\
\underline{-(x^3 - x^2)} \\
-5x^2 + 11x \\
\underline{-(-5x^2 + 5x)} \\
6x - 6 \\
\underline{-(6x - 6)} \\
0
\end{array}
$$

$$\therefore x^3 - 6x^2 + 11x - 6 = (x - 1)(x^2 - 5x + 6) = (x - 1)(x - 3)(x - 2)$$

Here, knowledge of laws of exponents, particularly those relating to multiplication and division is a prerequisite. Students should also be able to subtract directed numbers and work with brackets.

1.1.3 Synthetic Division

Let $f(x) = x^3 - 6x^2 + 11x - 6$, then $f(1) = 0$ which implies that $x = 1$ is a root of the cubic polynomial. The procedure for synthetic division is then set out as shown below:

$$
\begin{array}{c|cccc}
1 & 1 & -6 & 1 & -6 \\
  & \downarrow & 1 & -5 & 6 \\
\hline
  & 1 & -5 & 6 & 0 \\
  & a & b & c &
\end{array}
$$

$$\therefore x^3 - 6x^2 + 11x - 6 = (x-1)(x^2 - 5x + 6) = (x-1)(x-3)(x-2)$$

This strategy requires students to understand the synthetic division algorithm, which involves multiplying and adding integers repeatedly.

1.2 Objectives of the Study

This study sought to compare the three strategies of factoring cubic polynomials presented above. The objectives were to first test whether there are any significant differences in students' achievement scores as a result of the strategies used to factor cubic polynomials and secondly, to determine which strategies are better understood and preferred by low-performing students.

1.3 Theoretical Framework

This study was largely influenced by some aspects of Bruner's cognitive theory and Van de Walle's constructivist theory of mathematics education. According to Bruner (1960), any mathematical idea can be taught in a simple form for any student to understand as long it is adapted to the student's intellectual capacity and experience. Van de Walle (2004) asserts that all students can learn all the mathematics we want them to learn provided we offer them opportunities to do so. Based on these two learning perspectives, the researchers conceived that even low-performing Grade 12 students are capable of learning any mathematical aspect we want them to learn provided they are offered opportunities to explore different strategies of solving mathematics problems. As students solve mathematical problems using different strategies, they are likely to arrive at a strategy they understand better which they can easily employ to solve such problems in future.

2. RESEARCH DESIGN

In this study, the repeated measures research design (Shuttleworth, 2009) was employed. This research design uses the same participants for each treatment condition and involves each participant being tested under all levels of the independent variable (Shuttleworth, 2009). The researchers adopted the repeated-measuresresearch design because it allows statistical inference to be made with fewer participants and enables researchers to monitor the effect of each treatment upon participants easily. According to Minke (1997), the primary strengths of the repeated measures design are that it makes an experiment more efficient, maintains low variability and keeps the validity of the results higher with small number of participants.

2.1 Sample

A purposive sample of twenty-five low-performing Grade 12 students from a secondary school in the Capricorn District in Limpopo province took in the study. Low performing students are students that persistently scored below pass mark in mathematics examinations for three years before this study. The school and the students were used because they consented to participate in the study. According to Tabachnick and Fidell (2006), the minimum sample size for detecting treatment effect(s) in a repeated-measures design is 10 + the number of dependent variables (3 in this case). Hence, the recommended minimum sample size was satisfied.

2.2 Instruments

A cognitive test was used to collect data to measure students' achievement in factoring cubic polynomials. The test items were generated based on the concept and depth of knowledge specified in the National Curriculum Statement, Mathematics Grades 10-12 (Department of Education [DoE], 2008). The test was made up of essay type questions designed to allow the students show their understanding of the three strategies of factoring cubic polynomials. The appropriateness of the test items was evaluated by six mathematics teachers who had at least five years of mathematics teaching experience. After the evaluation process, the test was pilot-tested on a sample of ten students (from another school) in order to detect and correct any errors and ambiguities in the instrument before the main study was conducted. The final instrument was a ten-item instrument.

2.2.1 Reliability and Validity of the Instrument

The reliability of the achievement test was established by calculating Kuder-Richardson (KR 20) reliability estimate, using data from the pilot study. From the Kuder-Richardson 20 calculations, a reliability value of 0.71 was obtained meaning that the instrument was reliable (Gay et al, 2011).

   The test's content validity was established through expert judgement. The experts were one Mathematics subject advisor, one Head of Mathematics Department and four mathematics teachers who had experience in teaching Grade 12. They independently judged if the test items reflected the content domain of the study. Based on their judgements, the content validity ratio (CVR) of each item was calculated using $CVR_i = \frac{\left[n_e - \left(\frac{N}{2}\right)\right]}{\left(\frac{N}{2}\right)}$ where CVR_i is the content validity ratio for the ith item; n_e is the number of judges rating the item as reflected the content domain of the study and N is the total number of judges (Lawshe, 1975). The mean of the test items' CVR_i was computed in order to find the content validity index (CVI) of the test. A CVI value of +1.00 was obtained which implies that there was complete agreement among the judges that the test items reflected the content domain of the study (Wynd et al, 2003).

2.3 Procedures

After the students were exposed to the three strategies of factoring cubic polynomials, the test was administered to assess individual students' ability to use each of the three strategies. Students wrote the test three times, using a different strategy each time. The duration of the test was one hour and it was marked out of fifty.

2.4 Research Hypothesis

The research hypotheses were:
   $H_0: \bar{x}_1 = \bar{x}_2 = \bar{x}_3$ (There is no difference between the mean scores of the students using the three strategies. That is the mean scores of the students using the three strategies are equal)
   H_A: At least one mean $(\bar{x}_i)$ is different from the others.

3.   FINDINGS

Table 1 shows the descriptive statistics of the students' scores using each of the three strategies. The result shows that the mean percentage scores of the students for the three strategies were 54.32% for equating coefficients, 31.76% for long division and 67.68% for synthetic division. Although, these results seem to suggest that synthetic was better than the other two strategies, other statistical tests had to be conducted to determine if the differences in the mean scores were statistically significant. Hence, the repeated-measures ANOVA F-test was applied to the data.

Table 1. Descriptive statistics of the students' scores.

Student	Scores		
	Equating coefficients (Strategy 1)	Long division (Strategy 2)	Synthetic division (Strategy 3)
1	26	30	42
2	30	2	54
3	22	4	54
4	28	6	32
5	32	4	80
6	84	78	84
7	48	18	46
8	24	6	66
9	66	22	92
10	78	62	92
11	72	28	82
12	82	28	84
13	62	18	58
14	34	34	88
15	32	62	94
16	66	20	52
17	90	78	92
18	54	14	88
19	76	16	28
20	88	54	80
21	26	14	30
22	70	66	74
23	68	56	50
24	38	34	68
25	64	40	82
Mean ($\bar{x}$)	54.32	31.76	67.68
SD	23.03	23.91	21.41

A one-way repeated-measures analysis of variance was performed on the data to evaluate the study hypotheses.

3.1 Results of Repeated-Measures ANOVA

3.1.1 Sphericity

Sphericity is the condition where the variances of the differences between all combinations of the repeated-measures levels are equal. Violation of this assumption causes the repeated-measures ANOVA test to increase Type I error rate (Laerd, 2012). The SPSS computed significance value for the ANOVA test would be too low and thus we risk rejecting the null hypothesis when actually we should not.

Table 2. Mauchly's Test of Sphericity.

Mauchly's Test of Sphericity[a]							
Measure: MEASURE_1							
Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	**Sig.**	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Strategy	.959	.974	2	**.615***	.960	1.000	.500

Mauchly's Test of Sphericity indicates that the assumption of sphericity has not been violated ($\chi^2(2) = .974, p = .615$), which is non-significant. Hence, there is no need to adjust the degrees of freedom of the repeated-measures ANOVA F-Test and we report the results in the row labelled 'Sphericity Assumed' in Table 3.

3.1.2 ANOVA F-test

Table 3 shows the main results of the repeated-measures ANOVA F-test. The results in the row labelled 'Sphericity Assumed' indicate a statistically significant main effect of the independent variable (solution

strategy) on the dependent variable (students' test scores) (F (2, 48) = 32.066, p = .000). Therefore, the null hypothesis that the average scores for the three strategies are the same is rejected and we conclude that at least one mean ($\bar{x}_i$) is different.

Table 3. ANOVA F-test.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Strategy	Sphericity Assumed	16480.747	**2**	8240.373	**32.066**	**.000***
	Greenhouse-Geisser	16480.747	1.920	8581.923	32.066	.000
	Huynh-Feldt	16480.747	2.000	8240.373	32.066	.000
	Lower-bound	16480.747	1.000	16480.747	32.066	.000
Error (strategy)	Sphericity Assumed	12335.253	**48**	256.984		
	Greenhouse-Geisser	12335.253	46.090	267.636		
	Huynh-Feldt	12335.253	48.000	256.984		
	Lower-bound	12335.253	24.000	513.969		

Since a statistically significant result was found, the Bonferroni post hoc analysis was conducted to compare the mean scores for the three strategies in order to determine exactly where the differences lied.

Bonferroni post hoc analysis

The Bonferroni pair wise comparison table (Table 4) provides a comparison of the mean scores for all paired combinations of the levels of the repeated factor (solution strategy).

Table 4. Bonferroni pair wise comparisons.

Pair wise Comparisons

Measure: MEASURE_1

(I) Strategy	(J) Strategy	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	22.56	4.135	**.000***	11.917	33.203
	3	-13.36	4.933	**.037***	-26.054	-.666
2	1	-22.56	4.135	**.000***	-33.203	-11.917
	3	-35.92	4.500	**.000***	-47.500	-24.340
3	1	13.36	4.933	**.037***	.666	26.054
	2	35.92	4.500	**.000***	24.340	47.500

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

From the significance values of each pair wise comparison, we found:

The mean difference between the equating coefficients strategy ($\bar{x} = 54.32$, s. d $= 23.03$) and the long division strategy ($\bar{x} = 31.76$, s. d $= 23.91$) is statistically significant. The mean difference (22.56) had a probability (p = .000) which is less than alpha .05. The difference between the two means would be considered a substantial difference. Hence, the null hypothesis that these two means were equal was rejected and we therefore conclude that the students had better test scores on factoring cubic polynomials using the strategy of equating coefficients than using the long division strategy.

The mean difference (-13.36) between equating coefficients strategy ($\bar{x} = 54.32$, s. d $= 23.03$) and synthetic division strategy ($\bar{x} = 67.68$, s. d $= 21.41$) had a probability (p = .037) which is less than alpha (.05). This implies that the difference is also statistically significant. Therefore, the null hypothesis that these two means were equal was rejected and we conclude that the synthetic division strategy yielded better test results for the students than the strategy of equating coefficients.

The mean difference between the long division strategy ($\bar{x} = 31.76$, s. d $= 23.91$) and the synthetic division strategy ($\bar{x} = 67.68$, s. d $= 21.41$) had a probability (p = .000). This is less than alpha (.05), meaning that it is statistically significant. The difference (-35.92) would be considered a substantial difference. Hence, the null hypothesis that these two means were equal was rejected and we concluded that synthetic division had better test scores than long division.

Since the students' mean score using synthetic division strategy (67.68%) was better than their mean scores using long division (31.76%) and the of equating coefficients (54.32%) strategies, we concluded that the strategy of synthetic division made the low-performing students to achieve better test scores in factoring cubic polynomials.

3.1.3 Confidence Intervals of the Means

Table 5 shows the 95% confidence intervals of the mean percentage scores of each of the three strategies.

Table 5. Confidence intervals of the means.

	Estimates			
Measure: MEASURE_1				
Strategy	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	54.32	4.607	44.81	63.83
2	31.76	4.781	21.89	41.63
3	67.68	4.283	58.84	76.52

The result shows that if one takes repeated samples of low-performing Grade 12 students from the population and subject them to the same conditions, one would be 95% confident that their mean score would lie between 44.81 and 63.83 percent with the strategy of equating coefficients, 21.89 and 41.63 percent with long division strategy and between 58.84 and 76.52 percent with synthetic division strategy.

3.2 Discussion

Firstly, the study sought to test whether there were significant differences in low performing students' test scores due to using three different strategies to factor cubic polynomials. Secondly, the study sought to see which strategy was preferred and better understood by the participants. Results from repeated-measures ANOVA indicated that indeed there were statistically significant differences in students' scores due to the effect of using different strategies to factor cubic polynomials. Post hoc analysis showed that students scored better with synthetic division strategy than using long division and the strategy of equating coefficients. An important practical implication of the findings of the study is that it may take several attempts to see positive results in students' achievement but we should not give up. If one strategy does not work, we should try another. The findings also debunk the perception that exposing students to multiple solution strategies serves to confuse the students. Instead, making different solution strategies available to students could help many students to achieve better in mathematics. The findings are consistent with previous assertions by Bruner (1960), Van de Walle (2004), Donovan and Bransford (2005) and Naroth (2010).

3.3 Recommendations and Conclusion

The findings of this study point to the need for teachers to expose students to different strategies for solving not only cubic polynomials but also handling other mathematical aspects. The strategies for solving mathematical problems should not be limited to the strategies in the textbooks. This will enable teachers to offer students opportunities to explore techniques of dealing with mathematical problems and understand how and why certain strategies work (Naroth, 2010).

We also recommend that teachers be given opportunities to attend professional development workshops that are conducted by experts in the field to enable them learn and develop expertise on how to teach the problematic mathematical aspects such as factoring cubic polynomials.

A similar study with a large randomised sample of students could provide more definitive evidence to strengthen the findings of this study. Future research should extend this study to other mathematical aspects and Grades to see if similar results are obtainable. Such studies could contribute towards improving students' achievement and the quality of mathematics teaching in South African secondary schools.

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FACTORS INFLUENCING THE ACCEPTANCE OF COLLABORATION TECHNOLOGY WITHIN THE CONTEXT OF VIRTUAL TEAMWORK TRAINING

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ABSTRACT

The purpose of this study was to identify the factors that influence electronic collaboration technology acceptance and predicted usage for virtual team collaboration projects in higher education courses. The research combined the unified theory of acceptance and usage of technology (UTAUT) with a virtual team-training model. All 108 participants completed a survey following their participation in virtual team training. Ten hypotheses were tested using a structural equation modeling technique, partial least squares. Five of the hypotheses were supported and five were not supported. The results indicated that three of the four UTAUT constructs were significant in predicting if the participants would use the collaboration technology in the future. Additionally, the findings revealed that the participants had a positive perception of the virtual teamwork training.

1. INTRODUCTION

Due to advancements in technology and corporate globalization, virtual teams are redesigning the way organizations conduct business (Zofi, 2011). While there are a variety of other driving forces for the shift in the way business is done, technology advances such as instant messaging, voice over internet protocol (VoIP), cloud computing, and video conferencing are having a significant impact on how we communicate with one another (Friedman, 2005). Virtual team projects using electronic collaboration systems are becoming increasingly more common in today's global market workforce (Lepsinger & DeRosa, 2010). Therefore, students pursuing a degree in business need to be prepared to work effectively in virtual collaborative environments (Chen, Sager, Corbitt, & Gardiner, 2008; Terris, 2011).

Colleges need to prepare students to work in virtual collaborative environments so that they are prepared to participate in our global workforce (Bower, 2011). The research described in the present paper incorporated a model for implementing virtual teamwork activities into the college curriculum (Chen et al., 2008) along with a second model, one that combined the technology acceptance model (TAM) (Davis, 1989) with seven other prominent theories in user behavior to form a unified theory of acceptance and use of technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003).

Technology acceptance theory (Davis, 1989) is one of the most widely used models for examination of user behavior toward the acceptance of new technologies. Technology acceptance theory has demonstrated that when new technologies are implemented, a number of factors may influence the level of acceptance of the technology (Davis, 1989). The theoretical foundation of the present study is technology acceptance research, chosen for the robustness and preeminence of the models and theories found within this research domain.

1.1 Conceptual Framework

Two theoretical frameworks were incorporated into this study. The first was a model for including virtual teamwork training in Management Information Systems curricula (Chen et al., 2008). The participants in this study engaged in activities designed based upon the criteria defined in the model presented by Chen and colleagues. The virtual teamwork-training model was derived from David Kolb's (1984) learning cycle. The virtual teamwork-training model incorporated learning processes involving abstract conceptualization, active and concrete experimentation, and observational reflection.

The second theoretical framework, UTAUT (Venkatesh et al., 2003), was used to identify the factors that influence the use of electronic collaboration technologies. The UTAUT model was modified for use in this study. Figure 1 shows graphically the derived model used in this study. The dependent variable for the model is the users' Intention to Use Collaboration Technology.
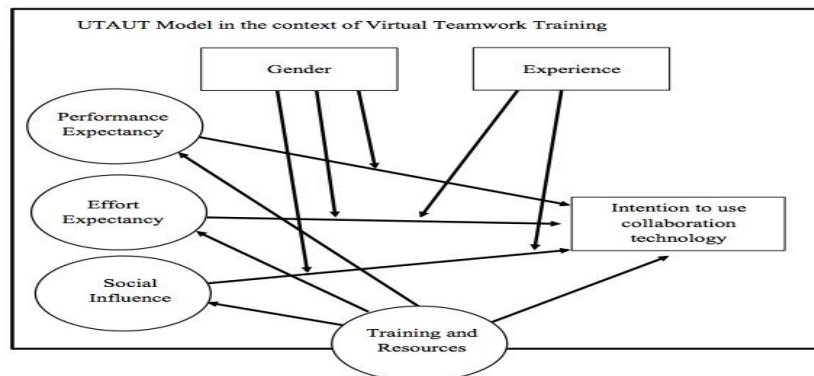

Figure 1. UTAUT model within the context of virtual teamwork training

Three of the independent variables in the model are Performance Expectancy, Effort Expectancy, and Social Influence. Venkatesh et al. (2003) defined performance expectancy as the "degree to which an individual believes that using the system will help him or her to attain gains in job performance" (p. 447). In the model for this study, performance expectancy is defined as the degree to which an individual believes that using virtual team collaboration tools will result in successful project development. Effort expectancy was defined in the UTAUT study as "the degree of ease associated with the use of the system" (Venkatesh et al., 2003, p. 450). In the present study, effort expectancy is defined as the degree of ease associated with the use of the electronic collaboration system. Social influence was defined in the UTAUT model as the "degree to which an individual perceives that important others believe he or she should use the new system" (Venkatesh et al., 2003, p. 451). In this study, social influence is defined as the degree to which an individual perceives that important others believe he or she should use virtual collaboration tools to perform tasks.

In the model used in the present study, Performance Expectancy, Effort Expectancy, and Social Influence are moderated by Gender and Experience and mediate Training and Resources. Moderator variables change the strength of an effect or relationship between two variables (Baron & Kenny, 1986). Researchers have found gender to be an important moderating factor of performance expectancy, effort expectancy, and social influence (Venkatesh et al., 2003). The UTAUT study showed that experience moderates the effects of effort expectancy, social influence, and facilitating conditions (Venkatesh et al., 2003). Experience in this study is defined as the amount of experience one has with computers.

Mediator variables explain how or why an effect occurs between an independent and dependent variable (Baron & Kenny, 1986). Venkatesh (2000) found evidence for mediation by the variable effort expectancy of the effect of facilitating conditions, which is referred to as training and resources in the present study, on the dependent variable actual technology use. The training and resources construct was derived from the UTAUT theory (Venkatesh et al., 2003) and the model for incorporating virtual teamwork training (Chen, et al., 2008). In this study, training and resources refers to the degree to which individuals believe they have been trained to participate in virtual teamwork activities and have adequate resources to accomplish tasks virtually. All three of the other independent variables in this model mediate the effects of training and resources on intention to use the collaboration technology.

2. PROCEDURES AND MEASURES

2.1 Procedures

Undergraduate college of business students in Principles of Information Systems courses participated in virtual team projects using a web-based video conferencing technology, WebEx. The instructor placed students in virtual teams of four students each. Students in the courses participated in four team projects. The projects that required face-to-face meetings included designing a network for a fictitious business, developing web pages for the business, creating a Visual Basic program for the same business, and developing example databases. The virtual meetings consisted of three discussion-based meetings and one problem-solving meeting. The discussion meetings were based on articles that were read prior to the meeting. In the problem-solving meeting, the participants developed a database proposal for their business.

The students were trained by the instructor to use WebEx. Based on a modified version of Harvey Daniel's (1994) literature circles, individuals in the teams were each given unique pre-discussion and during-discussion activities. In the first virtual team meeting, the students were instructed to discuss an article. During the meeting, each team participant executed his or her during-discussion activity. Following the meeting, each participant wrote on a discussion forum responses to questions related to the article that the team members had discussed during their meeting and a reflection on the virtual meeting experience. The team leader was asked to post a summary of the meeting. The role of team leader was rotated among the team members. This meeting process was repeated for two additional articles. The students then participated in a virtual team meeting to plan a database project. They worked together in WebEx to design the tables for a database they would develop later. Then each student wrote a reflection of this final virtual meeting.

2.2 Measures

After the team activities were completed, the students responded to the technology acceptance survey. The survey was given in class and extra credit was awarded to students who completed the survey. The items on the survey were created using preexisting scales from the UTAUT model (Venkatesh et al., 2003), the predicting collaboration technology use model (Brown et al., 2010), and the model of virtual teamwork training (Chen et al., 2008). The scales were reworded to apply to this study's research domain, virtual collaboration, as is common practice in technology acceptance research (Davis, 1989). A pilot study was conducted to test the survey's reliability, and modifications were made to improve reliability to an acceptable level. Cronbach's α values ranged from .79 to .93 on the five constructs (variables) and the student perceptions of the virtual teamwork training, into which the survey items were categorized as shown below. The items on the modified survey administered to the students are listed below, under the six categories.

Intention to Use Collaboration Technology:
- I intend to use WebEx, or a similar collaboration technology, in the future.
- I predict I would use WebEx, or a similar collaboration technology, in the future.
- I plan to use WebEx, or a similar collaboration technology, in the future.

Performance Expectancy:
- I believe WebEx, or a similar collaboration technology, will be useful for communication.
- Using WebEx, or a similar collaboration technology, will enable me to accomplish future work tasks more quickly.
- Using WebEx, or a similar collaboration technology, will increase my productivity.

Effort Expectancy:
- Using WebEx, or a similar collaboration technology, requires little mental effort.
- I believe WebEx, or a similar collaboration technology, will be easy to use.
- Using WebEx, or a similar collaboration technology, will be easy for me.

Social Influence:
- Future employers, people who will influence my behavior, will think I should use WebEx, or a similar collaboration technology.
- People who are important to me think I should use WebEx.
- My instructor thinks I should use WebEx.

Training and Resources:
- I have the resources necessary to use WebEx.
- I have the knowledge necessary to use WebEx.
- I received adequate training on how to use WebEx.

Virtual Teamwork Training items were taken directly from the virtual teamwork-training model (Chen et al., 2008). Those items are listed in Table 4 in the Data Analysis and Results section of this paper.

The moderating variables Experience and Gender were collected by the following survey questions:
- Computer experience – "How would you rate your computer experience?" (1-5, 1 = no experience…5 = expert)
- Gender – "Gender: _____"

2.3 Research Questions

The research questions and hypotheses are as follows:

3. To what extent do training and resources, performance expectancy, effort expectancy, and social influence explain a student's intention to use a collaboration technology?

H1 - User training and available resources will have a significant effect on intention to use the collaboration technology.

H2 – Performance expectancy will have a significant effect on intention to use the collaboration technology.

H3 – Effort expectancy will have a significant effect on intention to use the collaboration technology.

H4 – Social influence will have a significant effect on intention to use the collaboration technology.

4. Do gender and experience moderate the effects of performance expectancy, effort expectancy, and social influence on a student's intention to use collaboration technology?

H5 – The effect of performance expectancy on intention to use collaboration technology will be moderated by gender.

H6 – The effect of effort expectancy on intention to use collaboration technology will be moderated by gender and experience.

H7 - The effect of social influence on intention to use collaboration technology will be moderated by gender and experience.

5. Do performance expectancy, effort expectancy, and social influence mediate the effects of training and resources on a student's intention to use collaboration technology?

H8 – Performance expectancy will mediate the effects of training and resources on intention to use the collaboration technology.

H9 – Effort expectancy will mediate the effects of training and resources on intention to use the collaboration technology.

H10 – Social influence will mediate the effects of training and resources on intention to use the collaboration technology.

6. How do students perceive virtual team training?

3. DATA ANALYSIS AND RESULTS

3.1 Demographics

Out of 127 participants in the study, 108 (85%) surveys were completed. The demographics of those that responded included that 64 (59%) of the respondents were male and 44 (41%) were female. The mean age of those surveyed was 21.65 with a standard deviation of 1.5. The majority, 96 (89%) of the respondents reported that they had moderate to very strong computer experience. The majority of the participants that reported were Management 37 (34.26%), Marketing 33 (30.55%), and Accounting 25 (23.14%) majors.

3.2 Analysis of the PLS model

Using PLS analysis procedures (Henseler, Ringle, & Sinkovic, 2009), the measurement instrument (technology acceptance survey) was found to be both valid and reliable, with acceptable Cronbach α values and composite reliability for each construct. Partial least squares (PLS) structural equation modeling (SEM) was used to test the structural model with the defined variables. SmartPLS was used to estimate the model (Ringle, Wende, & Wills, 2005).

PLS analysis was used to test the study hypotheses for research questions one and two. PLS analysis revealed the dependent variable, intention to use the collaboration technology, exhibited an R^2 value of .64, This R^2 value indicated that 64% of the variance in the dependent variable was explained by the independent variables performance expectancy, effort expectancy, and social influence.

The first four hypotheses were then tested. The total effects are reported in Table 1. The results show that training and resources (TR) had a significant effect on the intention to use the collaboration technology (IU). Hypothesis 1 was supported (H1: $\beta = 0.44$, $t = 5.08$, $p < .001$). Performance expectancy also had a significant effect on the intention to use the collaboration technology. Hypothesis 2 was supported (H2: $\beta = .45$, $t = 4.48$, $p < .001$). However, effort expectancy did not have a significant effect on intention to use the collaboration technology. Hypothesis 3 was not supported. Social influence did have a significant effect on the intention to use the collaboration technology. Hypothesis 4 was supported (H4: $\beta = .34$, $t = 2.85$, $p < .01$).

Table 1. Results of testing hypotheses 1, 2, 3, & 4 (N= 108)

	Original sample (O)	Sample Mean (M)	Standard deviation (STDEV)	Standard error (STERR)	t-stat (|O/STERR|)
TR → IU	.44	.44	.09	.09	5.08
PE → IU	.45	.47	.10	.10	4.48
EE → IU	-.14	-.16	.14	.14	1.02
SI → IU	.34	.29	.12	.12	2.85

The results for testing hypotheses 5, 6, and 7 are shown in Table 2. The findings revealed that gender did not moderate the effects of performance expectancy on intention to use the collaboration technology. Therefore, Hypothesis 5 was not supported. Neither gender nor computer experience moderated the effect of effort expectancy on the intention to use the collaboration technology. Hypothesis 6 was not supported. Neither gender nor computer experience moderated the effect of social influence on intention to use the collaboration technology. Hypothesis 7 was thereby not supported.

Research question 3 was answered using hypotheses H8, H9, and H10. The hypotheses predicted that performance expectancy, effort expectancy, and social influence would mediate the effects of training and resources on the dependent variable, intention to use the collaboration technology. To assess for mediation, Soper's Sobel test calculator was used in this study (Sobel, 1982). A summary of the mediating effects of the independent variables on the effect training and resources had on the dependent variable, intention to use the collaboration technology, is shown in Table 3.

Table 2. Results of testing hypotheses 5, 6, and 7 (N= 108)

	Original sample (O)	Sample Mean (M)	Standard deviation (STDEV)	Standard error (STERR)	t-stat (|O/STERR|)
PE * Gender → IU	-.09	-.04	.12	.12	0.75
EE * Gender → IU	-.05	-.04	.10	.10	0.52
EE * Experience → IU	.13	.14	.11	.11	1.17
SI * Gender → IU	.16	.13	.12	.12	1.34
SI * Experience → IU	-.14	-.11	.12	.12	1.19

Table 3. Summary of the mediating effects (N= 108)

	Construct	Direct Effect on Intention to Use	Indirect Effect on Intention to Use
H8	Training and Resources	.49 **	.10 **
	Performance Expectancy	.66 **	
H9	Training and Resources	.49 **	.33
	Effort Expectancy	.17	
H10	Training and Resources	.49 **	.21 **
	Social Influence	.55 **	

** $p < .001$

3.3 Virtual Teamwork Training Survey Items

Descriptive statistics were used to analyze the students' perceptions of the virtual teamwork. Table 4 displays the results for the five items included on the survey. The survey items used a 7-point Likert scale with 1 representing strongly disagree and 7 representing strongly agree. Each of the virtual teamwork items had response means of 5.59 or higher, indicating that the students agreed to strongly agreed for each item.

Table 4. Virtual teamwork-training item descriptive statistics (N= 108)

	Survey Items	M	SD
Q16	My understanding of virtual teamwork has increased as a result of this class.	6.06	1.04
Q17	My ability to work in a virtual environment has been enhanced as a result of taking this class.	6.06	1.00
Q18	This class was useful in terms of preparing me to work in virtual teams at some future time.	5.92	1.08
Q19	Virtual teamwork training is an important component of business school curriculum.	5.59	1.14
Q20	I have a good basic understanding of virtual teamwork.	5.87	1.03

4. DISCUSSION

4.1 Factors that Influence Students' Intention to Use Collaboration Technology

Training and available resources had a significant effect on intention to use the collaboration technology. Providing students with adequate experiential training will increase their knowledge of the technology and ultimately increase their intent to use it. The findings of this study supported the UTAUT (Venkatesh et al., 2003) study's findings and the study by Brown, Dennis, and Venkatesh (2010) that found facilitating conditions had a significant effect on intention to use. This demonstrates to faculty members the importance of providing virtual teamwork training in the college curriculum. Additionally, providing students with tools (resources) such as WebEx or similar collaboration technology will impact their intention to use the collaboration technology.

Students who believed they would perform well using the collaboration technology also intended to use the technology. The results support the UTAUT (Venkatesh et al., 2003) study's finding that performance expectancy will have a significant effect on a person's intention to use a technology. If students believe they will perform well with technology they will be more likely to use it. Faculty may wish to demonstrate the collaboration systems in their courses and assure students that those systems are not difficult to use. WebEx is much like many of the systems that students might already be familiar with, such as Google Hangout and Skype.

Effort expectancy did not have a significant effect on intention to use the collaboration technology. This was in contrast to the findings of Brown et al. (2010) and the original findings in the UTAUT model (Venkatesh et al., 2003). Effort may be irrelevant with today's students, since they are so immersed in technology. Effort may not play as significant a role in determining whether they intend to use a technology as it has for past generations.

Social influence had a positive significant effect on the students' intentions to use the collaboration technology. This supports both the findings in the Brown et al. (2010) study and the UTAUT model (Venkatesh et al., 2003). This effect indicates that students who believe that future employers think that they should be able to use virtual collaboration technologies will be more inclined to use the technology in the future. It is important for faculty who are planning to incorporate virtual team learning activities to relay to students the need for learning these skills before they enter the workforce. Faculty could have guest speakers from industry talk to their students about how virtual collaboration is used in industry. Additionally, videos are available that demonstrate how virtual teams work in business and industry using various technologies such as Second Life, WebEx, and other group systems.

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4.2 Moderators of Factors Influencing Intention to Use Collaboration Technology

Gender was not a significant moderator of performance expectancy in this study. While it contrasted with previous studies (Brown et al., 2010), this finding is particularly interesting. Participants in this study were traditional-aged college students. Today's generation of students, both males and females, are increasingly computer savvy. Women and men in this age group may be equally proficient with using technologies such as video conferencing systems and group collaboration systems, more so than past generations. The technologies of this age, including smart phones, tablet computers, and social networking applications, have contributed to this new gender-neutral phenomenon of computer application expertise.

Effort expectancy was not a significant factor in this study. Therefore, gender and computer experience could not be considered moderators for effort expectancy. Gender and computer experience were also not found to be significant moderators for social influence. This may be due to the age of the participants, which appears to have limited both gender differences and the range of computer experience.

4.3 Mediation of Effects of Training and Resources on Intention to Use Collaboration Technology

Performance expectancy was found to significantly mediate the effects of training and resources on intention to use the collaboration technology. This indicates that training and resources increases students' performance expectancy and positively impacts their intention to use the collaboration technology. While teaching virtual teamwork skills to students, it is important to reiterate to them how learning such a skill will help them in the future. Providing examples of how such systems are used in business and industry and discussing various cases in which groups may be required to work virtually will help students interpret how learning the skill will help them perform better on the job in the future.

Since effort expectancy was not a significant factor in the study, it was also not a significant mediator. As mentioned above, effort may be irrelevant with today's students since they are so immersed in technology.

Social influence was found to significantly mediate the effects of training and resources on intention to use the collaboration technology. This indicates that training and resources increase students' perceptions that future employers may believe they should learn to use collaboration technology. Such perceptions, in turn, positively impact students' intentions to use the technology. Students may not be aware of how prevalent virtual meetings and virtual teams have become in today's work force. Students must realize that employers will expect them to be able to collaborate with team members from a variety of locations and not only share ideas but also produce outcomes such as marketing plans, budgets, and development of software applications.

4.4 Student Perceptions of Virtual Teamwork Training

Five survey questions dealt with student perceptions of the virtual teamwork. The responses indicate that the students believed the virtual teamwork-training model was successful. The students also provided positive comments in their reflections of their meetings. It was evident from their discussions in class and the reflections that substantial improvement from the previous meeting was noticed each time they participated in a new meeting. Having multiple meetings provided value to the participants. These activities were also more representative of how actual virtual teams work in business and industry.

Harvey Daniel's (1994) literature circle activity was adapted and used in conjunction with the virtual teamwork training. One important finding of this study is that the literature circle activity was a successful tool for facilitating initial virtual meetings. Many of the comments from students related to how smoothly the meeting went because the participants were prepared. This positive behavior was an outcome from incorporating the pre-discussion and during-discussion activities of the literature circle activity sheet. These study results underline the importance of providing training to help students to learn to collaborate in virtual environments. The virtual teamwork-training model could be adapted to classes in a wide spectrum of subject areas, not just in business or information systems courses.

4.5 Limitations

While it was interesting to apply the UTAUT model to a college environment with traditional-aged college students, the findings might have been different with a wider spectrum of ages. Additionally, the majority of the students were business majors, which may have influenced their perceptions as well. If students majoring in other programs such as social sciences, education, and nursing had participated in the study, its generalizability could have been improved.

4.6 Suggestions for Future Research

A number of suggestions can be provided for future research as a result of this study. First, it would be interesting to conduct the study by including graduate students and participants from business and industry with a wider range of ages represented. Gender and computer experience could play a greater role with individuals who are not digital natives.

Virtual teamwork is not just a skill that could be taught in business schools; it could be taught in other disciplines as well. Faculty researchers could implement virtual teamwork training in a variety of courses from various colleges to see if there were differences among students from various disciplines.

This study identified the students' perceptions of the virtual teamwork training but did not assess the quality of the training itself. The virtual team meetings in the study were observed but not assessed. Through observation and other data-collection methods, future studies could assess the quality of the virtual meetings and the quality of the products created by the team members.

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SURVEILLANCE IN PROGRAMMING PLAGIARISM BEYOND TECHNIQUES: AN INCENTIVE-BASED FISHBONE MODEL

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ABSTRACT

Lots of researches have showed that plagiarism becomes a severe problem in higher education around the world, especially in programming learning for its essence. Therefore, an effective strategy for plagiarism surveillance in program learning is much essential. Some literature focus on code similarity algorithm and the related tools can help to deal with the tedious and time-consuming task of detecting plagiarism to some extent. However, it is somewhat cursory to determine plagiarized programs only with automatic tool. Meanwhile, there is little research on incentive strategy of plagiarism surveillance. In this paper, we focus on the incentive mechanism of programming plagiarism surveillance. We aim to use some incentive strategy for plagiarism to gain the students' learning outcome. In the context of a programming learning information system EduPCR, a fishbone model is proposed, which consists of three aspects: problem, reason, and strategy. The questionnaire and interview conducted to survey the students' attitude about the incentive model show that the incentive model is welcome and practical in programming plagiarism surveillance. Our research is not only valuable for the programming learning but also for plagiarism surveillance of documents in other formats in academia.

KEYWORDS

Plagiarism surveillance, Incentive mechanism, Fishbone diagram, EduPCR

1. INTRODUCTION

Since teachers in academia often evaluate students' learning effect towards their assignments submitted. Plagiarism becomes a severe problem in higher learning around the word, especially in programming leaning since its code rules. As Parker put that if a code is all copied from another one or there is a little modification in it, then it can be considered as code plagiarism (Schleimer et al, 2003).

Some literature focus on code similarity algorithm and many software tools have been developed. For example, in the context of programming assignment, techniques for measuring code-similarity were adapted to detect plagiarism of assignments (Parker et al, 1989; Joy & Luck, 1999; Ji, 2007). GPLAG used program dependence graph analysis to identify code plagiarism (Liu et al, 2006). PlaGate can be integrated with existing plagiarism detection tools to improve plagiarism detection performance (Cosma & Joy, 2012).

Many survey-based researches were conducted to clarify the definition of plagiarism in programming assignments. Dick et al (2001) launched a scenario-based survey to discover the acceptability of different scenarios related to plagiarism, and reached a consensus on plagiarism behavior. Cosma and Joy (2008) used a set of scenarios to collect opinions from academics, and concluded a definition of source code plagiarism. Bennett et al (2005) built a model to explain the incidence of plagiarism and tested it through a survey collected from 249 students. To explore university students' perceptions of plagiarism, a focus group study is proposed (Gullifer & Tyson, 2010). To support deep understanding of different linguistic patterns, a new taxonomy of plagiarism was presented (Salha et al, 2012).

There are a lot researches on anti-plagiarism. Walker et al (2010) did research on measuring plagiarism. Shen et al (2007) proposed a flexible anti-plagiarism system model based on user-defined plagiarism standards. Ranald et al (2006) presented a checklist for identifying the absence of a holistic approach to dealing with student plagiarism. The attitude and strategies about plagiarism and why it happens should also deserve attention. Park (2004) carried on a research to explore why an institutional framework for dealing with plagiarism by students is necessary. To study investigates factors affecting the adoption of anti-

plagiarism software, Lee (2011) used protection incentive theory as a basis, examined influence of threat and coping appraisals.

Since anti-plagiarism techniques are relatively mature, we believe that the ideal solution to plagiarism should base on more management than technique. In this paper, we design a fishbone diagram model for plagiarism surveillance based on incentive mechanism. After all, there needs to be an incentive for students to learn more (Dana V., 2011). The fishbone model is embedded in an e-learning system EduPCR.

2. BACKGROUND

Code review was firstly introduced by Fagan in 1976, and then has been a common programming practice and widely used for many years (Fagan, 1976; Fallows & Chandramohan, 2001; Mäntylä et al, 2009). Afterwards observing the successful practices of code review in software industry, many computer science educators have shown their interests in introducing peer code review (PCR) processes to their courses and a number of good learning outcomes have been reported (Li, 2007).

We designed and implemented a PCR system EduPCR and applied it in the assessment of two programming language courses *C programming* and *Object Oriented Programming in Java*, and works very well to improve learning outcome (Wang et al, 2012). The activity diagram of EduPCR is depicted in Fig. 1.

(1) New assignment. In this phase, the teacher sets a new assignment to the system, and the system will inform all students on class though short massages which consist of both job description and deadline.

(2) Submit manuscript. After receiving the notification of new assignment, students should finish their manuscripts (first edition of code) and submit them as quickly as possible. Then the computer scans the number of students who submit their manuscript in a certain interval. When the number is more than or equal to 3, the reviewer assignment is performed among them. When only one or two has not been assigned, they will be merged into the just-built-group (more than or equal to 3 members) and assigned among them.

(3) Review. Student who is assigned as reviewer will receive a short massage as notification. Afterwards, they should finish their review task and submit comments before the deadline.

(4) Revise manuscript. After a reviewer finishes his/her review task and submits comments, the author will receive a notification that he/she should revise their manuscript according to reviewer's comments and submit the revision code before the deadline.

(5) Check marks. When all students' revisions have been submitted or the whole assignment is done, the teacher will give students marks for their work concerning the qualities of manuscript, review and revision. Then, students can check their marks on the system.
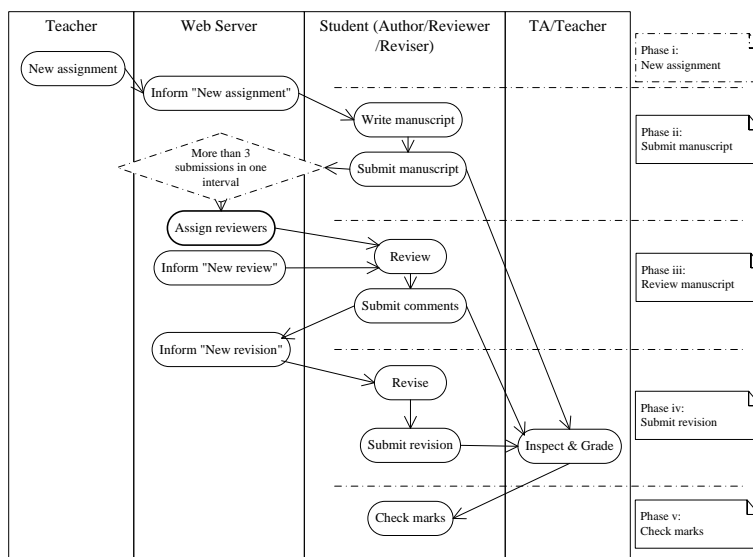

Figure 1. Activity diagram of EduPCR

3. PLAGIARISM SURVEILLANCE MODEL IN FISHBONE DIAGRAM

Our plagiarism surveillance model is in PRS (problem, reason and strategy) infrastructure and has 6 sub questions including *resource*, *individual difference*, *source code*, *penalty by teacher*, *schedule*, and *learning outcome*, as described in Fig. 2.

3.1 Resources

Students can get the code resource from many ways to complete a task, such as Internet, open source software, and students who have completed the task. In our opinion, the third case, just mentioned, is probably of plagiarism. To minimize the influence of plagiarism, we utilize a filter strategy. It means that when a student submits his/her source code, in *phase i* of Fig. 1, the system will compare his/her code with all code submitted by other students. If the code similarity exceeds a pre-defined threshold (we will adjust it in practical situation), the system will reject this submission. He/she can apply teacher's arbitration. Teacher's reflection options include *rejecting application*, *receiving application*, or *increase the thresholds* (after a certain number of arbitrations).
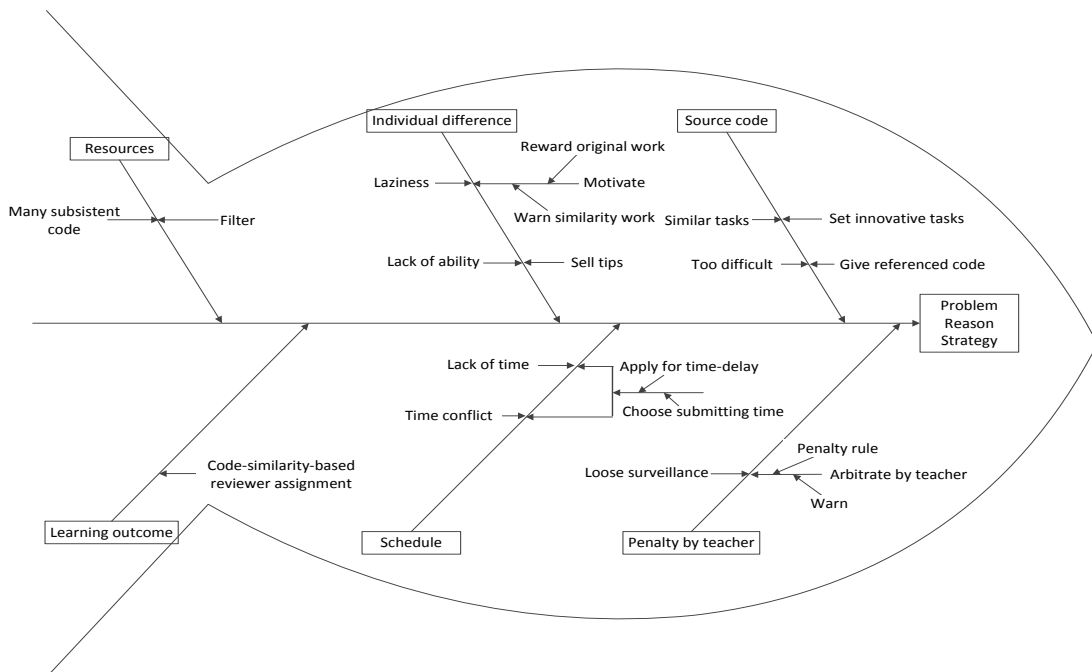
Figure 2. Fishbone model of plagiarism surveillance

3.2 Individual Difference

It consists of laziness and lack of ability. Actually, not all students are diligent, and some students are too lazy to complete the task. They tend to plagiarize others' works. Similarly, some students are lack of programming ability to complete a task independently, they have to refer to the others' works.

To motivate the lazy students, the students with original work will be rewarded while those with similar code will be warned, as depicted in Fig. 2 and the *phase v* of Fig. 1. The system displays the top ten highest similar works and the top ten lowest similar ones in different sections. For the students who are lack of ability to complete a task, we will prepare some tips. A tip can be a code segment or algorithm description, as described in Fig. 2 and the *phase ii* of Fig. 1. At each time when a student utilizes a tip, he/she will get a small-amount deduction of mark.

3.3 Source Code

The tasks of programming course maybe relatively similar. Students can easily find the same tasks from Internet or some higher grade students which can be regarded as plagiarism. Therefore, teachers should try hard to set innovative tasks to reduce the similar tasks, as described in Fig. 2 and the *phase i* of Fig. 1. Besides, some tasks are so difficult that every students have to plagiarize by various ways. To decrease the difficulty of the task as well as the number of students who plagiarize for this reason, teachers are asked to give some referenced code before a very difficult assignment is starting *phase i* of Fig. 1.

3.4 Penalty by Teacher

Teachers' loose surveillance is another reason leads to plagiarism so that we set a penalty rule uniting teachers' arbitration as described in Fig. 2 and the *phase v* of Fig. 1. That is, once we find plagiarism happens between two students, we penalize both of them. Each of them can ask for teacher's arbitration and retexture. After the arbitration, if one didn't plagiarize or one is plagiarized by the other unwittingly, he/she will not get penalty, while the one who plagiarized will get a more serious penalty.

3.5 Schedule

Students in high education always feel lack or conflict of time, as it described in Fig. 2. And for the schedule factors, plagiarism problem obviously increase according to the interview results. To this, we design a strategy that students can choose time to submit their manuscript and apply for time-delay. But without doubt, the options and application should obey some regulation which is showed as below.

We set four options for submitting deadline, as it presented in Fig. 3. Teacher should make option seriously considering both the course arrangement and students' other exams. And in order to incentive students to submit manuscript early, if one student chooses to submit his manuscript (e.g. option 1) before the teacher's setting (e.g. option 2) and does submit his program on schedule, he/she will get an award in score. In contrast, if one chooses the time (e.g. option 4) much later than the teacher's setting (e.g. option 2), he/she will get some deduction in score. Considering about someone's particular situation, those who choose the time (e.g. option 3) won't get any loss in score.
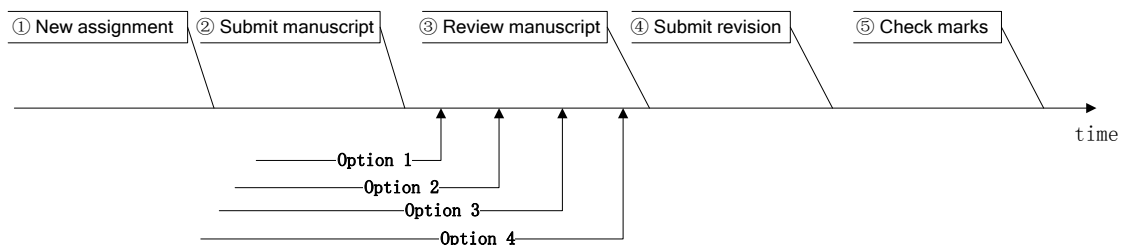
Figure 3. Submission time selection and time-delay request

3.6 Learning Outcome

It's obvious that plagiarism problem will severely reduce learning outcome, and it is inevitable though we take a series of measures and strategies for plagiarism surveillance. Concerning the ultimate goal of education is helping students to learn more, we propose an code-similarity-based reviewer assignment strategy, as described in Fig. 2 and the *phase ii* of Fig. 1. It can help students improve learning outcome even they have plagiarized. In this approach, students who plagiarise or have similar programs will be assigned in the same group. In order to improve their programming skill and learning skill, a reviewer should submit not only their comments but a report, as depicted in the *phase iii* of Fig. 1. The report describes what is similar in their programs such as program structure, algorism etc. In order to get a high grade, students have to write the report seriously, and their programming and learning skill will be improved to some extent.

4. INVESTIGATION

4.1 Questionnaire

To validite the plagiarism surveillance model, a survey is conducted to the students who used EduPCR.

Firstly, we investigate how many times have the student plagiarized in four aspects, and the results, presented in Table 1, reveal that the plagiarism problem is very serious. In the table, the item "Request" presents the times of requesting to plagiarize other people's assignment. The data shows nearly all of the students have plagiarized others' programming works and more than half of them have plagiarized more than 4 times. The next item "Offering" means the times of offering assignment to good friends. According to the statistical result, more than half of the students have offered their homework to close classmates. The following item "Algorithm" stands for the times of referring to the major algorithm of others. And nearly 70% of the students admitted that they have referred to the mainly algorithm of others. The last item "Similar" indicate the times of searching and referring to the similar answers from the Internet, and almost half of the students have referred to or even just copy the answer to the similar task from the Internet.

Table 1. The results of Q1 in questionnaire

Times	0	1 to 4	More than 4	Total
Request	0.033	0.396	0.571	1.0
Offering	0.483	0.407	0.11	1.0
Algorithm	0.352	0.571	0.077	1.0
Similar	0.516	0.363	0.121	1.0

After realizing the serious plagiarism in code programming, we investigate the students' attitude towards the planning to carry out plagiarism surveillance in the EduPCR system. The results show that 69.15% of students agree with the idea of plagiarism surveillance, which indicates that the idea of plagiarism is valid.

In order to prove the plagiarism surveillance model is successful, we have set questions about some strategies in the plagiarism model. For example, we set filter with a certain threshold (such as 85%) in the system, when someone submits his or her homework, the system will compare his/her homework with the submitted programs of other students, and if the similarity exceeds the threshold, the students cannot submit his/her homework successfully. According to investigation, only 41.3% of students think the strategy of setting a certain threshold is reasonable, and more than half of the students think it is not reasonable for the reason that the threshold should adjust to different task.

Another example is about teacher's arbitration to the filter and the penalty rule mentioned above. About 52.2% of the students think the strategy is reasonable; 33.7% of the students think it is just ok; and only 14.1% of the students think it is not very reasonable. And we can conclusion that the strategy of teacher's arbitration to the filter and the penalty rule is much accepted.

4.2 Interview

To comprehend the plagiarism in programming better and ameliorate our surveillance model, we have interviewed some students who have finished the class of C or Java. The record can be concluded as follows. (1) The reasons of the plagiarism could be lack of time and programming ability. The conflicts between programming with other things will also lead to plagiarism. (2) The methods students most take to plagiarism include copying or referring to others and searching on internet. (3) Most students think if there are some strategies to surveille the plagiarism, they can refuse close classmates' request to copying program without the risk of breaking up. And some students think when the task is very difficult, there should be some tips otherwise the strategy may take much inconvenience to them. All in all, the reasons and methods of plagiarism are various, and the surveillance for plagiarism is much necessary.

5. CONCLUSION

Plagiarism problem is an old problem in high education especially in programming study, and there have already some measures to prevent it. However, there is not a satisfactory effect yet because plagiarism is inevitable among students. Considering about its essence of inevitability, we propose a plagiarism surveillance strategy by designing a fishbone model based on incentive mechanism and introduce it into our EduPCR system. According to questionnaire and interview among students who have used the system EduPCR, this model is reasonable and practical. Especially, to promote the overall learning outcome, this model is based on incentive mechanism. In a word, we regard the plagiarism problem as more management issue than technical one. Nevertheless, there are still some issues remaining to discuss.

Should the model be technique-based or management-based? As it's described above, our research on plagiarism surveillance is based on incentive mechanism which belongs to a management domain. However, strategies such as code-similarity-based reviewer assignment, the measurement of code similarity are indeed about technique. So our plagiarism surveillance model is technique-based at first stage, then it should be management-based more and more.

Whether the new model could be introduced directly into another existing e-learning system? A good model should be flexible. Since our plagiarism is based on the e-learning system developed by ourselves, the need to implement another e-learning system could be a challenge. Someone may wonder whether this model could be introduced directly into another existing system. That is a requirement to increase the model's adoption of other e-learning system and is what we should think it over. Fortunately, most of our strategies in the fishbone model can apply to other e-learning system. To the strategies dedicated to EduPCR system, we will improve their adoption to others system by more precise design.

In the future, we will conduct a case study of 4 years students' programming data on C and Java programming courses to find their plagiarism status or tendency. Thus we can improve our plagiarism surveillance model more flexible and more effective according to the case study. The investigation can help us recognize students' plagiarism behavior better as well.

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ELEARNING STRATEGIC PLANNING 2020: THE VOICE OF FUTURE STUDENTS AS STAKEHOLDERS IN HIGHER EDUCATION

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ABSTRACT

Most universities are undertaking information technology (IT) strategic planning. The development of those plans often includes the voices of academics and sometimes engages alumni and current students. However, few engage and acknowledge the voice of future students. This paper is situated within the *Griffith University 2020 Strategic Plan,* and refers directly to the *Griffith 2020 IT Strategic Directions* document. Specifically, this paper reports on a research project involving primary school students, aged 10-14 years old, who might be expected to participate in university studies in 2020. The students' ideas about studying in university in 2020 were used to complement other voices to inform the *Griffith 2020 IT Strategic Directions* plan. Data were collected using semi-structured focus groups at three schools located in close proximity to the university. The paper provides insights into future university students' views on the use of technologies in their future studies.

1. INTRODUCTION – FUTURE UNIVERSITY STUDENTS AND IT STRATEGIC PLANNING

Many organisations including universities have realised the benefits of strategic planning and, more recently, have understood the importance of information technology (IT) strategic planning. This paper specifically refers to a university in Queensland, Australia. In August 2012, that University's Council adopted a strategic planning document to guide the university over the next ten years. As part of building this strategic roadmap, it was recommended that an IT Strategic Plan be developed to position the university's IT through to the year 2020 (O'Brien, 2012a).

In the development of the university's IT Strategic Plan, the Pro-Vice Chancellor (Information Services) who led the process, called for participation from all stakeholders across the university (O'Brien, 2012b). It was suggested that a group of stakeholders not represented on the university campus should be consulted as part of the ITSP process. This group represented *future students* and was the catalyst for the initiation of this research project. This paper provides a summary of the views of future students gained through this research project aimed to inform the university's IT Strategic Plan.

2. CONTEXT OF THE FUTURE STUDENTS RESEARCH PROJECT

The Pro-Vice Chancellor (Information Services) prepared a background paper (O'Brien, 2012a) which discussed the following five key trends and eight challenges and opportunities that could influence the IT Strategic Plan.

Key Trends
- Ubiquitous connectedness - mobile technology and wireless availability;
- Convergence - Separated devices morphing into one and increasing functionality;
- Information abundance - Online availability of information, big data collection and always available;
- Access over ownership - Owning vs accessing and cloud based services; and
- Consumerisation - Takeup of innovations; e.g. iPhone Challenges and Opportunities
- Shrinking innovation cycles - Faster, smarter, cheaper
- Open everything
- Digital content
- Collaboration and crowdsourcing
- Easier for people to work together
- Growth in social media use
- Data mining and analytics
- Opportunities to collect big data

The intention of the discussion paper, together with the formation of an advisory group, was a starting point for discussion about futures and possibilities for envisioning the role of IT directions in shaping the future of the university. Funding was provided for the employment of a Research Assistant to conduct this research project to go beyond the usual activities for strategic planning by engaging with future students – students currently aged approximately 10-14 years old - who might become students at the university in 2020. This was supported as being an excellent idea which was respectful of young people use of technologies and views about possible scenarios for their future studies at university.

3. REVIEW OF RELEVANT LITERATURE – THE VOICE OF FUTURE UNIVERSITY STUDENTS

While there is considerable literature which has sought the views of school students about the use various technologies for learning in school settings, and there is literature about university students perceptions about access to and use of technologies in their studies, there is little research which directly sought future university students' views on technologies and their use in future university studies. However, the literature review conducted revealed three key themes around student voice that related to this research project, and this guided the conceptual framework of this research; namely,
   Theme 1: Student voice and its potential value and importance;
   Theme 2: Student voice about using ICT; and
   Theme 3: Student voice to inform IT strategic planning.

3.1 Theme 1: Student Voice and its Potential Value and Importance

While student voice is not a new topic, and that there have been various contributions to research made over the last thirty years, research tended to be interested in seeking students' opinions about a range of educational matters, but there was little research about how those opinions influenced school decision-making (Rudduck & Fielding, 2006), and evident in the following literature review, much of the research focused on schooling, rather than university. Levin (2000) suggested that students should not be at the bottom of the reform agenda, but should be given a 'voice' in reform agendas, as students need a voice so "that reform will be more successful…that education reform cannot be successful unless students are more involved" (Levin, 2000, p. 156). Furthermore, Levin suggests five arguments for the inclusion of students in reform change. Firstly, "effective implementation of change requires participation by and buy-in from all those involved, students no less than teachers" (Levin, 2000, p. 156).

This argument comes from organisational change theory and makes sense for all parties involved to be a part of the decision-making process for it to be successful. Secondly, "students have unique knowledge and perspectives that can make reform efforts more successful and improve their implementation" (Levin, 2000, p. 156). Students can explain from their perspective what it means now or they can speculate for the future.

Thirdly, "students' views can help mobilise staff and parent opinion in favour of meaningful reform" (Levin, 2000, p. 156). This is consistent with organisational change theory which suggests that if the change is initiated from within with a positive message then that acceptance can be reverberated through others. Fourthly, "constructivist learning, which is increasingly important to high standards reforms, requires a more active student role in schooling" (Levin, 2000, p. 157). Constructivist learning requires the learners to be more engaged and in control of their own learning. It suggests that students use their voice to negotiate their learning in the classroom. Finally, "students are the producers of school outcomes, so their involvement is fundamental to all improvement" (Levin, 2000, p. 157). For Levin, schools are where students learn, and have a significant impact on student learning. Therefore, Levin argues giving students a voice in a reform agenda in the school can have a large impact on the success of the reforms.

Beattie (2012) asserts that "students are not the problem; they are part of the solution" (2012, p. 158), as student voice is the missing ingredient in school transformation. In an article discussing "the Youth and Adults Transforming Schools Together (YATST) initiative to provide training and support for students and educators, working as partners to transform their schools" (Beattie, 2012, p. 159), students aged 14-18 years were encouraged to participate in transforming schools as 'a peaceful revolution' by instigating a cultural shift in their school where these students had a say in the school decision-making process. This initiative expanded to include over twelve schools in the network. While Beattie suggests that "authentic youth-adult partnerships in school transformations are unchartered territory…(with) few prototypes to inform the work" (2012, p. 140), this initiative highlights the success of allowing student voice to participate in decision-making to transform schools.

The previous research by Beattie reflects acknowledgement of the importance of students from within a school context, where those students are part of a school. Mitra (2006) goes further to show that the position of the 'challenger' can influence the success of student voice with school decision-making as part of a reform process. Three cases were discussed where the position of the voice was within or outside the school system. The outside school example provided by Mitra was an independent group that represented the student body to lobby for change. In that example, student voice is not restricted to current students but voice from outside is considered, and this can include lobbying for students or representing their voice. In this instance, this lobby group were passionate outsiders presenting their views of student voice, but there was no discussion of how the voices of students were actually captured and there was no indication as to whether or not the lobby group included future students. Mitra (2006) explains that, "the concept of student voice must gain legitimacy among powerful stakeholders in the school" (p. 315). This research also proposes that student voice from outside of the university can influence strategic planning decisions and has the potential to gain different perspectives, as well as confirming perspectives held by current university stakeholders.

3.2 Theme 2: Student Voice about using ICT

In Australia, there are examples where data are collected seeking student perceptions of their use of ICT. An example is through Australia's participation in the Programme for International Student Assessment (PISA) involving fifteen-year-old students. Conducted every three years, this has included items relating to access to and use of computers. For example, in 2000, PISA reported that 91% of students had access to a computer at home with 98% having access to a computer at school (OECD, 2005), which was above the OECD average of 78% and 87%. In 2003 Australia students recorded access at home of 97% and 100% reported access at school (OECD, 2005). In 2009, around 470,000 students participated from 65 participating countries. The questions changed to students who *use* a computer at home and at school with Australia recording 96.7% for home use and 91.6% for school use (OECD, 2011). Australia scored highly in these results well, above the OECD average, and these data, while giving some insights into students' current access and use of computers at home and at school do not ask students about their perceptions of their possible future use of technology for university studies.

While not directly requiring student responses, the Australian Bureau of Statistics (ABS) collects data through surveys every four years through a national census. Data were published by the ABS in 2011 together with data from the "2009 and 2006 Children's Participation in Cultural and Leisure Activities Survey and the household use of information technology topic in the ABS 2008-09 Multipurpose Household Survey" (Australian Bureau of Statistics, 2011). This reported interesting information, such as "In the 12 months prior to 2009, an estimated 2.2 million children (79%) aged 5-14 years reported accessing the

internet, up from 65% in 2006" (Australian Bureau of Statistics, 2011, p. 2). The ABS reported that Internet use changes depending on the age of the child, with younger children using the Internet for entertainment, but when they are older, they tend to use it primarily for information and socialising. The majority of children (59%) were found to spend less than 4 hours a week on the Internet, but time spent on the Internet increased with age. To illustrate, "An estimated 841,000 children, almost a third (31%) of all children, owned a mobile phone…only 4% of children had used their mobile phone to access the internet" (Australian Bureau of Statistics, 2011, p. 3). Again, the ABS census does not ask students about their perceptions of their possible future use of technology for university studies.

Research which more directly acknowledges student voice is evident in the work undertaken by Moyle and Owen. For example, two major reports which were provided for the Department of Education, Employment and Workplace Relations (DEEWR) (Moyle & Owen, 2009a, 2009b) asked a variety of students about their thoughts on learning with ICT. Moyle and Owen's (2009a, 2009b) research was undertaken with Australian school students, VET, university and early career teachers. Over half of the survey responses (n=654/1082) and focus group participants (n=209/299) were from primary and secondary students with data collected in 2008. The goal of the research project was to "gain an improved and contemporary understanding of the expectations and experiences of learners…of how information and communication technologies may be utilised to improve learning outcomes"(2009b, p. 7). Themes identified in the research suggest that students reported:

- high levels of computer and internet use from home and schools;
- high level of mobile phone ownership;
- low level of use of computers and Internet at local libraries and internet cafes; and
- technologies assisted their studies and they felt confident in using technology.

Their research, conducted approximately 5 years ago, provided valuable insights through student voice about using ICT. Interestingly, their research provided some findings in relation to the students being asked about their future expectations, and those expectations related to the use of ICT. Generally, the students wanted faster, better and newer technologies for home and in school, and they expected that their teachers were able to use them (Moyle & Owen, 2009b, p. 50). In research presented by Sheehy and Bucknall (2008), a variety of differing aged children were asked about their thoughts about how technology might be used for future education systems. The conduct of a focus group allowed students to express their ideas as interactive discussion, drawings and flip charts. Four groups of students (n=24) were selected and participated in these focus groups. The students were various ages from 10-17 years old and the conclusions suggested that the students were limited to their current educational experience "where ICT is used to support or allow these practices to occur but the underpinning model of learning remains the same as their best current experience" (Sheehy & Bucknall, 2008, p. 111). They found that students were interacting with technologies in new ways but that, interestingly, students did not count that as learning. Sheehy and Bucknall (2008) indicated that, "If we wish to move towards innovations in our use of ICT and to incorporate this into our imaginative blueprints for the future, then we need to equip learners with the conceptual tools to reflect on learning and how it occurs" (pp. 112-113).

Nearly all of the data presented in the studies above is over five years old. Since then, we have seen new technologies such as iPads, smart phones, and students living in an increasingly networked world. It would be reasonable to suspect that students now have greater access and use of computers, mobile phones and the Internet than when those studies were conducted. Furthermore, the Australian studies were limited to the student voice about their views of their use of ICT rather than asking their perceptions of possible future use of technologies. There seems to be some scepticism and reluctance about asking students about their views on the future.

3.3 Theme 3: Student Voice to Inform IT Strategic Planning

The third theme relates to research where students have been involved in IT Strategic Planning. Walker, Sloan, Boyle, and Walsh (2011) employed a methodology for informing information technology strategy through suggesting that a top-down, middle-out and bottom-up approach can be used to inform a technology enhanced learning approach. As part of the top-down approach, they explain that student voice was collected as part of an annual eLearning survey. This survey was delivered by the Students Association and included only current students. The middle-out approach used a more formal forum with various representatives

involved including students. No details of the student involvement were discussed. As part of the bottom-up illustration, the authors presented strategic planning as an informal "Friday fry-up" to allow staff the opportunity to informally participate. For their example, student voice was included as part of the strategic planning process, but there was no discussion of whether or not that voice was asked about the current situation or future scenarios. As strategic planning involves thinking about the future, a limitation of involving the current students involved, it is unlikely that they will experience the impact of the decisions made by the current student population if their views inform the IT strategic planning.

Elsewhere, and more aligned with the orientation and purpose of this paper, Haywood, Macleod, Haywood, Mogey, and Alexander (2004) talk about student views of ICT at the University of Edinburgh and how those views have influenced the university's strategic planning process. Over thirteen years of data were collected from beginning and second year students through various methods, including surveys, interviews and scrutiny of the data server information. The data highlighted clear trends that were developed into a set of statements about their students and their views, attitudes and expectations. They termed this "consumer consultation" as their student expectations "may not align to those of the university…measuring change helps decision-making by enabling some prediction of the near future"(Haywood et al., 2004, p. 229). This view was used as "the evidence-base to inform our development of ICT skills and e-learning strategies within the university"(Haywood et al., 2004, p. 30).   The data were collected about current practices including access to ICT, ICT use, and views of teaching and learning with ICT. However, no discussion around the future ideas for ICT could be located. A limitation recorded in the results suggested that students had a rather limited exposure to 'well-developed or sophisticated' e-learning and that could influence the student voice views about appropriate IT strategies for the future. This could be dismissed as a limitation for any project asking students about their views of the future, unless specific cohorts of students are asked; e.g. post-graduate students who have studied at different universities and/or worked in different environments and would have a wider view of what was possible.

Davies (2011) presents details of an action research project undertaken during the 2009-2010 academic year at an independent school in England. The students of the school were aged from 14 – 19 and from an international background. The project was designed to understand teaching and learning with ICT at the school. Twenty-five student researchers participated in the study through multiple cycles of research, with the project culminating with a presentation to the whole school. This presentation contained details of the data collected and possible improvements to the school ICT learning. Interestingly, "During this event they made it known that the students want to be involved in school decision-making and have a right to do so" (Davies, 2011, p. 76). A key aspect of this research project is that it was managed and driven by the students. Two students were invited to join the committee that made decisions on ICT purchases at the school. The student commitment to drive this innovative change in school decision-making highlights that students are capable of making effective contributions.

Collectively, the literature reviewed has highlighted that there is little research which focuses on student voice in relation to future IT strategic planning, but there are signs that there is a growing acknowledgement that there is value in students participating as stakeholders in the IT strategic planning process.

4. THE RESEARCH DESIGN AND METHODOLOGY

This research project aimed to capture the 'voice' of future university students to inform the university's IT strategic planning for 2020. Along with a series of associated activities to gain other university stakeholder input, the voice of future students were sought. Students in the age range of 10-14 years old participated in a series of focus groups to obtain their thoughts about what a university should be like in 2020. This age range was selected because these students could potentially be commencing or continuing studying at university in 2020. In accordance with timelines for the compilation of the university's strategic plan, this project was completed in a six-week timeframe from its initiation, ethics approval, requests to the schools involved and associated approvals, data collection and analysis, through to the preparation of the final report. The guiding research question was - *How will future students engage in higher education in 2020?*

Ethical clearance was appropriately requested and approved by the university prior to the study commencing. The university granted human ethics approval after the submission and review of consent forms for the schools and the parents/caregivers of the students. Students were invited to participate by their

school and only those students who returned signed consent forms were allowed to participate in the focus groups. On the day of the focus group, it was explained to the students that they had the option to elect not to participate. At a later date, students were given a small university gift for participating and contributing their ideas.

Thirteen schools located in reasonably close proximity to the university were invited to participate in this research project, with an understanding that the timeline was important. Four principals accepted the invitation, but only three schools were able to participate in line with the project timeframe. Each school identified the students who were invited to participate in this project. Consent packages were sent home for parent/caregiver approval. At each of the three participating schools, one forty-five minute semi-structured interview was completed with the students following an approved protocol. A total of 48 students participated in the interviews. There was a mix of male and female students. A member of the research team led all interviews with a school representative (class teacher or head of school) in close proximity either in the room or just outside. The questions were organised according to three areas – *About the Students*, *About the Technology*, and *About the University*. These themes were intended to scaffold the students through thinking about themselves as students, then thinking about and discussing their use of technologies, to then be able to consider and propose their ideas *About the University* in 2020. Examples of the questions *About the University* included the following:

- How will you attend university? Where should the university be?
- Should you attend in person? Should there be people from all over the world?
- Should important people give lectures? Should you be able to join lectures at other universities anywhere in the world?
- Could you be anywhere in the world and join lectures? How will you attend lectures?
- How will you access textbooks? How will you keep your notes?
- What do you think assessment should be?
- What should a library look like? Should there be books? When can you access the library?
- Should the content be available to anyone? Do you need to have access to get the content?
- Do you think you should be able to use your own devices at university? Who should own the software? Hardware? (eg: printers) Should we use printers? Do you think you will use paper?
- What can the university know about you? If you visit their website? Search about university in Google? Collect information about the websites you visit? In order to know what to send you?

The students were also invited to add additional thoughts they might have about studying at a university in 2020. No identifiable data about students were collected during the interview process, and participants were assured that they could not be identified in the report or in any other publication. The focus group interviews were audio recorded with recordings transcribed by a research team member. Each school used a different approach to identify potential students. Age was not confirmed formally as part of the process as the expectation was on the school to select or nominate students in the 10-14 age group.

5. SUMMARY OF KEY FINDINGS AND DISCUSSION

Findings are summarised here, using three broad themes used in the interview format - *About the Students*, *About the Technology*, and *About the University*.

5.1 About the Students

Firstly, the students were asked about their knowledge of university to understand if they knew about universities, if they were aware of the local universities, and if they thought that they wanted to attend university in the future. This theme was used to prepare the students to think about their future and to confirm if they were planning to attend a university. The schools nominated students whom they thought might be potential university students, and the students were aware of many local universities. They generally conveyed why thought it was important to study at university. For example, they could see the benefits for future employment, reflected in comments such as:

- *If you go there you might get a better chance of a better job.*
- *You get a better job with more pay so you can live in a big house.*
- *You study a lot so I can get a job.*

Some had already visited campuses with their family, because a parent was studying. The majority of the students interviewed indicated that they had aspirations to go to university.

5.2 About the Technology

Students were then asked a series of questions about ICT to obtain their understanding of ICT and how they use it at home or school. They were asked about the software they use at home and what was available at school. They were asked if they liked using ICT and what they would like to use. They were asked why they liked using ICT and what they think ICT would be like when they finished school, which will be close to being 2020 for most of the students interviewed. Student responses confirmed that the students were using a variety of ICT at home and in the classroom.

They provided an extensive list of suggestions about what ICT would be like in 2020. Students built those suggestions based largely upon their current use of ICT in the classroom and at home. Current classroom examples included Interactive WhiteBoards/SmartBoards, iPads, data projectors, iPods, gaming websites, eBooks, and school Internet-based resources. They were aware of a variety of different software, with most frequently referred to as being Microsoft Office products. Students provided a list of Internet-based ICT they were using with most comments being made about educational or non-education gaming websites.

Students explained the variety of ICT that they have access to at home, and they referred predominantly to gaming devices. Students believed that there should be more ICT at school and they liked using ICT. Students want to use ICT because "it is fun", "educational", "easier to concentrate", "better than going to the library and having to borrow books. It is easier than having to read a whole book to find what you want", "faster than writing", "like in writing assignments it is easier, than having to hand write them", and "helps me understand". Furthermore, the students cited that they access websites for gaming, social networking ("for example, Facebook"), convenience ("like if we all got like iPads then everyone would work and then you could do everything on there. Take it home and bring it back"), and that they were motivating ("makes you want to learn").

The students offered some interesting ideas for ICT in the future including that it would become easier to use computers with touchscreens, there would be individual whiteboards, and there might be robots teaching or serving. They considered that they would be using laptops in the future, which is consistent with their current expectations as many of the students were already attending or expected to attend a school where a 1-to-1 laptop program was offered in the senior years. It is worth noting that it seemed that some of the responses were influenced by movies examples, such as drawing and manipulating a screen in the air shown in the Iron Man series of movies.

5.3 About the University

Students were asked how they would attend university and a question was posed if they would attend online or in person. Students very quickly responded that they still wanted to attend in person, with example responses such as:
- *Cause I think you learn more when you hear or watch it being done rather that listening.*
- *I reckon it would be good if you were there in person.*
- *It would be better if you went to it as you easily get distracted at home.*

However, there was the caveat provided that the students wanted the option to attend online, but they wanted personal contact with other students and their university teachers as they thought that you would not be able to learn as well at home as reflected in the examples of responses, such as:
- *I think you should attend the university in person because then you get to see the face.*
- *Should have personal contact.*
- *If you didn't know then you could ask someone else.*
- *Should be good to go to university because it's easier to land. You get an explanation on how to do things.*

-      *I think you should get a university as a person instead of other computer because if you just use computers you won't learn much. But if you go to university you meet more people and you can learn more.*

-      *I think you should go to the university because if you look at up on a computer you might not understand. At the University you can ask people.*

-      *In a way it's better to go to university but in a way sometimes your friends will be there and you can get more help, teacher. But if you're at home you can have more concentration and you but you might not understand the questions real good.*

Students could see the value of having access to lectures given by important people using ICT to deliver the lecture ("Yeah that would be pretty cool", "You can see how differently they teach"). They were also supportive of being able to access lectures from anywhere in the world. They were interested in attending university in other countries and offered reasons for this such as "experience", "travel" and "like better course then what is offered". Students suggested that it should be easy to travel to university from their home. Interestingly, some students hinted at networked schools by highlighting that universities might be connected with schools ("one in each school", "more university so much closer", "consider school so that parents don't have to travel far").

Students wanted access to textbooks online "because you could take it home" and "if you lose the hardcopy you can still use it". Students could see the benefits of online assessment but didn't want assessment to be online. Students want the traditional library with books, though they also indicated that they didn't like traditional library environments because "they are usually brown and black and boring and depressing". They provided a comprehensive list of 'wants', including:

- access to technology in the library, whether it is supplied or they bring their own devices;
- communal workspaces and individual areas, places to talk and places to be quiet;
- colourful interesting spaces where they can bring drinks and food;
- big comfortable furniture that is flexible to use;
- people to help and those people to be like sales people rather than being behind desks;
- environments where they could take drinks and food;
- quiet spaces plus also noisy spaces but the two separated so they could decide; and
- the library should be accessible 24 hours a day and with longer opening hours.

The students thought that you should only have access if you were connected to the university; e.g. as a student or worker at the university. The students highlighted that, because you have to pay to be a student, then the library should only be available to the people that pay. Students thought that you should be able to bring your own device, and mentioned computers, laptops, phones, iPads, e-readers, tablets, kindle, but that the university should provide devices for those people that don't have their own. Students said that the university should provide access to software and hardware but that they were prepared to pay for it as part of their fees or as an extra. They also said that if it was part of a specialised topic then the university should supply it. Students are used to a Resource Scheme annual fee that their parents pay at the beginning of the school year.

Students were conscious of conserving paper because of the impact on trees. They also suggest that you need computing equipment to be able to show and edit documents such as on a laptop or iPad. They also highlighted some technology reliability issues with using USB's and the risk of losing documents on a computing device. Students said that they were generally happy to share their personal details with the university if they visited on an Open Day or visited the website.

-      *so they can understand that you were there from a young age and that you always wanted to go to uni to study that course…they have that perspective of you.*

-      *that you have a genuine interest in it not just in the moment thing that you want to go to university is a genuine interest.*

They believed that this would help them build a relationship with the university, especially if they were going to study that course. Some students disagreed, because they thought that it was private information and they were afraid of how it could be used, especially for negative contact. Students saw that using information about website visits and tracking was an invasion of their privacy as they did not want the university to know what they were using the Internet for.

6. REFLECTIONS ON THE PROCESS AND CREDIBILITY OF STUDENT VOICE

Rudduck and Fielding (2006) contend the 'big issues' that underlie the credibility of student voice are power relations, the commitment to authenticity, and the principles of inclusiveness. Power relations in their context relate to student teacher interactions with "teachers being prepared to 'see' young people differently" (Rudduck & Fielding, 2006, p. 225). This means seeing students with a level of maturity to be able to offer serious, courteous and constructive contributions. A common theme of student voice literature is based on school interactions between students and teachers for school governance. The teachers in this case hold the balance of power and students can feel anxiety to provide honest feedback to improve school regimes. For example, "Younger students are concerned because commenting on what teachers do is seen as 'rude' or 'wrong'; older students, however, are more inclined to be anxious because they fear retaliation" (Rudduck & Fielding, 2006, p. 226).

The teachers involved in organising students for this research played different roles in assisting in collecting the data. In one class, the teacher participated with the researcher in conducting the interview, in another interview the teacher sat at the front of the class during the focus group, without participating verbally but listening and showing some minor non-verbal responses. Another teacher separated the participating students and let the interview proceed without being present in the room, and was located outside the door with the other students. In each of these three interviews, the power relations between the students and the researcher were different and this was reflected to some extent in the quality of responses from the students.

As Rudduck and Fielding (2006) suggest, "Authenticity is about ensuring that the process of consultation and participation seems credible to students" (p. 226). They go further to suggest that authenticity rests on three things:

1.   students involved in determining the focus of consultation – the topic seen as significant and permitted by the students;
2.   the interest of the adults is real; and
3.   discussion of their suggestion and active follow-through.

Students involved in this research process were not involved in determining the stimulus for the interview but it was felt that the questions and content could generate valid responses. A simple question format and approach was taken to allow the students to interact with the researcher. The interview approach of asking the students as 'future' students allowed an opportunity of respect for the students to show that there was a belief that they could attend university and the university was interested in what they had to say. Due to the process of the research, there is no opportunity for the students to see where their feedback was used in the IT strategic planning development, although they were each provided with a certificate of participation, a reward gift with the university logo, and a summary report given to the participating schools.

Upon reflection, an important principle is to create a strong sense of inclusion whereby all students voices are heard, rather than only the voices of those students who have the confidence and linguistic competence to participate effectively. For this research, a limitation is that not all students in the specified age range were invited to participate because of the timeframe in collecting the data for the university IT strategic plan. The schools were asked to identify students aged 10-14 years who would possibly be attending university in 2020. This restriction on participation or purposive sampling was chosen to access the 'knowledgeable people' when "there is little benefit in seeking a random sample when most of the random sample may be largely ignorant of particular issues and unable to comments on matters of interest to the researcher"(Cohen, Manion, & Morrison, 2011, p. 157). This provides some tensions between being inclusive of student voice and being selective through purposive sampling.

7. CONCLUSION - IT STRATEGIC PLANNING AND STUDENT VOICE

The resulting *Griffith 2020 IT Strategic Directions* (Griffith University, 2013) involved wide consultation and views from various stakeholders were often conflicting, and there is an explicit acknowledgement that we can not predict what the university might be like in 2020. The authors of this paper believe that the

resulting document is carefully crafted, cognizant of IT trends and challenges, and provides a construction of students as scholars in 2020:

> As we move towards 2020 the world of a scholar has fundamentally changed. Global mobile access to scholarship, in all its forms, is the norm. Collaboration across disciplinary, organisational and national boundaries is easy. Research, teaching and learning are significantly multimedia digital endeavours. Griffith's competitors are undeniably global, offering flexibility of time, place and approach in the ways in which a scholar can learn, teach and research.
>
> Griffith's students are creators of new forms of content, which informs future teaching, and changes the relationship between teacher and student. (Griffith University, 2013, p. 6)

This engagement with young people who might be university students in 2020 demonstrated that the students, aged 10-14 years old, are already thinking about university and have a desire to attend university. Therefore, their views can add value to university IT strategic planning processes. A success factor identified by Ward and Peppard (2002) in looking at successful strategic planning for information technology is to "understand the customers" (p. 36). In the case of a university, prospective 'customers' could be defined as the current school students. Ward and Peppard explain that we need to understand "what they do with the product or service: how they obtain value from it, and the problems they may encounter in gaining that value" (2002, p. 36). Consequently, how the students might wish to use ICT at the university, how it might benefit their study, and any problems they have with using the ICT are relevant.

The key message provided by the students in this research project was the importance of the physical connectedness when they envisioned in attending university in 2020. They wanted to see their lecturers/tutors in person, they wanted to socialise on campus in friendly spaces, and they wanted access to a range of ICT. In the last eight years there have been major improvements in ICT and it is unknown what ICT would look like in 2020 but this student voice message fundamentally suggests that students want to be social, as well as university students undertaking studies. As universities strive to take advantage of learning online environments, it is important for universities to understand that these school students who might be attending university in 2020 want to physically be there to enjoy the experience.

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LAPTOPS IN CLASSROOM INTERACTION: THE DYNAMIC REACH OF THE LAPTOPED SITUATION

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ABSTRACT

Laptops and other networked technologies are commonplace at university campuses. While a range of studies researches the negative effects of multitasking, screenpeeking and other laptop related side effects this article emphasize the situational impact of student-laptop interaction. Departing from Goffman's framework on unfocused interaction and Meyrowitz concept of middle region we explore the technology mediated, situated, social interaction. In particular focus is the non-spoken interaction emphasizing both student-laptop interaction and the social interaction within and around the classroom. The article expands the concept of middle-region by connecting it to different modes of interaction, which are labeled intra-, inter-, trans-, and extra-situational interaction. The research thus aims at providing educators and researchers with a model to advance their understanding of situations ingrained with mobile technologies.

KEYWORDS

Laptops, ethnography, situation, unfocused interaction, middle region

1. INTRODUCTION

With the rather dramatic increase of laptops, mobile phones and tablets that have co-constructed new use patterns in everyday life, our interpretation of what a situation is, changes accordingly (Meyrowitz, 2004; Jenkins, Ford and Green, 2012; Lee and Wellman, 2012).

The laptop, now part of students' and teachers' everyday activities, changes the norms in the classroom (Fried, 2008; Lindroth, 2008; Young, 2006). Mobile technologies and ubiquitously available services introduces these new use patterns into the classroom and raise questions regarding traditional definitions of a situation and the mode of interaction the participants expect.

Generally, and not very surprising, research on mobile technologies in education has analyzed if and how technology affects learning, didactics or instructional design. Both Sana, Weston & Cepeda (2013) and Aguilar-Roca, Williams & O'Dowd (2012) focus on the possible negative impact of laptops in traditional lecture halls. However, this article takes a different approach. Instead of a traditional learning or pedagogic perspective it deconstructs the networked situation and, from a micro sociological perspective, dissects its interactional parts. The contribution with this approach is a thorough understanding of a networked situation. Which, in turn, may prepare higher education on how to educate networked individuals as described by Lee and Wellman (2012).

Within the tradition of situational studies, Goffman offers several basic frameworks for analyzing situated interaction. However, scholars such as Meyrowitz (1990) and Thompson (1995) have extended Goffman's definition to also suit mediated interaction, stating that a situation including mediating technologies (in Meyrowitz case, the TV) is not delimited by barriers of perception, but through the notion of perceptual field (Meyrowitz, 1985; 1990 Rettie, 2009). According to Meyrowitz, technology, such as the TV, affects interaction, increases our perceptual field and thus alters the delimiters of a situation. The laptop, with arguably different characteristics than television, has in different ways challenged how new modes of interaction redefine a situation. These emerging situations Meyrowitz (1990) refer to as *middle regions*. Meyrowitz expansion of the situational model has been critiqued for not describing the actual consequences of the concept of middle region (Julsrud, 2005). What does this blurring of social and situated boundaries

mean to the interaction within this middle region? The paper at hand explores the notion of middle region and its applicability to the studied networked situation.

This article answers the following questions. What types of interactions are enacted within a the networked situation and what are the consequences from an educational perspective?

The research presented in this paper focuses on the interaction in a higher educational classroom endowed with laptops. The findings are based on an ethnographic field study with data from interviews, observations and video recordings. Through a first round of categorizing the data, four sets of interaction were identified: *connecting, sharing, leaving*, and *layering* (presented in section 4). Furthermore, we propose that for educators, instructional designers and researchers these modes of interaction can serve as valuable analytical tools for reducing the complexity of the laptopped classroom.

2.   UNDERSTANDING LAPTOP INTERACTION

Goffman's work on the *interaction order* focuses on situated face-to-face interaction in general, talk, body language, eye works etc. Within this order there are two modes of interaction, focused and unfocused where focused interaction revolves around the spoken word such as turntaking. Unfocused interaction is according to Manning (2005) and Burns (1992) in particular about the non-spoken interaction. In our analyses we focus on non-spoken interaction since the interaction with, through and around the laptop in general are about mouse movements, clicks, writing and how the students divide their attention between the screen, the teacher and other subjects and objects. The notion of the Interaction Order puts emphasis on the norm and expectations on behaviour patterns while co-present with, and mutual monitored by others. This order or norm is constantly negotiated as people are entering and leaving situations. This norm is what people use to make sense of a situation, to understand what mode of situation it is and how one is expected to behave, that is, what 'definition of the situation' is applicable (Thomas, 1923). A definition is formed when people act on their judgement of the situation (Goffman, 1963; Burns, 1992; Manning, 2005; Meyrowitz, 1985). The understanding a person will come up with becomes the definition of possible behaviours within the situation. While Goffman states that this area of research is about unmediated interaction Meyrowitz sees the potential also for mediated interaction.

2.1 Perceptual Field

For Meyrowitz, the two notions, co-presence and barriers of perception, are subcategories of the more inclusive notion perceptual field. While Goffman's unit of analysis is the physical situation, Meyrowitz argues that if the perceptual field is altered by the use of technology, also the situation, or how we interpret the situation may changes accordingly. To use Meyrowitz own words:

"For while situations are usually defined in terms of who is in what location, the implicit issue is actually the modes of behaviours that are available for other people's scrutiny" [Meyrowitz, 1990 p. 88] Hence, when technologies such as Instant Messaging (IM) make a user digitally present in other locations the perceptual field is increased to include aspects of this location as well. As such, it also affects the very definition of the situation as it also increases the perceptual field, that is, the reach of our senses within as well as outside of the physical location. Laptops and other technologies such as mobile phones and tablets increase the available action space to also include aspects that are digitally represented. Hence, what we do and say is affected not only by location as such but the patterns of interaction and access to information. This makes the situation more dynamic. It may increase the situation to also include others not locally present. But, it may also be more divided or layered since there may possibly be different streams of information not accessible to everybody taking part of the situation. As such, the situation is more dynamic, more divided but also more outreaching, with technology present (Meyrowitz, 2004).

2.2 The Middle Region

Following this line of argument Meyrowitz states that the alternation of the perceptual field contributes to a connection between different situations, i.e. technology increase the reach of our senses and thus, of the situation. Equally, when the mobile technologies and with them associated use patterns are performed in new

and different situations, the patterns and situation merge or integrates into a new situation with its own "behavioural patterns", as Meyrowitz express it (1990). He argues that TV, computers and other media technologies thus contribute to, what he calls, middle regions. The notion of region is a reference to Goffmans (1963) widely known work on front and back regions (or stages) and how we behave differently depending on the situation. The classic example is at the restaurant where the waiters change their behaviors as they move between the kitchen (back stage) and serving§ customers (front stage). Hence, digital and portable technologies support what Meyrowitz (1990) calls situational integration. Others, outside of the local situation able to 'monitor' a situation and thus make these situations partly integrated. It is argued that as users of these technologies mix different situations the result may be experienced as less differentiation between the private and the public (Meyrowitz, 1990). Thus, the middle region is a mix of both front and back stage, but lacks the extremes. As such, the notion of middle region means mixing of situations as a result of portable technologies used in different situations.

3. METHODOLOGY

The empirical material used in the analysis here is a subset of a larger longitudinal study, conducted by the first author. The data has been collected and analyzed using qualitative, ethnographic methods (Clifford and Marcus, 1986; van Maanen, 1988; Hammersley and Atkinson, 1995). The students and the department in this study are located at one of Sweden's largest universities.

   The ethnographic material was gathered using open-ended interviews with the students and through video recordings of lecture settings. While each activity was conducted to get a different perspective of the studied phenomenon it also saturated the researchers' understanding of the practice, i.e. the ethnographic work can best be described as explorative. 16 persons have been interviewed within a total of 10 interviews, (seven female students and nine male). Out of these, two were group interviews. The interviews were open ended and lasted between 45 to 90 minutes. They were transcribed and analyzed together with the observations. The interviews especially contributed with a better understanding of the students' way to express themselves around the experience as laptop users. Four lectures were video recorded from the back of the classroom with the purpose to capture the minute-by-minute interaction around the laptop computer and on the screen. Each lecture was analyzed and relevant parts of the video recordings were transcribed. Video recording during lectures have been made with written consent from both students and lecturers.

   The field notes and interviews have been transcribed and iteratively organized according to an analytical scheme. This transformation of data into empirically and analytically viable interpretations is indeed an active and creative work of the researcher. It is therefore the researchers' interpretations that become visible also in the descriptive accounts produced during the study. During the analysis of the empirical material we looked specifically on interactions involving the laptop, i.e. interaction with resources and persons that affected mutual monitoring, copresence and barriers of perception. The analysis involved categorizing observed use. First in rough categories such as 'interaction with distant others' and 'interaction with non-educational resources'. In the second cycle, the analysis focused on the situational characteristics of these interactions, creating sets defined by their similarities or differences concerning their relation to the situation where they were observed.

4. LAPTOPS IN CLASSROOM INTERACTION

Here, we present empirical material from the ethnographic study divided into four different sets of interactions where the laptops play a central part.

4.1 Connecting

The section below describes one student and the first ten minutes from one of the in-class video recordings of a lecture. When entering the lecture, the student establishes herself by opening the rucksack, picking up the laptop and placing it on the desk. The student then connects the cable to an electrical outlet and opens the lid

of the laptop. The student then sits down and log in to the wireless network. The laptop is in standby-mode. Thus, the screen has several open windows from the last use session. A web browser is visible, with several open tabs and a few other unrecognized applications. The student switch applications, from the browser to Spotify. During the following minutes Facebook is visited, Gmail, and two of the biggest daily newspapers, before a document with plain text is opened.

This is a preparation for the lecture and a setup of some form of, for the situation, proper workspace. Additionally, the use pattern of visiting these web services is a habit developed elsewhere but brought into the lecture situation with the mobile technology. As the student navigates to different web sites, the browser suggests site-addresses through the auto-complete function in the browser's address bar. These are based on the users browsing history. This is one of the ways where previous interactions and activities, initiated in other situations, reach into the classroom situation. Different use patterns follow into the classroom as the laptop is carried between different locations. Additionally, when students log in to the Wireless LAN at the university, the login webpage urges the user to shut down possible peer-to-peer downloads of copyrighted content. The main reason for this is not that students frequently start these peer-to-peer services in class, but rather that it is common for students to have their laptop in standby mode when moving between home and school and the peer-to-peer software reengages with the download activity as soon as the laptop is opened.

In interviews, the students often refer to how the laptop facilitates a connection with their past activities through the access to information from past. Thus, the interaction with the same portable and personal device, with software, and online services, enables what one student describes through terms of intimacy and feeling of safety, a relationship that is about a personal association with documents, URLs, chat messages, that is, information that means something specific to that particular student. These traces or breadcrumbs of interaction have a specific meaning to the creator. But this is a resource built up over time and over a range of different situations. It is the sequence of use; the trace of use is engraved in the laptop that builds such a relationship. Then the resources of past interaction are available to support the user without the need for further preparations. This transferability of use patterns between different situations suggests what may be called transsituational interaction. A mode of interaction that due to the mobility of the device is possible to bring between different situations.

4.2 Sharing

Instant messaging, Facebook-updates and tweeting are part of the ongoing interaction in the classroom. In interviews the variation in students´ attitudes regarding Facebook and chatting during lectures become evident. Several of the students state that they do not engage in non-lecture related activities. Others state that they try to keep use at a minimum level but if the lecture becomes too boring they may engage in non-lecture related activities anyway. The video recordings confirm these heterogeneous patterns. The attitudes towards interaction with non-present others range from something some student never do to minute-to-minute communication during the lecture.

These synchronous or near synchronous interactions with non-present students, friends and others become an additional mode of interaction and a sort of mutual monitoring that extends outside of the local situation. During interviews student talk about this monitoring of others online presence as comforting and as being among friends. During participant observations the researcher and student's talked about social media as district heating. Meaning that it is not only the actual messaging that has a meaning, but also the awareness of others online presence.

4.3 Leaving

During a lecture there are a range of different use patterns coexisting such as taking notes or instant messaging with the present others. Some students engage in use patterns that have nothing to do with the local situation. In the video recordings of the classroom the following mode becomes visible when students read or play online games for 30 minutes, during a lecture and only once in a while gazes towards the teacher. In interviews, student comment on this as an act of habit, politeness but also for practical reasons. As they explain, out of habit because both themselves and others expect them to attend lectures. Out of politeness because of a perceived personal obligation toward the teacher and for practical reasons since the lecture might touch upon an interesting subject. During the interviews it was also mentioned that a few of the

students had experienced efficiency during these situational breakouts. However it's an efficiency regarding other assignments or tasks not obviously related to the present situation. It is a mode of interaction that is of extrasituational charactar. They do not engage with the present others at all. It is as if they are physically present but from an interaction perspective they are absent.

4.4 Layering

Laptop use in the studied setting is characterized by a variety of parallel activities. The following description is taken from one of the video recordings. The camera is placed in the back of the classroom. 46 students are attending the lecture and most of them use their laptops on and off during the lecture. One of the authors was also present during the lecture, taking notes. During the lecture it is observed how the students alternate the lecture related material open on their laptops with chat-sessions, online java-libraries, online games, online newspapers and Facebook. From moment-to-moment the students shift their attention, between the teacher's activities and more personal on-screen activities.

In the video-recordings we can observe instant messaging between co-present students in the classroom. It is possible to group the messaging into two groups; instant messaging between pairs of students in the classroom, as well as online group chat involving more than two students. Chatting between two students is common in the data, for instance through online instant messaging services. The group chats requires a more structured approach where there needs to be some shared area for the discussion. There needs to be some mode of negotiation on what service to use. During interviews Google Wave, IRC and Facebook have been mentioned as channels for such communication. These channels are often talked about as back channels (McCarthy and Boyd, 2005). A back channels is a form of secondary channel that complement the talk in the classroom. While these modes of back channels have been used on several occasions they are, according to the interviews, rare and have only involved a subset of students. Still, within these back channels, collaborative notes have been gathered, images or pictures of tables or slides have been shared. Students have been seen taking pictures with their mobile phone and when asked about it confirmed that they shared them in a Google docs.

Different screens affect the use patterns in the classroom in different ways. The teachers projected screen affects the on screen behaviour but so does the screen-peeking between the students. Depending on the perspective (lecture or leisure) or position (back or front of classroom) of the participant within the situation there will be different sections or layers of the interaction that are accessible.

We see the screen-peeking and the related spreading effect as a form of local interaction that is internal and stays within the specific situation. It is characterised by the screens visibility within the classroom to others than the owner. One other local interaction is the back channel interaction. It is also an interaction primarily between the participants of the same physical gathering but this interaction relies on online services such IM. It is a mode of interaction that is parallel to the material or analog interaction. It is mediated by the screen and various services and sometimes open only to parts of the group. These two examples: screenpeeking and back channel, are example's of internal interaction, that is interaction that primarily involves people locally present.

5. MODES OF INTERACTION IN CLASSROOM SITUATIONS

The modes of interaction presented below are analyzed based on their interactional characteristics, interaction that affected mutual monitoring, copresence and barriers of perception, that is, the basis for a middle region. But, it is not sufficient to state that the studied classroom shares the characteristics of a middle region. We also need to break down the studied middle region into its interactional parts.

Hence, the different modes of interaction are analysed based on their characteristics and relationship towards the situation as a middle region. To assist the discussion around these modes they also need a name. Considering the characteristics of the first mode of interaction where use patterns and services from one situation are transferred to another. Hence, its about *transsituational interaction*. The second mode exemplifies synchronous interaction between situations, that is, *intersituational interaction*. The third mode illustrates patterns and interaction that to a large extent lack connection or relevance to the present situation.

Thus, a mode of *extrasituational* interaction. Finally, we call the last mode *intrasituational* interaction since the interaction stayed within one single situation.

These modes are only theoretically distinct, in practice students flow between and integrate the different modes. First we analyze the modes and in the final section the focus is on the dynamics between them.

5.1 Intersituational Interaction

When students engage in interaction with persons not in the same physical location, the barriers of perception that Goffman (1963) use to define a situation can be questioned. If a situation is defined by the physical setting, online interaction involving people in different locations would have to be understood as a new, combined situation: a *middle region* framed and defined by the situational norms from several situations. Rather than focusing on our un-aided perception that acts as a delimiter of a situation, the notion of perceptual field is less rigid and focuses on mediated presence in all its various forms.

Students talk about these dynamics in the perceptual field as comforting. In educational situations students have access to online friends for support, advice and to pass the time. But, there is a distinct difference between students' motivations for engaging in intersituational interactions. Obviously it is a difference if the interaction is initiated by the student or by one online, non-local contact, that is, if you are the initiator or receiver. Many students talked about the opportunity to engage in intersituational interaction as a kind of a safety valve. At times, when the lecture felt irrelevant they engage's in intersituational interaction, not to disconnect them selves completely from the situation, but to make it bearable. However, it is also a fact that many students felt a need to have strong self-discipline to deal with a constant temptation. The increase of the perceptual field and the expansion of the reach of the situation that the technology makes possible is a challenge for the individual to handle.

5.2 Transsituational Interaction

The perspective presented here sees students' interactions as an ongoing continuous unfolding stream of activities. What they do with their laptops is obviously connected to previous activities. Almost every single resource used on their laptop is accumulating use history over time. For example web browsers collect history information of the past visited web pages, they could also be adapted with included bookmarks, quicklinks, autofill functions, which are more dependent on users interest, previous use and effort to design a local setup of the browser. IM, Facebook, Skype and other communication tools are dependent on students adding new contacts over time, they also support search and history of previous communication. As users access these resources, developed over time, we argue that they engage in past interactions. Interactions could in this sense form a chain of connections between different situations. Our interaction and information history is embedded in our technology: documents, log files, open tabs, play lists and documents are always present. The technology together with this information support the transcending of procedures and patterns from one situation to another.

5.3 Extrasituational Interaction

In extrasituational interaction we point out a mode where students actually stop partaking in the co-located activities. In some ways they even stop to continuously and attentively concern themselves with addressing the locally present persons or interaction.

Students can engage in extrasituational interaction using mobile technologies, and obviously it can be achieved without any technology support – students occasionally let their minds wander in class, even before mobile technologies were commonly available. The reasons for extra situational interaction are different but sometimes not as arbitrary as one may think. Some students attend lectures with the intention to participate but resign to the online temptations. Others attend explicitly to engage in extrasituational interaction in parallel to the lecture and only listen in to certain specific parts. Thus, during the lecture they work on other assignments and engage with the situated interaction when specific topics are up for discussion. The technology is used to make the surrounding situation stay out of the students super local situation. The interaction mode is a mode that is characterised by its excluding qualities.

5.4 Intrasituational Interaction

Students access to several screens around them in the classroom allows for non-verbal interaction. This is done by screen peeking or glancing (as described in Lindroth and Bergquist, 2009). Participants within the same context engage in mutual monitoring of other participants' on-screen activities, which allows for interaction concerning specific content or use. For example, on-screen material is used for engaging in non-verbal interaction through pointing and gesturing towards the student's own, or other students' screen. The on-screen resources employed in the intra-situational interaction vary from very closely related to the topic of the lecture to topics obviously non-related. It is observable how particular activities or use spread within the classroom. As students have visual access to other students' screens viewing specific content or engaging in use often spreads among other students who are able to observe these activities e.g. visiting certain webpages.

However, intrasituational interaction also addresses the activities among students, which employs online resources for the interaction. This interaction is less visibly accessible, in particular to the teachers. The mediating resources include IM, Facebook, Skype and other similar services. These allow co-located students to add a channel of interaction to what can be heard and seen in the lecture hall. Such "back channels" allow participants to communicate around the content of the lecture as a collective activity. This extra layer allows for interaction in pairs as well as groups of students. As such it includes some and excludes others from part of the interaction. The mutual monitoring of the participants of the situation is thus affected. While some students have access to all the different layers of the interaction, others, including the teacher, are partly unaware of the different channels.

5.5 Extending the Concept of Middle Region

The four modes of interaction coexist in the studied setting. Hence, student and technology co-create a situation where interaction is layered, use patterns are mixed and parts of the situation are shared. At times, students even enter the situation just to stay out of it, as in the case of extrasituational interaction.

We argue that the modes of interaction extend the concept of middle region. It is an extension that focuses on the students' perceptual field, which is constantly and dynamically changed by inter-, trans-, extra- and intra-situational interaction. As a consequence, it is no longer clear who is part of a situation and what situation one is part of. Rather, it is an interchanging, dynamism where situations, through participants interaction, reach and withdraw into and from each other. Thus, the situation acquires multisituational characteristics. While the concept of middle region suggests a merger of situations and the associated norm systems. Multisituationality adds an interactive parttaking with different dispersed locations as well as the layeredness of the present location, as expressed above as intrasituationality. With the advent and use of mobile technologies the perceptual field becomes dynamic, which in turn leads to what we call multisituationality.

5.6 Implications for Practice

Our first choice of teaching method is no longer to gather 30 to 40 students with different agendas into one large room for 90 minutes. That is, if we schedule the students, we always ask ourselves, what do we gain by meeting face-to-face, what is the purpose and what is the relevant group size? Instead, we use a multisite Wordpress where we write, embed our Youtube videos and gather all the course related material into course blogs. Open to the world, of course. When we meet, we meet to discuss, work together or present what the students have done so far. Peer review and peer assessment are standard procedures. As part of this, the student publish the assignments on their open blogs. We talk about this as maximized openness. The course material and assignments are open in a MOOC-like way. The result of the assignment is never sent to the teacher only, it is always peer-reviewed, and most often, published on the student's blog. An important part of this open approach is devotion and engagement, that is, the assignments are designed to inspire and be of interest, not only as an assessment, but to everybody interested in the subject matter. Since all the material is open to the world the engagement is not only a teacher-student-course engagement.

This is a direct result of multisituationality and the dynamic reach of the situation. Of course you can ask the students to close down their phones and laptops during lectures. But closing down is working against instead of inline multisituationality. Multisituationality is about the present location dynamically reaching in to other distant locations and vise versa. Instead of building a teaching bunker shielded from the world we

chose to openly distribute the learning situation and make it available and observable – monitored by others. It is a different monitoring compared to Goffman's original description. Multisituationality implies monitoring by distant as well as local others, it implies many simultaneous active norm systems. Working inline with multisituatonality implies that we dynamically stretch and reach out to the learners. The studied situation, the traditional classroom in general, is already distributed as a result of multisituationality. Thus, taking multisituationality in account during course design is central to meet the expectations of the networked individual.

6. CONCLUSION

This article analyzes an instantiation of Meyrowitz (1990) notion of middle region. Within this region we saw four modes of interaction: intrasituational interaction, transsituational interaction, intersituational interaction and extrasituational interaction that together establish the middle region. By extending the reach of a situation, we question Goffman's definition of a situation and add these modes of interaction and multisituationality to Meyrowitz (1990) notion of middle region. Additionally, the social situation does no longer determine what we do in a particular location. These students are much more opportunistic in their choice of actions and thus transform the definition of the situation. When it is not our senses that delimit a situation, when the students mix use patterns in between, the situation collapses since there is no longer a homogeneous norm in action but rather a heterogeneous blend of different agendas.

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SALAPIGGY: USABILITY TEST OF THE SIFTEO CUBES AS A GAME INTERFACE FOR THE MONEY COUNTING GAME FOR PRESCHOOLERS

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ABSTRACT

Kinesthetic learning, one of the VAK learning styles, is now also being adapted by different gaming consoles and platforms. This paper presents Salapiggy, a two-part kinesthetic educational Sifteo game that has both a tutorial on money and sorting game. It is localized in the Philippines and uses Filipino as the User Interface Language and the Philippine peso as Game Objects. Salapiggy is geared to enhance both the player's monetary recognizing skills and basic arithmetic computation skills. The purpose of this research is to determine whether the children who would play the game will be able to do basic computations through money familiarity and eventually play the game, by attaining a certain amount of points. The test results show that players were able to recognize the value of coins and bills displayed and the goal of having them perform arithmetic operations using the cubes were successful.

KEYWORDS

Sifteo, Money Math, Salapiggy, Kinesthetic Games, Localized Game, Filipino, Educational Game, Primary Schooler, Tangible User Interface, Kinesthetic Learning

1. INTRODUCTION

Electronic games, now commonly known as video games, are interactive games operated by the computer circuitry. There is a wide range of platforms that can be used to play these video games. They include personal computers, arcade consoles, video consoles, and hand held devices. [1] These video games involve a player or players that interact with the game platform usually by through a controlling device. The original purpose of the creation of these video games is to be an interactive system that provides the users fun and entertainment. Today, they make up the "biggest industry in terms of turnover".[2]

1.1 Background of the Study

The rapid digital technology advancement today revolutionizes electronic games from the precursor pinball machines introduced during the 1930s to the popular graphically rich and portable games in the late 2000s. Before, given the original purpose of these video games, they were not included in the school curriculum. Some educators feared their negative effects such as bad posture, violence aggression, and bad habits. Numerous dedicated studies, however, proved that games can serve a wide range of advantages in terms of the work performance done by those who play. Expert video game players often outperform non-players on measures of basic attention and performance. Recent research suggests that playing video games, even for a relatively short period of time, improves performance on a number of tasks that measure visual and attention abilities.[3] These good results from the researches, allowed game technology to be slowly integrated into school systems and games related to school subjects that can help students were created. Thus, from the entertaining video games, the educational video games emerged.

1.1.1 Kinesthetic Learning and Tangible User Interfaces

Kinesthetic Learning, or the learning style with physical activity, has already been a part of the classroom learning experience, usually in physical education classes. Eventually, as technology advanced, the sense of kinesthetic became a part of the new emerging gaming devices. Consoles like Wii and Kinect cater active play and even include educational games for active learning. These gadgets are called the "tangible user interfaces" and they are used to cater both physically active and enjoyable learning games. Inspired by this, the Sifteo Cubes were created.

1.1.2 The Sifteo Cubes

The Sifteo Cubes are flattened square block shaped interfaces with a colour display atop. Each cube can interact with each other when placed in a close proximity. They are connected wirelessly and can be manipulated by shake, press, neighbor, tilt, and flip.The original version of the cubes needs to run with a computer that has the Siftrunner program in order to load the applications and have an audio output. The aim of this research is to explore the unique features these cubes has to offer. Using the developer's kit provided, the goal is to develop an educational game for the original cubes.

2. MONEY MATH AND KINESTHETICS

Paul Richard, executive vice president of the USA National Center for Finance Education (NCFE), showed the importance of teaching money to children at a young age. He suggested that "As soon as children can count, introduce them to money." [4]This is because children are not born with 'money sense.' They learn about money by what they see, hear and experience. [5]This research aims to know whether the Sifteo cubes would be able to cater the money math game and help the children recognize the individual values of the currency and make basic operations with them. The learnability on using the cubes and going through the game will be tested and evaluated.

Computer programmers and educators team up to create various educational video games that can help a student in different academic subjects. One of the difficult subjects students face in school, Mathematics can be made more engaging by designing challenging tasks that are meaningful for children in which they actively participate. [6] John Edelson suggested that the best way to eliminate math anxiety is to present the exercises in a non-threatening way, that is, instead of opening a math book, try turning to technology to help them conquer fears. That is why educational games such as mathematical educational games should be fun in order to encourage kids to play and learn and at the same time enjoy.[7] And a lot of these mathematical games that cover a wide range of sub topics and have been deployed and implemented using different gaming consoles. Using the computer, there is a long list of online and installable mathematic games that cover a wide range of subtopics can be played. Typing in "math game for kids" in the search bar can lead you to hundreds of games for children that can help them to do basic arithmetic operations such as addition, subtraction, multiplication, fractions, and so on. There are also math games that are designed for gadgets ``on the go". [8] Mathematical game applications have also been designed for smartphones such as Android devices and iPhones. Kids can now play these games in various consoles including the touch screen interfaces. Kinesthetic gadgets or tangible user interface did not escaped the list of the game designers and educators as mathematical games were also designed for them. Mathematical Kinesthetic games like *Scoop* (a movement-based game that is purposed to reduce math anxiety[9]),and *Math Mazing* (a 3D gesture recognition exer-game for arithmetic skills[10]) are designed for Kinect. These games promote active play where users use movement of their hands and feet while learning and it also help students with their math anxiety. Both *Scoop* and *Math Mazing* aims to teach children mathematics in a kinesthetic, fun and effective way[11]. Another tangible user interface is the Sifteo cubes. These digital blocks cater "intelligent play" and kinesthetic games that are classified into different categories and age groups. The alpha version of these cubes was presented at the TED conference last July 2009[12]. There are mathematical games available for download where you can operate with numbers and simple fractions such as *Math Cube*, *Peano's vault*, and *Mount Braniac*.

The games discussed above have been shown to help students learn in school and their attitude toward learning math. Included in learning elementary mathematics is also doing basic operations in monetary units. There are also a long list of computer games like *Thinklet* that cater doing computations with money or money math. Another web application from that also has a money math game but is quite different from the other games that do money math is mathisfun.com's *Money Master*. Usually, the games that do money math uses the US dollar or Euro (in *Thinklet*'s case) as monetary unit values. But with *Money master*, the country may be chosen and the images of the currency of that country will be used as learning objects for performing basic arithmetic operations. However, even though the money images have been localized, the standard language used is still in English. In addition, the user interface that caters this game is only limited with desktop computers or laptops. Gesture-based interaction devices such as Wii, Kinect, X Box, and the Sifteo cubes are more exciting than conventional interaction devices like keyboard, mouse, and joystick. [13] Implementing a money math game that uses the local language of the player with these tangible user interfaces, such as the Sifteo cubes, there would be a bigger benefit in learning.

Pankow and Brotherson discussed ways in talking to children about money and the suggestions they included started with the early years of childhood, 4 to 8 years of age. One of their recommendation is to ``discuss basic math concepts with young children and play games that include counting, addition and subtraction." The researchers recommend to start off by having the kids be familiar with the local currency and perform basic operations with them. The skills that are to be developed by the child, such as money value recognition, will be able to aid them to learn other things about money and can help them in the future.[14]

2.1 Salapiggy

Salapiggy is an educational money math game designed for primary schoolers. It uses real money images as game objects and aims to help students aged 6 to 8 years old to recognize each denomination of values of the currency, manipulate them, and do basic arithmetic operations with them. Salapiggy has two parts: the lecture or tutorial part and the game proper.

Figure 1. Salapiggy game and tutorial screen shots (Siftulator)

2.1.1 Tutorial Part

The tutorial part of the game starts with the introduction of the Filipino terms that usually refer to money. It also briefly explains the use of money, different shapes and sizes and the materials that it is composed of. Afterwards, each kind of the Philippine money is discussed in more detail. Given the target age group of the players of the game, the smallest amount of the money discussed is one peso and largest amount is fifty pesos. For each value, the person seen and the identifying color is introduced. Also, the tutorial also shows some items that the certain amount can buy.

2.1.2 Game Mechanics

In order to gain a score, the player should sum up the values shown in each cube, and then arrange it in ascending order. The player can:

- **Neighbor** the cubes to arrange it in ascending order
- **Shake** the cubes to change the money displayed
- **Press** the cubes to display a hint(the total amount of the coins)
- **Flip** all the cubes to go back to the menu

Whenever the player arranges the cube in correct ascending order, the score is incremented and displayed along with an image that says the player answered correctly. In the case that wrong answers are made, instead of telling the player that an incorrect sorting was done, the game prompts the player to try again.

3. DISCUSSION

The main objective of the test is to determine whether the children to play the game would be able to recognize the money images displayed on cubes, to be able to do basic computations, play the game, and attain a certain amount of points. It is evaluated in the following main criteria:Learnability, and User Satisfaction. Learnability is based on the ability to perform during an initial task, improve performance over the entire usage history, and eventually achieve a specific performance.[15,16] Satisfaction refers to the user's perceptions, feelings and opinions[15]

Each student is given a maximum of 30 minutes to play with the cubes and become familiarized with the gesture. They are observed, and guided if needed. The start of the game involves forming the word "salapi" that is divided into "sa", "la", "pi". Each syllable is displayed per cube.

The moment that they are able to form the word and neighbor the cubes would be the start of their familiarization and learning on how to operate the cubes. They would then go through the tutorial part of the game. Each instruction is displayed separately per cube. After this, they would go to the game instructions module. This is where the players are taught on how to play the game. Once the players are able to follow the instructions, score a point and use the hints in the game, it will be the mark of learnability.

Evaluation of the application follows after playing the game. Questions on the ease of use and following the game instructions were asked. The players were also asked to give their opinion on the game and rate it having 1 as the highest score and 5 as the lowest.

3.1 Game User Interface

The game objects used for recognizing money are scanned images of the real Philippine Currency. The characters and other game backgrounds were designed to look child-friendly and attractive so that the target users would be able to appreciate it more. There are also human characters drawn in cartoon that do the lectures and instruct the player on what to actions to execute. In order to cater localization of the game, the background music used is an instrumental version of the Philippine Folk Song entitled *Bahay Kubo* (Nipa Hut). It is a short mp3 file that is looped throughout the life cycle of the application.

In e-learning, as in classroom-based courses, "courses that accommodate the …cultural preferences … will offer the best – and fastest - learning outcomes"[17] To maximize the educational purpose of the game, the instructions and tutorials of Salapiggy is designed with the target players' native language, Filipino. Simple terms are used in order to suit the age group of the players.

3.2 Flexibility

The game is designed to cater software localization. That is, to adapt to the other countries' currency and local language. There is an advantage for countries whose currency breakdown is the same as that of the Philippines'. Just by customizing the tutorial language and currency images of the game sprites, Salapiggy could be utilized to one's local learning environment

3.3 Test Methodology

The testing involves a total of 10 students with ages ranging from 6 years old to 8 years old. They are composed of two 6 year olds, four 7 year olds, and also four 8 year old elementary students. All 10 students know how to read and do basic arithmetic operations. All of the students who went through the testing were first time Sifteo cube users. The individual software testing had three parts, first was the lecture or tutorial part, then the game demo or the game instructions, and lastly, the sorting game. Each player is timed from the moment they started the game until they reach 10 piggy points. After the player has finished playing, an interview was conducted to learn the insights of the students who played the game. After everyone has already played the game, we gave them a chance to play again.

3.4 Testing Observations

Figure 2. Children playing Salapiggy with the Sifteo cubes

The Sifteo cubes were new devices for the children, since it is their first time to use it, they have no idea on how to manipulate it at first. Also, due to the popularity and commonality of the touch screen devices, the users thought that the press feature is just soft touch. During the tutorial part, since all the instructions and lectures are in Filipino, they all read it out loudly and comfortably and were able to comprehend the text well. With the help of comments like ``Tama!'' (Correct), the player is clapping and smiling and is motivated to play more and score higher. After playing the game, the child becomes more confident of doing it the second time. Everyone is excited to have their second turn. During the group play, the players were observed to coordinate and help each other to achieve the correct answer.
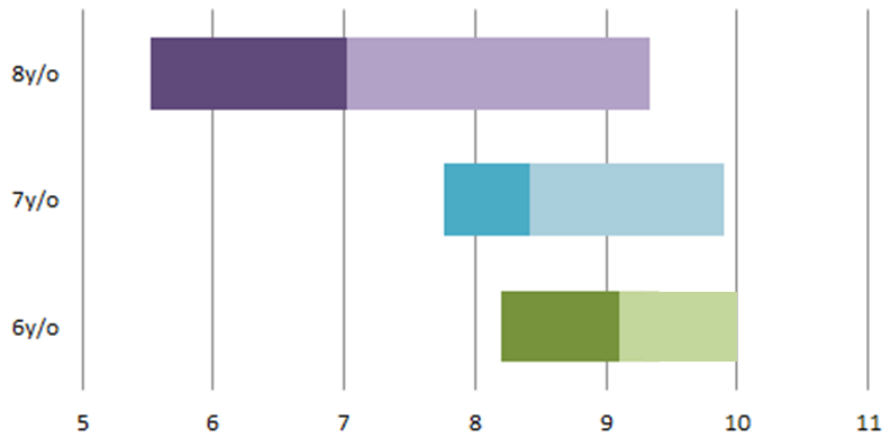
3.5 Test Results

Figure 3. Gantt Chart. Represents the least, average, longest time of the players to reach 10 piggy points. The X-axis represents the time and the Y-axus represents the age of the players.

Each student was timed as they played the game. After consulting a statistics major, he suggested that given the same goal score they are to reach, their time can be graphed by using the Gantt chart where the left end of each bar shows the fastest time the player was able to attain 10 points while the right end of the bar shows the slowest time the player attains 10 points. The divider of the color shows the average time of the children per age. On the graph displayed, the x axis represents the time while the y axis is the age group of the players. The graph shows that the least time for the 6 year old test cases (green bar) to reach 10 points is 8.2 minutes and 10 minutes maximum. Their average time is 9.1. For the 7 year old test cases (blue bar), the least time is 7.45 minutes, maximum is 9.15 minutes, and yielding an average of 8.11 for the four players. For the their fastest time is 5.53, slowest time is 9.33, and average time of 7.025.

3.6 Challenges Faced

A week was spent for testing because there is only one set of sifteo cubes used and we have to test the players individually for 30 minutes, plus the interview, second time playing, and the group playing. Even though the players want to score more, we had to limit the goal to be achieved to only 10 piggy points due to time constraints.

4. CONCLUSION

The test results show good software learnability of the players using the money sorting game using the Sifteo cubes. Even though at first, the players were not familiar with the tangible user interface and its basic functionalities, with the help of the instructions from the game and also continued use, they were able to familiarize the usage and gestures of the Sifteo cubes and play the game. In a reasonable amount of time, they were able to reach the goal and gain 10 piggy points. Despite the limited number of testers, the test results suggest that the money images are recognizable through the LCD display of the Sifteo cubes. Also, the goal of having them perform arithmetic operations using the cubes was successfully attained.

5. RECOMMENDATIONS

The researchers recommend that the player performance improvement and effectivity of the game to the players be evaluated with the help of experts. Moreover, we recommend that game be implemented in other localized languages in different countries. From this, a potential new line of research topics related to the Software Localization of Children's educational games can be done using Salapiggy.

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AN ONTOLOGY FOR SOFTWARE ENGINEERING EDUCATION

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ABSTRACT

Software agents communicate using ontology. It is important to build an ontology for specific domain such as Software Engineering Education. Building an ontology from scratch is not only hard, but also incur much time and cost. This study aims to propose an ontology through adaptation of the existing ontology which is originally built based on a qualification framework.

KEYWORDS

Ontology, Agent, Malaysian Qualification Framework

1. INTRODUCTION

Software agent is the popular technology used today. How do software agents communicate with each other? They communicate using ontology. The definition of ontology is diversed. Tom Gruber (1993) defines the term ontology as "*an ontology in a specification of a conceptualization*", conceptualization refers to "*an abstract model of how people think of things in the world, usually restricted to a particular subject area* " (Gruninger, 2002). The results of the works of Welty, Lethmann, Gruniger and Uschold reported in 1999 with regards to the definition of information systems ontology are: an ontology is a catolog, a glossary, a collection of taxonomies, a set of general logical constraints, a set of text files, a thesaurus and a collection of frame (Smith and Welty, 2001). Based on statement made by Smith and Welty in 2001, ontology in the information systems would continues to flourish. Yes, today it is flourishing in many application domains such as business enterprises as they continue to make effort using ontology as common ontology in order to provide a shared framework of communications (Uschold et. al., 1998, Obrst et. al., 2001; Puustjarvi & Puustjarvi, 2010). Application of ontologies in the application domain of medicine and traffic control have been successful in 2000's. The idea of common ontology has been proven useful when applied in smaller scale (Viinikkala, 2003). In this study, it is believe building a common ontology in Software Engineering Education is necessary and useful. As automation requires a higher degree of accuracy in the description of its procedures and ontology is a mechanism for helping to achieve this. Ontologies are designed in order to enable knowledge sharing with and among agents (Gruber, 1993).

Why ontology is developed? One of the reasons of developing ontology is sharing common understanding of the structure of information among people or software agents (Musen 1992; Gruber,1993). For example, suppose several web-sites contain medical information, if these web-sites share and publish the same underlying ontology of the terms they all use, then software agents can extract and aggregate information from these web-sites. Software agents can use this aggregated information to answer user queries or as input data to other applications. Once aggregation or integration of several ontologies of large domain, it is considered as large ontologies. Another example, developing a small ontology in the domain of Software Engineering (SE) Education for Instituition of Higher Learning. Once SE ontology is developed,

software agents used it as data and this ontology can be used as a basis for application such as curriculum design support system which can create suggestions for designing learning outcomes or answer queries of curriculum designers.

Developing ontology from scratch is hard, however Ra et. al. (2012) note that reuse of pre-developed ontology save time and cost. The idea of reusing pre-developed ontology triggers the effort of this study which adapting the pre-developed ontology developed by Lilian et. al. (2007) in their work group project. The proposed ontology may be used as a shared framework by a group of curriculum designers who are designing software enginerring programmes for Instituition of Higher Learning in Malaysia.

2. RELATED WORK

There is a different in object-oriented design such as designing classes and relations with ontology design. Object-oriented programmers makes design decision based on operational properties of a class whereas an ontology designer makes these decisions based on structural properties of a class (Noy et. al., 2001). Referring to the definition presetned earlier, in this study is: ontology is a formal explicit description of concepts in a domain of discourse. In ontology, classes sometime is called concepts, properties of each concept describing various features and attributes of concept i.e slots sometimes is called roles or properties and restrictions on slots i.e. facets sometime is called role restriction. An ontology together with a set of individual instances of classes constituite a knowledge base. In reality, there is a fine line where ontology ends and the knowledge base begins.

2.1 The Computing Ontology and It Application in Education

It is recalled that this study adapted the work of a workgroup which has set up and progressively working on Ontology of Computing Project (Cassel et. al., 2007). The purpose of the Working Group is to extend the community of individuals contributing to the development of the ontology and to validate or modify partially completed sections. The group also considered issues related to visual presentation of the ontology for the purpose related to curriculum development and the overall structure of the ontology. Accreditation criteria such as Eurpean Qualification Framework is used as guidelines and reference.

For the application of ontology to educational purposes, IFIP working group in 2002 has identified seven critical components of a curriculum development effort (Cassel et. al., 2003). The seven components are: Body of Knowledge (BOK), Foundation Materials, Application Context, Social Context, Breadth and Depth, Thematic Coherence and Outcomes. This study focuses on two components which are relevant to the research objectives i.e. BOK and Outcomes. BOK is topics that define the field to be studied. Outcomes refer to learning outcomes for any proposed curriculum, it is a clear set of goals essential for determining a realistic, collection of topics and activities that will form the students' experience (Cassel et. al., 2007). The ontology addresses questions of BOK and contributes to the understanding the issues of foundational knowledge and depth and breath. The relationship between outcomes and BOK information are also included in the ontology.

Cassel and other researchers (2007) in their project also note that in relating learning outcomes to topics in ontology, the context is not always clear; therefore as a consequence, the ontology related learning outcomes have to be generic and on high level of abstraction. They recommended that these learning outcomes could be a starting point or point of reference for more specific educational based learning outcomes. As learning outcome is about tasks that have to be performed by a person, it has to be clear what level of performance is expected. The European Qualification Framework where the ontology project of Cassel and her colleagues proposes possesses eight levels (refer Appendix). In order to contribute to a better international understanding of mutual programmes, educational instituition is strongly advised to earmark their programmes according to the eight levels. The ontology proposes in this research is adhered to Malayian Qualification Framework (MQF) which contains the eight learning outcomes domains.

To begin with, the components of learning outcomes are to be speicified. In Cassel's project, the components of learning ourcomes are: 1) level of performance (EQF level 5 & 6 are choosen); 2) issue (choose from ontology, one or two layers below the main chapter identification); 3) knowledge (describe using a verb in and agreed format); 4) skills (describe using a verb and an agreed format); and 5) personal

competence (describe using an agreed classification system for personal competence). Cassel et. al. (2007) suggested before associating learning outcomes with ontology topic, definitions and interpretation of learning outcomes components need to be made. Knowledge as third component of learning outcomes are explored based on: IT ontology, the topic space, relation between IT ontologies topics and pre-requisites for performance of learning outcomes dependent on specific topics. (specific areas of ontology). Some specific ontology sections, for example, computing history area and sub-area are presented in Table 1. Knowledge at cognitive level is the scope of the proposed ontology.

In fact, the terminology used in designing learning outcomes must be clear and meaningful. In classifying the educational objectives would help curriculum designers clarify and tightened the "language" of educational objectives (Krathwhol et. al., 1964). There are three major parts of a complete taxonomy – the cognitive, the affective and the psychomotor domains. The affective domain includes objectives (this study applies it in learning outcomes) which describes changes in interest, attitude and values; and the development of appreciations and adequate adjustment. The psychomotor domain is the manipulative or motor-skill area (Bloom et. al., 1956). Among the three domains stated above, most of the work of curriculum development has taken place in cognitive domain. This domain is also the focus domain of this study. The taxonomy was further qualified as intellectual behaviours that represented the intended outcomes of the educational process. Bloom's taxonomy of cognitive domain comprises six level of intellectual behaviour: knolwedge (K), comprehension (C), application (AP), analysis (AN), synthesis (S), and evaluation (E) (Bloom et. al., 1956). These six level can further categories learning outcomes to lower level learning outcomes and higher level learning outcome. Later on, learning outcomes need to be refined based on each level's key terms.Bloom's is well known for cognitive domain. This research uses teaching and learning taxonomy such as Bloom's Taxonomy as a vehicle for specification of learning outcomes in SE courses. The SE courses follow the specification of SWEBOK in 2004 (Bourque & Dupus, 2004). The research illustrates how a faculty may express and document programme objectives through learning outcomes at course level. As such, the problem of designing curriculum to cover measurable keywords and a particular topic in learning outcomes become less nebulous, making the learning outcomes more measurable and clearly specified.

Table 1. Example of Computing History Areas and Sub-area (Source: Cassel et. al., 2007)

Area	Sub-area
Early Methods, Devices and Machines	Numeration Systems
	Early Calculation Devices
	Abacus
	Mechanical Calculating Devices
	Babbage Machines
	Analog Computers
	Mechanical Computers
	Early Electronic Machines
HARDWARE – NON- SYSTEM	Logic Design Basics
	Hardware Control
	Machine Instructions
	Computer Arithmetic
	Computer Performance
	Datapath and Control
	Pipelining
	Memory
	Hardware Networks
	Multiprocessors
	Different Architectures

3. SOFTWARE ENGINEERING ONTOLOGY

This research adopted the following format of learning outcomes statement (Soulsby ,2009). The format adopted in this study is as follows:

To (action verb) *(object) (target) (modifiers)*

With the basic format stated above, the components of learning outcomes need to be specified (in this study, it is referred as *(object) (target) (modifier)*). The definition and interpretation of the components of learning outcomes is adopted according to MQA: "*The curriculum ....address learners' needs as individuals and citizens. It identifies outcomes relating to knowledge, skills, personal attitute and attributes. It is underpinned by clear values*". (MQA, 2010,p.5). The structure adopted is later formed based on MQA.

According to MQA (2010), knowledge is the first domain used in MQF, it is demonstrated by mastery of the subject matter, the knowledge of major idea, observing and recalling information and recognising concepts. Skills is the second domain used in MQF (known as practical skills), it is demonstrated by carrying professional task, reading and undestanding instruction, perceiving and responding effectively and applying learnt skills in a safe environment. Personal attitude and attributes are interpreted as competence in this research. Competence is described in terms of students' responsibility and autonomy as of the decriptor defining qualification level stated in MQF appendix 1 (MQF,2007). this research focuses on cognitive domain i.e. knowledge which is described as the theoritical and/or factual stated in BOK in which the ontology is built upon.

The details of the structrue of the proposed ontology is not discussed in details in this study as it only presents the overall idea of proposed ontology.

4. SUMMARY AND STATUS

The work undertaken in this study is an intial work and it is ongoing. It is hope that it shed some lights on ontology adapation based on a pre-developed ontology. It is believe that the proposed ontology is able to help curriculum designers who need to applies ontology in their work specifically in the area of software engineering education.

Figure 1. Structure of the Proposed Software Engineering Ontology (Cognitive domain)
(Adapted from: Malaysian Qualification Framework Domain (Level 1), Software Design Areas and Sub-area (Bourque &
Dupus, 2004) and Taxonomy Level (Cognitive Domain))

MQF Domain	Learning Outcome	Area	Subarea	Taxonomy Level	Action Verbs
Knowledge	Course learning outcome	Software design fundamental	General design concepts	Comprehension	Classify, convert, defend, describe, discuss, distinguish, estimate, explain, express, extend, generalise, give examples, identify, indicate, infer, locate, paraphase, predict, recognize, rewrite, report, restate, review, select, summarise, translate
			Context software design		
			Software design process		
			Enabling techniques	Analysis	Analyze, appraise, break down, calculate, categorize, compare, contrast, criticize, diagram, differentiate, discriminate, distinguish, examine, experiment, identify, illustrate, infer, model, outline, point out, question, relate, select, separate, subdivide, test
		Key issue in software design concurrency	Concurrency	Application	Apply, change, choose, compute, demonstrate, discover, dramatize, employ, illustrate, interpret, manipulate, modify, operate, practice, predict, prepare, produce, relate, schedule, show, sketch, solve, use, write
			Control & handling of events		
			Distribution of components		
			Error & exceptional handling & fault tolerance		
			Interaction & presentation		
			Data persistence Functional-oriented(structured) design		
			Object-oriented design	Analysis	Analyze, appraise, break down, calculate, categorize, compare, contrast, criticize, diagram, differentiate, discriminate, distinguish, examine, experiment, identify, illustrate, infer, model, outline, point out, question, relate, select, separate, subdivide, test
			Data-structure centred design	Comprehension	Classify, convert, defend, describe, discuss, distinguish, estimate, explain, express, extend, generalise, give examples, identify, indicate, infer, locate, paraphase, predict, recognize, rewrite, report, restate, review, select, summarise, translate
			Component-based design		
			Other methods		

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APPENDIX

Descriptor Defining Levels in the European Qualification Framework (extracted from: Cassel et. al., 2007)

Level	Learning outcomes relevant to the Level		
	Knowledge	Skills	Competence
	In the EQF, knowledge is described as theoritical and/or factual	In the EQF, skills are described as cognitive (use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, tools and instruments)	In the EQF, competence is described in terms of responsibility and autonomy
Level 1	Basic general knowledge	Basic skills required to carry out simple tasks	Work or study under direct supervison in a structured context
Level 2	Basic factual knowledge of a field of work or study	Basic cognitive and practical skills required to use relevant information in order to carry out tasks and to solve routine problems using simple rules and tools	Work or study under supervision with some autonomy
Level 3	Knowledge of facts, principles, processes and general concepts, in a field of work of study	A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information	Take responsibility for completion of tasks in work or study adapt own behavior to circumstnaces in solving problems
Level 4	Factual and theoritical knowledge in broad contexts within a field of work or study	A range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study	Exercise self-management within the guidelines of work or study contexts that are usually predictable, but are subject to change supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities
Level 5	Comprehensive, specialised, factual and theoritical knowledge within a field of work or study and an awareness of the boundaries of that knowledge	A comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems	Exercise management and supervision in contexts of work or study activities where there is unpredictable change review and develop performance of self and others
Level 6	Advanced knowledge of a field work or sutdy, involving a critical understanding of theories and principles	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredicatble problems in a specialised field of work or study	Manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts take responsibility for managing professional development of individuals and groups
Level 7	Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking critical awareness of knowledge issues in a field and at the interface between different fields	Specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields	Manage complex technical or professional activities or projects, taking responsibility for managing professional development of individuals and groups
Level 8	Knowledge at the most advanced frontier of a field of work or study and at the interface between fields	The most advanced and specialised skills and techniques, including synthesis and evaluation, required to solve critical problems in research and/or professional practice	Demonstration substantial authority, innovation, autonomy, scholarly and professional integrity and sustained commitment to the development of new ideas or processes at the forefront of work or study contects including research

TECHNOLOGY ENHANCED ANALYTICS (TEA) IN HIGHER EDUCATION

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ABSTRACT

This paper examines the role of Big Data Analytics in addressing contemporary challenges associated with current changes in institutions of higher education. The paper first explores the potential of Big Data Analytics to support instructors, students and policy analysts to make better evidence based decisions. Secondly, the paper presents an institutional framework for exploring Big Data at the University of Otago in New Zealand. Thirdly, a series of use-case scenarios are presented to demonstrate the benefits of Big Data in Higher Education, and some of the challenges associated with implementation. Finally the paper concludes by outlining future directions relating to the institutional project on Big Data at the University of Otago.

KEYWORDS

Big Data, learning analytics, Higher Education

1. INTRODUCTION

Institutions of higher education are increasingly facing unprecedented challenges due to increasing and diverse student profiles and levels of literacy, a decline in government funding, dynamics in market conditions resulting in a reduction in the value of endowments coming from alumni and other stakeholders, declining support from business and private sectors, increasing operational costs, growing regulatory demands (government, regulatory bodies, and private sectors) for continuous monitoring of performance, transparency and accountability (Hazelkorn, 2007).

Additionally, higher education institutions are being called upon to expand the number of students, increase the proportion of students in certain disciplines and address the pervasive and long-standing underrepresentation of minorities. In response, many institutions are under pressure to compete globally in order to attract more international students and highly qualified academic staff, adding more operational challenges.

Further, corporate-academic partnerships are increasing. However, to attract and sustain partnerships, corporations require institutions of higher education to demonstrate a commitment to the utilization and development of advanced technologies that are likely to support applied research outputs, and with potentials for knowledge transfer and commercialization.

Also, within the institutions of higher education, new technologies continue to have a significant impact on academic careers as research and teaching become more reliant on these technologies (Economist, 2008). Likewise emerging social technologies are transforming the way students interact with others and their learning environments. As learning technologies continue to penetrate all facets of higher education, a plethora of useful 'data traces' are generated. However, leveraging these data traces has many challenges, both at a technical and policy level. While rudimentary data analytics has always had a place in universities, this new more pervasive movement has the potential to reveal a vast array of currently unknown data that is likely to transform our current conceptions and practices of higher education.

While there is a growing appreciation for the need for 'rich' evidence-based data extracted from analytics for effective decision-making (Oblinger 2012), the area is still evolving. More work is required in the areas of institutional data warehousing, aggregation, and analysis. This paper to outline a process by which conceptual ideas concerning analytics can be realized through the design and implementation of a framework for Technology Enhanced Analytics (TEA) within the Higher Education Sector.

What is significant about our approach is the identification and inclusion of various stakeholders that traditionally haven't been considered within Higher Education analytics. It is our belief that the identification and distribution of appropriate analytics to these stakeholders is best approached through a central warehouse model, governed by key institutional representatives charged with the development and deployment of policies aimed at leveraging the benefits of Big Data institutional analytics.

2. BIG DATA AND ANALYTICS

Using data for making decisions is not new; business organizations have been storing and analyzing large volumes of data since the advent of data warehouse systems since the early 1990s. For instance business have employed business intelligence (BI) techniques to various data warehouse systems to discern insights on consumers' behaviours, detecting useful patterns and creating models that can explain present customers' behaviours and predict future trends. Web analytics (WA), an early approach to BI, focuses on analysis of webpage page visits to understand and improve how people use the Web. Over the years, business has grown beyond WA developing more sophisticated techniques to track and trace social actions, such as bookmarking to social sites, posting to twitter or blogs, and commenting on stories to predict and recommend Web pages of interest.

As the rate of growth in data volumes continues to escalate, business organizations continue to seek for ways to capture, store and analyze greater levels of human and machine-generated data. In 2012 the term Big Data emerged as an approach for dealing with increasing volumes and the variability of massive data generated by users and technology environments (e.g. open source software and loud architecture).

Current literature suggests that Big Data refers to data which is fundamentally too big and moves too fast, exceeding the processing capacity of conventional database systems (Manyika, et., al. 2010). Generally Big Data has come to be identified by three fundamental characteristics:

- Volume—large amount of information is often challenging to store, process, and transfer, analyses and present.
- Velocity—relating to increasing rate at which information flows within an organization— (e.g. organizations dealing with financial information have ability to deal with this).
- Variety referring to data in diverse format both structured and unstructured.

Due to its complexity, Big Data requires exceptional technologies to efficiently process large quantities of varied data within tolerable time elapses. Current areas of research on Big Data tend to focus on both technical and applied aspects. The technical aspects of Big Data include distributed computing, algorithm development, integrated systems, network and database architecture, and storage. Applied areas of research tend to emphasis ways to examine the implications and applications of Big Data in education, health care, government, business and social services. More specifically, the application of Big Data in higher education is concerned with approaches and techniques aimed at efficiently collecting, aggregating, analyzing, and interpreting vast amounts of information stored in institutional systems.

3. LEARNING ANALYTICS AND BIG DATA IN HIGHER EDUCATION

Long and Siemens (2011) indicated that Big Data presents the most dramatic framework in efficiently utilizing the vast array of data and ultimately shaping the future of higher education. The application of Big Data in higher education was also echoed by Wagner and Ice (2012), who noted that technological developments have certainly served as catalysts for the move toward the growth of analytics in higher education. In the context of higher education, Big Data connotes the interpretation of a wide range of administrative and operational data gathered processes aimed at assessing institutional performance and progress in order to predict future performance, and identify potential issues related to academic programming, research, teaching and learning (Hrabowski III, Suess & Fritz, 2011; Picciano, 2012).

As an emerging field within education, a number of scholars have contended that learning analytics with the Big Data framework is well positioned to address some of the key challenges currently facing higher education (see for example Siemen, 2011; Dawson, 2013). At this early stage much of the work on data analytics within higher education is coming from interdisciplinary research spanning the fields of

Educational Technology, Statistics, Mathematics, Computer science and Information Science. A core element of the current work is centred on data mining. Luan (2002) describes the features of data mining techniques as clustering and prediction. The clustering aspect of data mining offers comprehensive analysis while the predicting functions estimate the likelihood for a variety of outcomes (Romero & Ventura, 2010).

While educational data mining tends to focus on developing new tools for discovering patterns in data, Big Data (learning analytics) for instance focuses on applying tools and techniques to analyze large sets of data. Analytics also provides researchers with opportunities to carry out real-time analysis of activities. By performing retrospective analysis of student data, predictive models can be created to examine students at risk and provide appropriate intervention, and hence, enabling instructors to adapt their teaching or initiate tutoring, tailored assignments, and continuous assessment (EDUCAUSE, 2011; US Department of Education, 2012).

Big Data in higher education also covers database systems that store large quantities of longitudinally data on students and down to very specific transactions and activities on learning and teaching. When students interact with learning technologies, they leave behind data trails which can reveal their sentiments, social connections, intentions and goals. Researchers can use such data to examine patterns of student performance over time—from one semester to another or from one year to another.

The added-value of Big Data is the ability to identify useful data and turn it into useable information by identifying patterns and deviations from patterns. Schleicher of OECD, 2013 reported that: "Big Data is the foundation on which education can reinvent its business model and build the coalition of governments, businesses, and social entrepreneurs that can bring together the evidence, innovation and resources to make lifelong learning a reality for all. So the next educational superpower might be the one that can combine the hierarchy of institutions with the power of collaborative information flows and social networks."

Further, Big Data analytics could be applied to examine student entry on a course assessment, discussion board entries, blog entries, or wiki activity could be recorded, generating thousands of transactions per student per course. This data would be collected in real or near real time as it is transacted and then analyzed to suggest courses of action. As Siemens (2011) indicated that "[learning] analytics are a foundational tool for informed change in education" and provide evidence on which to form understanding and make informed (rather than instinctive) decisions.

Big Data can also address the challenges associated with finding information at the right time when data is dispersed across several unlinked different data systems in institutions. By identifying ways of aggregating data across systems, Big Data can help improve decision-making capability. Though Big Data is an emergent research area in higher education, there are higher education institutions that have implemented tools to capture, process and use Big Data. For instance, Arizona State University is using predictive analytics to increase graduation rates. Purdue University developed the Signals project in 2007, which gathers information from student information system, course management systems, and course gradebooks to generate a risk level for students, and those designated as at-risk are targeted for outreach.

Further, University of Wollongong in Australia implemented Social Networks Adapting Pedagogical Practice (SNAPP), a tool designed to expand on the basic information gathered within learning management systems, which included how often and for how long students interact with posted material. SNAPP enable visual analytics to display how students interact with discussion forum posts, giving significance to the socio-constructivist activities of students.

4. DATA ANALYTICS AT THE UNIVERSITY OF OTAGO

University of Otago is a research intensive University, and the oldest in the Southern Hemisphere. The University has an extraordinary record of accomplishment in research leadership and teaching. Over the years, the University has served as a wellspring of research and creative endeavor, and in providing public service. Like many another institutions, the University has its share of challenges.

Currently an institutional collaborative project titled Technology Enhanced Analytics (UO-TEA) consisting of an interdisciplinary team is being established to explore the potential of data analytics to address a number of these challenges. Over the next year the group aims to explore the implications of Big Data within the institution and ultimately develop platforms for data collection, aggregation, and build a data

warehouse that aligns with the needs of the various stakeholders: students, instructors, policy, and researchers. To do this a four element framework has been developed (see figure 1).
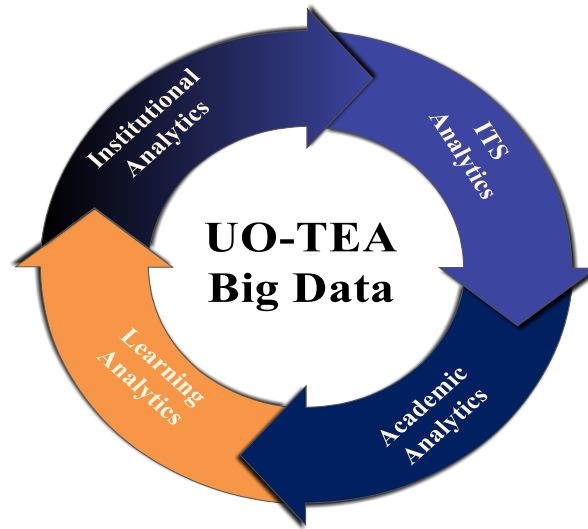

Figure 1. Figures Components of Big Data at Otago

4.1 Figures Components of Big Data at Otago

4.1.1 Institutional analytics

Institutional analytics refers to a variety of operational data that can be analyzed to help with effective decisions about making improvements at the institutional level. Institutional analytics include assessment policy analytics, instructional analytics, and structural analytics. Institutional analytics make use of reports, data warehouses and data dashboards that provide an institution with the capability to make timely data-driven decisions across all departments and divisions.

4.1.2 Information Technology Analytics

Information technology (IT) analytics covers usage and performance data which helps with monitoring required for developing or deploying technology, developing data standards, tools, processes, organizational synergies and policies. Information technology analytics aim at integrating data from a variety of systems—student information, learning management, and alumni systems, as well as systems managing learning experiences outside the classroom. Results of information technology analytics are used to develop rigorous data modeling and analysis to reveal the obstacles to student access and usability, and to evaluate any attempts at intervention. Freeman and Suess (2010) reported with analytics, IT systems can help by refining the associated business processes to collect critical data that might not have been collected institutionally, and by showing how data in separate systems can become very useful when captured and correlated.

4.1.3 Academic/Program Analytics

Academic analytics provides overall information about what is happening in a specific program and how to address performance challenges. Academic analytics combines large data sets with statistical techniques and predictive modelling to improve decision making. Academic analytics provide data that administrators can use to support the strategic decision-making process as well as a method for benchmarking in comparison to other institutions.

The goal of an academic analytics program is also to help those charged with strategic planning in a learning environment to measure, collect, interpret, report and share data in an effective manner so that operational activities related to academic programming and student strengths and weaknesses can be identified and appropriately rectified.

4.1.4 Learning Analytics

Learning analytics is concerned with the measurement, collection, and analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs (Siemens & Long, 2011). More broadly, learning analytics software and techniques are commonly used for improving processes and workflows, measuring academic and institutional data and generally improving organizational effectiveness (Jones, 2012). Although such usage is often referred to as learning analytics, it is more associated with 'academic analytics' (Goldstein and Katz, 2005). Learning analytics is undertaken more at the teaching and learning level of an institution and is largely concerned with improving learner success (Jones, 2012).

4.2 Data Analytical Framework at Otago
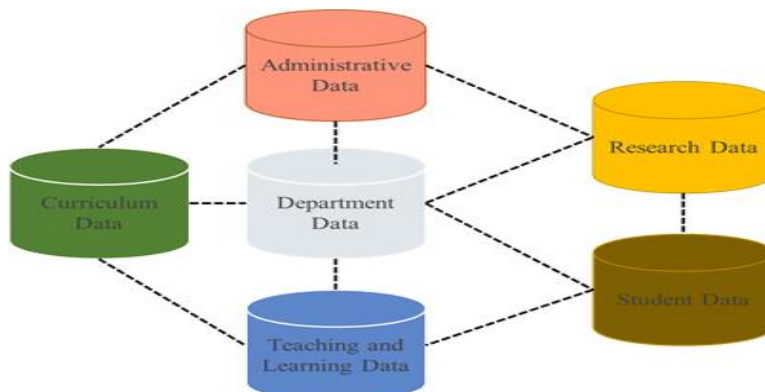
Figure 2. Big Data Analytical Framework at Otago

4.3 System Scenario
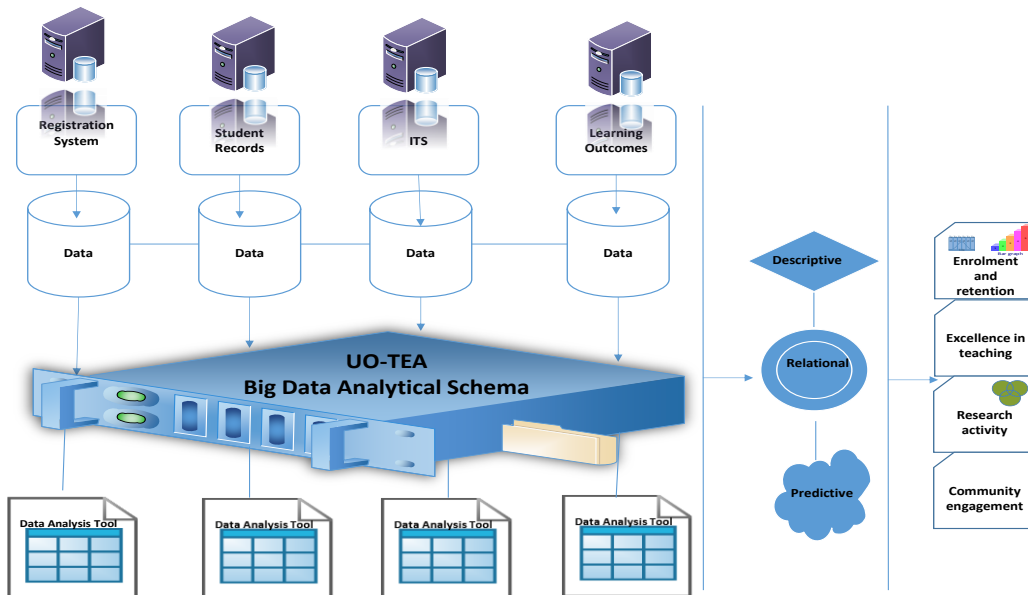
Figure 3. System Scenario

4.4 Simple Process Report Request Scenario
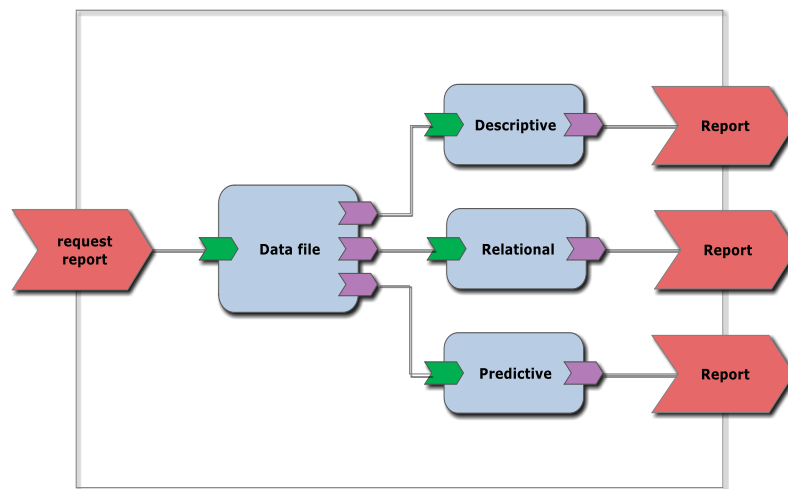
Figure 4. Simple Process Report Request Scenario

4.4.1 Possible Project Performance Outcomes

- Better understanding of institutional Big Data at University of Otago
- Better understanding of the requirements for effective data preparation for Big Data analytics
- A solid foundation for Big Data utilization
- Improved standardized and streamlined data processes
- Consistent ways to effectively leverage data analytics for improved accuracy, deeper knowledge and real time decision making
- Better data-driven decision making and practice
- Foundation for hypothesis testing, web experimenting, scenario modelling, simulation, sensibility and data mining

4.4.2 Possible Project Process Outcomes

- Better tools for collecting, processing, analysing and interpretation of data
- Better data system interoperability and system linking
- Enhanced data analytics and predictive modelling
- Better real-time rendering of analytics on students and instructors performances
- Reliable and comparable performance indicators and metrics within departments and divisions
- Better utilization of historical institutional data to make informed decisions
- Better ability to develop and utilize "what if" scenarios for exploring data to predict possible outcomes

5. CHALLENGES OF IMPLEMENTATION

We anticipate a number of challenges associated with the collecting and implementation of analytic techniques for analyzing Big Data in higher education. For instance, the costs associated with collecting, storing, and developing algorithms to mine data can be time consuming and complex. Furthermore, most of institutional data systems are not interoperable, so aggregating administrative data and classroom and online data can pose additional challenges. While combining data sets from across a variety of unconnected systems can be extremely difficult it offers better comprehensive insights that inevitable lead to improve capabilities

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of predictive modelling. Dringus (2012) suggested that one way of overcoming these problems, is to increase institutional transparency by clearly demonstrating the changes that analytics can help to achieve.

Big Data can be used to help carry out targeted decisions and faster decisions, for promotion purposes (marketing) or to protect our interests. Emerging evidence from research and practice communities suggests that learning analytics may enable learning experiences that are more personal, more convenient, and more engaging and may also have a direct positive impact on student retention. Analytics also has the potential to help learners and instructors recognize danger signs before threats to learning success materialize (Wagner & Ice, 2012). However, wide institutional acceptance of learning analytics requires a clear institutional strategy and the usability of analytics software packages. Further, as stated by Ali et al. (2013), perceived usefulness is one of the strongest drivers influencing users' intentions of adopting a software tool.

A report by the US Department of Education (2013) suggested that the successful implementation of Big Data in higher institution would depend on collaborative initiatives between various departments in a given institution. For instance, the involvement of information technology services departments in planning for data collection and use is deemed critical. This is consistent with views that the value of Big Data Analytics will be based on the ability to co-create governing structures and delivery of more progressive and better policies and strategies currently used (Schleicher, 2013). Wagner and Ice (2012) also pointed out that by increasing collaborative ventures on Big Data initiatives help all groups take ownership of the challenge involving student performance and persistence. Dringus (2012) suggested that the practice of learning analytics should be transparent and flexible to make it accessible to educators (Dringus, 2012; Dyckhoff et al., 2012).

In many instances, there is a divide between those who know how to extract data and what data is available, and those who know what data is required and how it would best be used. As Romero and Ventura (2010) note, analytics has traditionally been difficult for non-specialists to generate (and generate in meaningful context), to visualize in compelling ways, or to understand, limiting their observability and decreasing their impact (Macfadyen & Dawson, 2012).

The importance of communicating these ideas is also acknowledged by Macfadyen and Dawson (2012), who found analytics to have a negative or neutral impact on educational planning. They advocate delving into "the socio-technical sphere to ensure analytics data are presented to those involved in strategic positions in ways that have the power to motivate organizational adoption and cultural change."

Although the existence of an 'online learning environment' is often implied as necessary for the practice of analytics, most types of data are not specific to the web. Data can be generated from any interaction an instructor has with a student. It is the ability to obtain data in greater volumes and track students' activities with precision that has contributed to the development of Big Data as a research field in higher education. Becker (2013) believes that there are three interactive components to be studied when collecting data for analytics: location, population and timing. Location is defined by where and how students are accessing the learning space, while population refers to the characteristics of the group of learners participating in the learning space. Timing can be defined by any unit, from second or minute to semester or year.

Finally, Big Data raises the topic of the ethics of data collection in regard to quality of data, privacy, security and ownership. It also raises the question of an institutions responsibility for taking action based on the information available (Jones, 2012). Dringus (2012) suggests that bringing transparency to learning analytics as a practice could be used to help deter any potentially wrongful use of data. As the amount of data available for use is ever-increasing, the benefits will come from good learning management, reliable data warehousing and management, flexible and transparent data mining and extraction, and accurate and responsible reporting.

6. FUTURE DIRECTIONS

We are currently reviewing work on Big Data analytics in Higher Education and exploring data management and governance structures. This work will result to a detailed description of the current conceptual and theoretical underpinnings of Big Data analytics in higher education, as well as key performance indicators, metrics and methods for capturing, processing and visualizing data. We also intend to develop a set of diagnostic tools and an integrated technology enhanced data analytic framework and ultimately a Data warehouse for Big Data Analytics.

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TEACHERS' LEARNING IN ONLINE COMMUNITIES OF PRACTICE: TWO CASE STUDIES FROM AUSTRALIA

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ABSTRACT

Australia is a vast land with a dispersed population especially in rural or remote areas, which is geographically located in the Asian region. This has a strong bearing on its initial education (pre-service) and the ongoing professional development (in-service) of teachers. The vastness of Australia causes professional isolation and a lack of face-to-face contact with other teachers while the geographical proximity to Asia makes with languages and cultures a necessity due to geo-political and economic reasons. These two motives shape the work of teachers, whether they are still in training or already experienced professionals. Online social networking platforms such as 'ning' and 'edumodo' can bridge the geographical distance within Australia while also connecting it to its Asian neighbour. These online communication networks are increasingly more used to Communities of Practice (CoP) based on the theoretical framework of Etienne Wenger. The educational theorist describes CoP's as groups of people with a shared knowledge base, who interact due to a common interest or goal. This paper describes two case studies from an Australian university that involved online CoP's; one for 34 teacher in pre-service to overcome their geographic isolation and the another for 41 in-service teachers to develop their professional learning in order to engage with Asian languages and cultures. The first project failed completely whereas the second project was highly successful. The failure was mainly due to shortcomings in the technical, behavioural and organisational aspect (i.e. a lack of social capital and face-to-face interaction to accompany the online learning component), features which the successful CoP utilised. The opportunities, challenges and outcomes of both projects are described and analysed. These, in combination with the subsequent recommendation might assist readers who are contemplating similar endeavours.

1. INTRODUCTION

Australia is a large continent stretching 4000 km from east to west and about 3700 km from north to south. It has more than 800 000 km of road, half of them are not sealed. Of the 22 million people, 3.4 million are students. They attend 9 581 school and have 344 348 teachers to educate them. The sheer size of Australia means that about 5000 schools are in rural or remote areas. Some schools are 700 km away from the nearest town (Australian Bureau of Statistics, 2010).

This geographic isolation also brings social, cultural and professional loneliness for teachers, whether they are pre-service (in training) or in-service (on active duty). Attracting teaching staff to those rural or remote areas is challenging due to the lack of professional support networks, interactions and development opportunities. There is now a significant shortage of experienced teachers in these areas of Australia, especially in science and maths education (Hudson & Hudson, 2008).

Australia's geographic proximity to the Asia and the resulting geo-political (i.e. diplomacy, migration, humanitarian assistance) and economic reason (i.e. business, tourism, investment, trade) necessitate a familiarity with those Asian cultures and languages. Therefore, the Australian Government has a vested interest in fostering translingual and transcultural competences in school students as a way of facilitating future engagement with its Asian neighbours.

Both of these geographic challenges (the vastness of Australia and its location within Asia) have a strong bearing on initial education (pre-service) and the ongoing professional learning (in-service) of teachers. The central argument of this paper will be that online networks for pre- and in-service teachers can address the geographic isolation within Australia and enable engagement with the languages and cultures of its Asian

neighbours and as such provide an alternative support for these teaching professionals. A suitable theoretical framework to underpin these online professional networks are Communities of Practice (CoP) that are based on Etienne Wenger's (1998, 2004) work, who defines these as a group of people who share a common knowledge base and interact on an ongoing basis because they have the same interests or goals. Examples of CoPs are soccer moms and dads who use the time spent at their children's games to share parenting tips, artists who debate new styles or techniques in coffee houses or studios, gang members who help each other survive on the streets. These people may not meet every day but they do find value in their interactions because they use their time together to share information, solve each others' problems, vent their frustrations, discuss their aspirations and create tools, designs or other useful resources. Online CoP hold the added advantage of being able to connect to people all over the world, which is extremely valuable if the topic of interest is unusual, the participants live in remote areas or have personal circumstances (i.e. family, work, study commitments) or other issues (i.e. disability, mobility, shift work).

This paper will use a case study approach to describe and analyse two online CoPs under the auspice of an Australian university. The first one was target at 34 pre-service teachers to overcome academic and professional isolation in rural and remote Australian school while on teaching round though the use of 'ning', the other involved 41 in-service teachers and their year-long professional learning to engage with the cultures and languages of Asia. Both projects held various challenges, opportunities and outcomes which informed the formulation of recommendations that might enlighten others who are intending comparable undertakings.

2. METHODOLOGY AND RESEARCH QUESTIONS

To investigate the issue of teachers' learning in online CoPs, a case study approach seemed the most appropriate. Case study approaches are used to a greater extent in educational research to portray context-specific educational situations and to draw conclusions by generalizing from the findings. They are a scientific approach with quality criteria based on objectivity, reliability and validity. Results are able to be communicated directly and effortlessly to stakeholders (Kyburz-Graber, 2004, p. 53).

Case-study research asks questions of 'what', 'why' and 'how', rather than question of 'who' and it certainly does not ask question of 'how many'

(Kyburz-Graber, 2004, p. 54)

The strength of case study research as a research methodology is that it is close to the situation and the people involved. It is ideally suited for the analysis of a phenomenon against the context with the aim to understand the meaning behind the participants' behaviour and knowledge. With this in mind, the research questions centred around the issue of teaching in rural or remote communities, the arsing isolation in the first case study and the engagement with Asian cultures and languages in the second case studies. Of interest was the extent to which online CoP's can connect pre-and in-service teachers with their peers and to what extent these online CoP's are helping to overcome social and academic isolation.

3. CASE STUDY 1: PRE-SERVICE TEACHERS

The first case study reports on a project that was prompted by a 2010 Teaching and Learning grant from the School of Education at Deakin University in Melbourne, Australia. At its heart was the desire to develop an innovative and creative way to support 34 pre-service teachers in their final year of the Bachelor of Education Primary course on teaching rounds in rural or remote schools during the latter half of 2010. These pre-service teachers often feel lonely in such isolated places, have limited access to teaching resources and may have professional or personal issues within the placement that they cannot discuss with the local staff. Therefore, an online CoP was conceptualised and implemented as a seeding platform that would support teacher during their initial training and throughout their future teaching career.

3.1 Background to this Case Study

In Australia, pre-service teacher education is the initial training that comprises an academic degree at the university (usually a Bachelor or Graduate Diploma of Teaching/Education) with a professional experience component. These teaching weeks – often referred to as teaching round or practicum - can be stressful due to the pressure to complete them successfully and their weighing, as they are often the most important component of the academic degree.

The strain is exasperated for pre-service teachers in rural or remote settings, due to the geographic isolation and lack of face-to-face contact and support from university staff and peers. The emotional, social and academic support provided by these collegial or collaborative relationships potentially encourage and sustain pre-service teachers through their often challenging first teaching experiences (LeCornu, 2010; Davie and Berlach, 2010).

As a means of overcoming geographic isolation during teaching rounds in rural and remote schools, Web 2.0 technologies are being explored as an option to reproduce face-to-face mentoring in online forums, with a small body of research emerging (Davie and Berlach, 2010; McLoughlin, Lee and Brady, 2008; Rideout, Bruinsma, Hull and Modayil, 2007). Pre-service teachers are seen as an IT-savvy cohort and well versed in using social networking software in their personal lives. These online means can be utilised as a support mechanism during their teaching practicum while they are off-campus and especially if they are in non-metropolitan schools and as such outside the reach of a traditional school visit from the supervising university staff (Davie and Berlach, 2010).

There are several reasons why online supports seem to offer a way to overcome geographic isolation. For one, the current cohorts of pre-service teachers belong to the Net Generation, also called Net Gen, which Oblinger and Oblinger (2005, p 2.2) defined as "...born around the time the PC was introduced..." Unsurprisingly, 20 percent started to use computers when they were between 5 and 8 years of age. Such early exposure to Information and communication Technology (ICT) has given them considerable digital literacy skills, the aptitude for non-text expression (i.e. audio, video, graphics) and a liking for multi –tasking (Oblinger and Oblinger, 2005).

Higher Education Institutions have recognised the Net Generation's desire for constant connectedness, social networking and online interactivity with their peers; their high ownership of mobile devices (i.e. laptops, mobile phones, PDAs, iPods), proficiency in using Web2.0 tools (i.e. SMS, blogs, podcasts, videocasts , YouTube) and frequent engagement with social networking sites (i.e. Facebook, MySpace) (Oliver & Goerke, 2007).

Universities are trying to capitalise on these observations and at the same time prepare undergraduate and postgraduate students for a rapidly developing global and digital environment which is another reason why online learning choices are offered to these techno-savvy learners. Traditional face-to-face teaching on campus has been supplemented, complimented and sometimes even substituted with online options through Learning Management Systems (LMS), Web 2.0 tools and virtual worlds such as Second Life. Today's students are therefore used to seamlessly move between physical and visual worlds and as Frand (2000) says, more comfortable writing on a keyboard than on paper and happier reading from a screen than from paper.

A third argument for the use of new and emerging technologies in teacher education course is the preparation of teachers of the future, with online skills that will not only benefit them but also their future school students. Within these online CoPs, the participation of young professional who are digital natives can positively influence experienced professionals that are not or less digitally inclined and proficient. The advantage of a CoP lies within the equal access of both novice and expert users, which facilitates discussion and exchange without distinction or demarcation of legitimacy. The learning process thus becomes a joint activity and responsibility within an evolving community of practitioners that supports each other (Kirschner and Lai, 2007).

The literature was searched for similar projects as Australian universities have been using a variety of web based course shells (Blackboard, Oncourse, WebCT) for over a decade as part of the teaching and learning options for their students, either while engaged in on-campus provisions or during their teaching rounds.

One example was the use of a Learning Management System (LMS) for pre-service teachers during their teaching round as part of their Graduate Diploma in Education (Secondary) at the Australian Catholic University (ACU) in Canberra, the national capital. The academic team of McLoughlin, Lee and Brady (2008) used the LMS to enable online peer mentoring amongst the student cohort but also to discuss experiences during their teaching round.

Another example was from the Australian Catholic University (ACU) in Brisbane, Queensland where Drabble (2010) used the LMS for a cohort of Bachelor of Education students. In this instance, emails were send out by the course co-ordinator stay in touch with the pre-service teachers while on their teaching rounds, which helped them to feel connected to the university, reduced their angst and encouraged their confidence.

Both papers outline the advantages of using a university LMS as students' familiarity with the technology (which saves time on training), familiarity with each other (which saves time on introductions) and familiarity with the code of conduct (which saves time on orientation). However, a distinct disadvantage of a university based LMS is the loss of access once the teacher education course finishes. Deng and Yuen (2007) circumvented this issue with the use of second generation web based tools such as blogs, email and instant messenger (IM). Blogging allows the sharing of texts, still images, audio and video files. This in turn helps pre-service teachers to stay connected with their peers during school placements through sharing of ideas and impressions.

In light of these insights, a number of online social networking options were explored and 'ning' was selected as it was a free of charge, protected network, accessible from anywhere that requires little technological skills and time in setting up a profile to participate while offering flexibility through synchronous and asynchronous modes (ning, 2010). The former (real time chat) seemed ideal for urgent matters such as discussions on teaching tips for the next day or classroom management issues that need immediate attention. The latter afforded sharing of photos, videos and audio and appeals to the Net Generation of pre-service teachers that regard heavy text based modes such as email or IM as anachronistic.

The ning was offered to the cohort of 34 pre-service teachers in the latter half of 2010 before going on teaching rounds in rural and remote areas via several email invitations, which were accompanied by offers of information and demonstration sessions as well as phone support for training and troubleshooting. Most unexpectedly, not even one of the pre-service teachers took advantage of the valuable online support for reasons unknown, as none responded to the follow-up online survey and emails to investigate the reasons for this disinterest.

The lack of uptake seems to contradict contemporary discourses about the Net Generations' prolific use of web based technology.

It was hypothesized that pre-service teachers saw the ning as yet another burden on their already busy schedule rather than a help to ease the pressure and assist them through their teaching round. Based on that assumption, it was concluded that participation in an online CoP for teacher education courses would have to be mandatory. It would ensure that these future teachers are benefiting from the available assistance, are equipped with the latest technological skills, are connected to a network of practitioners and are making this a habitual part of their professional lives prior to moving into the workforce.

4. CASE STUDY 2: IN-SERVICE TEACHERS

The second case study was funded in 2011 by the Department of Education and Early Childhood Development (DEECD) in Melbourne, Victoria. It comprised experienced 41 teachers of Chinese (Mandarin), Indonesian and Japanese who were engaging in professional learning under the National Asian Languages and Studies in Schools Program (NALSSP), which has at its core the engagement with Asian cultures and studies. At the same time, teachers in Victoria requires 100 hours of professional learning over a period of five years in order to qualify for a renewal of their teaching registration. Hence, professional learning is compulsory and online options such as CoPs are especially relevant for those in rural and remote areas, those with family commitments or mobility and financial issues, which may prevent them from travelling lengthy distances to attend face-to-face mentoring or professional learning sessions.

4.1 Background to this Case Study

The growing influence of Asian nations as a major factor in the world's economy brings new opportunities especially in an era of rapidly increasing globalization. This was recognized by the Australian Ministerial Council on Education, Employment, Training and Youth Affairs (MEETYA) in its 2008 *Melbourne Declaration on Educational Goals for Young Australian,* which states that "Australians need to become 'Asia literate', engaging and building strong relationships with Asia" (MEETYA, 2008, p 2). Becoming 'Asia

literate' signifies the ability of Australian students to interact and communicate with people from Asian countries and cultures. These skills have to be acquired during their schooling hence the study of Asian languages is a core element of the Australian school curriculum. It is anticipated young Australian who are 'Asia literate' will have a competitive edge in a global economy which in turn will provide Australia with an economic advantage. The Australian Education Foundation (AEF) summarised the essence of Asia literacy in their *National Statement on Asia Literacy in Australian Schools 2011-2012* as the students' appreciation of cultural, social and religious diversity with an ability to be active and informed in order to make sense of their world while at the same time being confident enough to interact well with others (AEF, 2011).

This endeavour has been financially backed by the Australian Government with more than $ 62.15 million for the period from 2008 to 2012 alone under the National Asian Languages and Studies in Schools Program (NALSSP). The NALSSP was developed with a number of stakeholders: the Asian Education Foundation (AEF), embassies, non-government education authorities, as well as state and territory governments. NALSSP's explicit goal was the increase of student's opportunities to familiarise themselves with Asian languages and cultures with the funding used for a number of initiatives in various states and territories such as the one described here from the state of Victoria.

Victoria's Department of Education and Early Childhood (DEECD) holds the view that the study of languages and cultures of Australia's neighbours, namely China, Indonesia, Japan and Korea will assist students in their future careers and help the nation within a developed global economy. Compulsory languages education for all government school students from Prep (Preparatory class) to Year 10 where therefore mandated as it is believed that it will benefit students' personal development and hold social and economical benefits. The policy was formulated in the *Victorian Government's Vision for Languages Education* and launched by the Minister of Education together with the Minister of Multicultural Affairs and Citizenship with the goal to be achieved by 2025 (DEECD, 2008; DEECD 2011).

The case study under discussion was one of the strategic initiatives by DEECD (2011) to revolutionise language education in government schools, specifically the professional development, support and training with technology of the *Asian Languages and Cultural Studies Teachers*. The goal of the project was the professional development in new technologies for experienced language teachers to improve adaption rates and subsequently pedagogical practices in primary and secondary schools.

Professional development for in-service teachers has had a long tradition in Australia due to the former student-teacher apprenticeship model of teacher training. This rudimentary form consisted of an academically excelling secondary student who could become a junior teacher after shadowing a senior teacher for a short time. In the colonial period, this essentially left a teenager in charge of a classroom with over 40 students and a limited range of teaching skills. Once these teachers were in-service, it was inevitable that their basic preparation required further training, which was offered on the weekends, during school holidays or ad hoc but usually without incentives and as such unattractive. The Education Act of 1872 made schooling compulsory and as federation and the age of Industrialization approached, more secondary school educated citizens were needed and in turn better educated teachers, which led to the establishment of teacher colleges. However, teacher professional development was still largely seen as 'remedial' measure. It was designed to overcome a deficiency that the teacher had due to a lack of skills or knowledge. An exploding population through mass immigration from Europe and a greater awareness of competitiveness with countries overseas led to the up-grading of teacher qualifications with tertiary requirements such as Bachelor or Graduate Diplomas in the 1980s. The advent of computers, digital technology, the Internet and the Information Age required further up-grading of teachers' proficiencies to keep pace with the changing demands of a technology rich curriculum. By now, the notion of life-long learning has made ongoing professional development part of a teaching career (Hanewald, 2003). This view was further affirmed with the Victorian Institute of Teaching's establishment by an act of Parliament in December 2001 as a regulatory body that registers all teachers in Victorian government, catholic and independent schools. The registration and renewal is a prerequisite for employment in any school and dependents on completion of 100 hours of professional learning over a period of five years (VIT, 2011).

Teacher professional development or teacher learning as it is now referred to was seen as bridging the gap between the students' potential and actual performance and as such a cornerstone for effective schools according to the DEECD (2012). Teacher professional learning in this context is seen as keeping up-to-date with knowledge and skills and the developments in their field just like any other professionals who need to continuously learn to stay at the forefront of their chosen profession.

The teacher professional learning in this case study of 41 *Asian Languages and Cultural Studies Teachers* (Indonesian, Japanese, Chinese/Mandarin) focused on the use of new and emerging technologies through the use of mobile devices such as PDAs, smart phones, notebooks, iPods and iPads. These tools enable interaction with native speakers in different parts of the world and "...the greatest benefits of technology is that it can bridge distance and time..." (Nunan, 2010, p. 2005).

In Australia, the greatest difficulty in studying a faraway language and culture was limited or no access to native speakers, which Web 2.0 tools (i.e. blogs, media sharing, social bookmarking, social networking, video conferencing, wikis, virtual worlds) can overcome. Therefore, teachers need to be trained to use these technologies in their classroom so that their students can become digital fluent and ready for the challenges of the 21st century. Firstly, teachers need to learn the technical skills themselves, then their pedagogical use to embed them in existing classroom practices. Teachers will have to know which technologies are suitable for their teaching practice to find the best way in which these new tools can enhance teaching and learning activities and lastly, teachers need to be able to conceptualise a systematic and sequential approach to their introduction.

Hence, 21 Asian Languages and Cultural Studies teachers in primary schools and 19 teachers in secondary schools were issued with a substantial grant to purchase technological tools of their own choosing. They were also supported in their professional learning by a team of six carefully selected academics with specialization in at least one of the aspects related to the teachers' needs and two officers from the Department of Education and Early Childhood (DEECD) in Victoria for the duration of a school year that is from January to December 2011. The year started with teachers writing their project goals and other preparation work such as lesson plans, designing of new activities and resources and purchasing of mobile devices to successfully support the new teaching approach. Then, they attended two training days at a local university on pedagogical approaches to using new technologies and two days at a centre for the moving image to acquire the technical skills in handling the devices. This was followed by four terms (worth 40 weeks of teaching in total) during which teachers were supported via a social networking side by the academics. Edmodo was chosen as it is a free yet secure and user friendly platform, which offers multimodality (audio, video, still images, text) with a variety of features (asynchronous, synchronous, forum, personal messages, group announcements, hyper linking to the web, resource bank). As such, it provided an ideal online network for the building of this CoP. During the teaching year teachers also had the opportunity to email, phone, visit the academics at university or invite them to their school or attend a conference. However, none of the teachers made use of this option although they had two discretionary days during the year which could have been used for this purpose. One of the reasons may have been the substantial distance and time to travel from country Victoria to the metropolitan based university and the clashing schedules of school teachers and university academics. Another reason was the already established regional networks for regular teacher meetings and professional development, which teachers utilized for their technology based teaching collaborations. At the end of the year, teachers meet again at the university for two days to present their year's work in the form of a short video and write up their report. The scaffolding throughout the year ensured the sustainability of the project for teachers as they had every conceivable support, which put them in a position to continue this innovative work in subsequent years by themselves.

5. CONCLUSION AND RECOMMENDATIONS

The two case studies aimed at setting up and utilising an online Community of Practice as an innovative way to provide teachers (pre-service and in-service) with support for their daily work. Both case studies dealt with the same issue: the development of teaching professional that can educate students for the future demands of the workforce in a globalised and highly mobile world and the use of online CoPs to scaffold their learning. Web 2.0 tools alongside the need to support teachers in rural and remote schools or with Asian language and cultures are driving the establishment of online CoPs. Both studies also show that success or failure is possible. The mere offer of technology for educational purpose does not ensure that teachers take it up nor does it ensure that it will be a positive experience. While there are a range of reasons for teachers not to participate in technology such as those without general interest in developing their professional skills or particular disinterest in new technologies, those lacking sufficient skills to access online resource, those being weary of yet another fad in the exhausting array of digital programs or those simple worn-out from the

relentless demands of daily life, work and their studies the main difference in the described case studies seemed to have been the lack of social capital. In case study 1, there was no prior relationship between the online CoP facilitators and the pre-service teachers. This unfamiliarity prevented the building of a strong group as personal interactions were non-existent. In comparison the facilitators and participants in case study 2 were able to spent a block of time face-to-face at the beginning of the project and another intensive block of time at the end of the project year, with significant online interactions during the life of the project, which contributed substantially to its success. The built relationships enabled the sharing of pre-existing and newly generated knowledge, leading to innovative teaching in the actual primary and secondary classrooms, which became evident in the video presentations that were presented at the end of the year. Apart from the crucial importance of group members' relationships and the communal responsibility to produce and share resources, ideas and knowledge via the online platform, there choice of the online networking tool is vital. The use of new and emerging technologies in teaching contexts and their analysis made a set of technical, behavioural and organisational aspects in choosing an online platform lucid. The technical recommendations comprise selection of technology that is based on the needs of the teachers and aligns with their digital literacy skills; is user friendly, intuitive to use and requires little set up time and effort before participating; is compatible with a range of other online tools; offers multimodality (i.e. text, still images, video and audio files); enables asynchronous posting but also synchronous chat; and has at least one designated administrator who monitors the site. The behavioural recommendations include a clear articulation of the rationale and potential benefits for the engagement with the online CoP; communication of ethical online conduct that excludes inappropriate use (i.e. pornography, fraud, defamation, breach of copyright, unlawful discrimination or vilification); encouragement of collegial and collaborative relationships and free exchange of ideas. The organisational recommendations involve opportunities for trouble shooting (technical and organisational); regular monitoring of posts and moderation of discussion; and establishment of self-supporting peer mentoring. Finally, establishing a code of conduct (i.e. behaviour in relation to netiquette, cyber bulling and professional standards), introducing participants formally and initiating newcomers to the concept and purpose of CoP as well as their online versions, documenting lessons learned , providing a Frequently Asked Question (FAQ) section and acknowledging and encouraging contributions are tasks for the facilitator to further ensure that the group is achieving its goals and moving towards individual excellence.

With these guidelines in mind, online CoPs for teaching professionals will have a much greater likelihood of success.

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TEACHING TEACHERS FOR THE FUTURE PROJECT: BUILDING TPACK CONFIDENCE AND CAPABILITIES FOR ELEARNING

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ABSTRACT

In Australian Higher Education, the importance of initial teacher education (ITE) programs is evident through enrolments totalling 105 858 students in the broad field of Education in 2012 (DIISRTE, 2012) which represent 9.7% of the 1 094 672 students enrolled in higher education. This paper provides insights into the *Teaching Teachers for the Future (TTF) Project* involving all Higher Education Institutions (HEIs) which provide ITE programs in Australia. The 15 month long, $8 million TTF Project, funded by the Australian Government's ICT Innovation Fund aimed to develop the ICT capabilities of future teachers. The design of ITE programs need to build the capabilities of future teachers to be effective within increasingly eLearning environments in schools. Central was the use of the Technological Pedagogical Content Knowledge (TPACK) conceptualisation (Mishra & Koehler, 2006) for teacher educators to build pre-service teachers' TPACK confidence and capabilities to enhance eLearning approaches with their students. Key findings from the TTF Project indicate that the TPACK conceptualisation and the Australian Institute for Teaching and School Leadership's *ICT Elaborations for Graduate Teacher Standards* (AITSL, 2011a) can inform the design of ITE programs in preparing future teachers for using ICT to support teaching and to support student learning.

KEYWORDS

Initial Teacher Education, TPACK, Capabilities, ICT, eLearning

1. INTRODUCTION – INITIAL TEACHER EDUCATION, TPACK CONFIDENCE, CAPABILITIES AND ELEARNING

Various approaches and conceptualisations of eLearning, blended learning, and online learning have been proposed and developed for use in all levels of schooling and education. Regardless of the approach or the conceptualisation which might be adopted, there is strong agreement that technological changes are requiring new capabilities of teachers to interface with and transform their existing pedagogical content knowledge (PCK). A central challenge is for teacher educators, referring here to those who teach the teachers in initial teacher education (ITE) programs, to build capabilities which can explore, harness, model and design eLearning environments which, in turn, help to build the capabilities of future teachers to design and implement effective eLearning with their students.

The importance and impact of designing initial teacher education (ITE) programs in Australian Higher Education Institutions (HEIs) is immense, given that enrolments in the broad field of Education totalled 105 858 students in 2012 (DIISRTE, 2012) which represented 9.7% of the 1 094 672 students enrolled in higher education. It is also worth noting that the remaining 90.3% of students study in HEIs would have been taught by teachers who were trained and educated in ITE programs. Put simply, ITE programs need to lead the design and implementation of eLearning approaches, enabling the development of future teachers with appropriate dispositions, values, beliefs, and capabilities to capitalise upon the potential of new and emerging technologies to enhance learning and teaching. As Tondeur et al. indicate, research (Agyei & Voogt, 2011; Drent & Meelissen, 2008) has established that a "crucial factor influencing new teachers'

adoption of technology is the quantity and quality of pre-service technology experiences included in their teacher education programmes" (Tondeur et al., 2011, p. 134). However, while this is well understood, they highlight that research findings (e.g. Sang et al., 2010; Tearle & Golder, 2008) report that "beginning teachers feel they are not well-prepared to effectively use technology in their classrooms" (Tondeur et al., 2012, p. 134).

This paper provides insights into the *Teaching Teachers for the Future (TTF) Project* involving all Higher Education Institutions (HEIs) which provide ITE programs in Australia. The 15 month long, $8 million TTF Project, funded by the Australian Government's ICT Innovation Fund aimed to develop the ICT capabilities of future teachers. The design of ITE programs need to build the capabilities of future teachers to be effective in designing and implementing eLearning in schools. Central to this project was the use of the Technological Pedagogical Content Knowledge (TPACK) conceptualisation (Mishra & Koehler, 2006) for teacher educators to design and model eLearning approaches with their students. This paper presents key findings which indicate that the TPACK conceptualisation and the *ICT Elaborations for Graduate Teacher Standards* (AITSL, 2011a) can inform the design of ITE programs in preparing future teachers for using ICT to support teaching and to support student learning.

2. TEACHING TEACHERS FOR THE FUTURE (TTF) PROJECT

The *TTF Project* focused on "systematic change in the ICT proficiency of graduate teachers in Australia by building the ICT capacity of teacher educators and developing resources to provide rich professional learning and digital exemplar packages" (Australian Government, 2010, p. 1). The TTF Project involved all 39 Australian Higher Education ITE providers, with the lead agency being Education Services Australia (ESA) and partners being the Australian Council of Deans of Education (ACDE), the Australian Institute for Teaching and School Leadership (AITSL), and the Australian Council for Computers in Education (ACCE). Further details about the project are available elsewhere (http://www.aitsl.edu.au/teachers/ttf/ttf-project.html).

The TTF Project reflected an approach which respectfully understood the potential of capitalising upon the 'collective wisdom' of HEIs. As argued elsewhere (Finger, 2013a), the TTF Project adopted an *improvement* agenda rather than an *accountability* agenda. This collaborative approach, reflected through the establishment of the TTF National Support Network (NSN), the voluntary contributions of members of the TTF Research and Evaluation Working Group (REWG), and the collegial spirit of participants throughout the project. Central to the TTF Project was the Technological Pedagogical Content Knowledge (TPACK) conceptualisation (see Mishra & Koehler, 2006) which took into account the need for technological knowledge (TK) and well as pedagogical content knowledge (PCK). The *Australian Professional Standards for Teachers* (AITSL, 2011b) also interfaced with the TPACK conceptualisation, and a TTF Project outcome was the development of AITSL's *ICT Elaborations for Graduate Teachers* (AITSL, 2011a) to complement and elaborate upon the standards.

3. TPACK AND PRE-SERVICE TEACHER EDUCATION LITERATURE REVIEW

A systematic literature review of TPACK undertaken by Voogt et al. (2013) examined 55 peer-reviewed publications between 2005 and 2011. That review found that there were different understandings of TPACK, and that teacher knowledge (TPACK) and their beliefs about pedagogy and technology determined whether or not a teacher might teach with technology. A search of the Association for the Advancement of Computing in Education (AACE) EdITLib publications, using 'TPACK" as the search term, resulted in 526 papers identified, with 232 papers published in 2012-2013. Mishra, in his December 2012 Newsletter lists 15 dissertations which utilised TPACK (Alshehri, 2012; Anderson, 2012; Benson, 2012; Bilici, 2012, Corey, 2012; Easter, 2012; Gillow-Wiles, 2012; Habowski, 2012; Hineman, 2011; Matherson, 2012; McBroom, 2012; Mishne, 2012; Mudzimiri, 2012; Rathsack, 2012; Unger, 2012). This provides evidence of an expanding body of TPACK research which is making a significant contribution to informing ITE, and the professional learning of practising teachers.

Tondeur et al. (2012) undertook a meta-ethnography through exploring qualitative evidence in relevant literature relating to pre-service teacher education. This review was useful in identifying 12 themes, as displayed in Table 1.

Table 1. Themes from a meta-ethnography of qualitative studies (Synthesised from Tondeur et al., 2012)

Key Themes relating to the preparation of pre-service teachers	
Themes and elaboration of the themes	**Relevant Literature**
1. Aligning theory and practice This relates to how well theory was embedded in practice.	Angeli & Valanides (2009); Goktas et al. (2008); Jang (2008); Lavonen et al. (2006)
2. Using teacher educators as role models The use of ICT needs to be modelled to pre-service teachers.	Angeli & Valanides (2009); Tearle & Golder (2008); Thompson et al. (2003); Clift et al. (2001)
3. Reflecting on attitudes about the role of technology in education It is important to reflect on the role of technology in education and to change attitudes.	Goktas et al. (2009); Tearle & Golder (2008)
4. Learning technology by design It is important for pre-service teachers to learn how to design and implement learning experiences which incorporate technology.	Angeli & Valanides (2009); Thompson et al. (2003); Sahin (2003)
5. Collaborating with peers Pre-service teachers need opportunities to discuss, share concerns and ideas with peers.	Jang (2008); Barton & Haydn (2006); Brush et al. (2003); Thompson et al. (2003)
6. Scaffolding authentic technology experiences Pre-service teachers acknowledged that it was important to be able to apply educational technology knowledge in authentic technology experiences	Goktas et al. (2009); Tearle & Golder (2008); Brush et al. (2003)
7. Moving from traditional assessment to continuous feedback Pre-service teachers felt that, while tests are important, there is a lack of relationship between the traditional tests and what is needed in order to make progress in using ICT in the classroom; e.g. such as developing ICT portfolios.	Lavonen et al. (2006); Barton & Haydn (2006); O'Reilly (2003); Sahin (2003)
Key Themes relating to the institutional level	
8. Technology planning and leadership It is important that leadership occurs at the programme planning and coordination level.	Goktas et al. (2009); Haydn & Barton (2007); Lavonen et al. (2006)
9. Co-operation within and between institutions Co-operation at the institutional level assists successful technology integration.	Thompson et al. (2003); Clift et al. (2001)
10. Staff development Many teacher educators were found to lack the knowledge, skills, and self-efficacy to teach or model technology integration to pre-service teachers, and, therefore, staff development is essential.	Goktas et al. (2009); Thompson et al. (2003); Seels et al. (2003)
11. Access to resources The research confirms the importance of access to resources, such as hardware, software, learning management systems)	Goktas et al. (2009); Haydn & Barton (2007); Thompson et al. (2003); Cuckle & Clark (2002)
12. Systematic and systemic change efforts The preparation of pre-service teachers to use technologies needs to be part of a systematic change process.	Goktas et al. (2009); Thompson et al. (2003); Seels et al. (2003)

Collectively, the themes identified by Tondeur et al. (2012), the literature review by Voogt et al. (2013), and the growing TPACK research base provides a context in which the TTF Project research and evaluation is located. The literature establishes the importance of pre-service teacher TPACK capabilities for successful eLearning.

4. TTF PROJECT RESEARCH AND EVALUATION DESIGN AND METHODOLOGY

Three major research and evaluation strategies were designed and implemented; namely, (1) the development and administration of a *TTF TPACK Survey*, (2) the implementation of Most Significant Change (MSC) methodology, and (3) the facilitation of and opportunities for institution-initiated TTF research and evaluation projects. This paper focuses on data analysis obtained through both parametric and Rasch analyses of the *TTF TPACK Online Survey*.

Jamieson-Proctor et al. (2013) outline the development of *TTF TPACK Survey* instrument which aimed to evaluate the change in pre-service teachers' TPACK as a result of their involvement in the TTF intervention conducted throughout 2011 at all participating Australian HEIs. The *TTF TPACK Survey* was administered

online pre- (T1) and post- (T2) the TTF intervention in each HEI to seek evidence of changes to the pre-service teachers' self-perceptions of their *confidence* to use ICT with a range of pedagogical strategies, and to support their future students' learning with ICT. Additionally, it aimed to measure the pre-service teachers' perceptions of *usefulness* of ICT for teaching and learning. Jamieson-Proctor et al. (2013) detail more fully the validity and reliability of the *TTF TPACK Survey*. However, this paper notes that a limitation of the data is that the online survey sought self report information from the pre-service teachers. This approach was justified according to limitations posed by the scale of the project and the design of the data collection needed to be logistically possible. Furthermore, it should be noted that the MSC methodology employed at each HEI, enabled the survey data to be complemented by the MSC stories.

The *TTF TPACK Online Survey* data collections were undertaken in mid-June and early November 2011. A total of 12881 participants completed the first survey (T1) and 5809 participants the second (T2). Participants tended to be female, Australian, spoke English at home, and tended not to identify as either Aboriginal Australians or Torres Strait Islanders. They ranged in age from 17-62 years with an average age of 29 years, and with secondary school as the most likely previous qualification for both participants and their parents.

5. TTF PROJECT SUMMARY OF SELECTED FINDINGS – PRE-SERVICE TEACHER CONFIDENCE

This paper presents a selection of findings related directly to future teachers' TPACK confidence and capabilities. TTF research and evaluation findings are provided elsewhere in the TTF Project final report (available at http://www.acde.edu.au/pages/images/TTF%20Final%20Report.pdf). Moreover, the TTF Project Special Edition of *Australian Educational Computing* provides further scholarly insights into TTF project outcomes and impact (Campbell, 2013; Chandler & Redman, 2013; Gronn et al., 2013; Heck & Sweeney, 2013; Henderson et al., 2013; Kearney & Maher, 2013; Lloyd & Mukherjee, 2013; Masters et al., 2013; Doyle & Reading, 2013; Reading & Doyle, 2013; Sweeney & Drummond, 2013; White & Geer, 2013; Williams & Sutton, 2013; Zagami, 2013). Specifically, in that journal issue, Finger et al. (2013b) provides a summary of key findings from the *TTF TPACK Online Survey*.

5.1 Pre-Service Teachers' Confidence about How ICT Supports Teaching

Pre-service teachers were asked to respond to items relating to their confidence, as a future teacher, about their use of ICT, to support teaching. In response to these items, means were calculated and the range of ratings extended from approximately 4.2, where a rating of 4 is equivalent to being moderately confident through to approximately 5.6, where a rating of 7 would be extremely confident and a rating of 6 would also reflect a high level of confidence. Growth in confidence was evident for all items between T1 and T2, as shown in Figure 1.
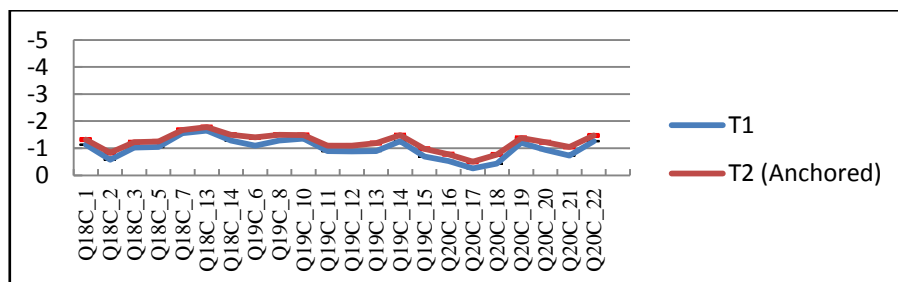
Figure 1. Confidence to use ICT, as a future teacher, to support teaching (*TTF Project TPACK Online Survey* Items 18C, 19C & 20C *combined*)

At the individual item level, as illustrated in Figure 2, participants were *most likely* to be confident that ICT would support teaching in relation to:[1]

- engage with colleagues to improve professional practice;
- teach specific subject areas in creative ways;
- use ICT for reporting purposes such as reporting to parents/carers;
- select and organise digital content & resources;
- use a range of ICT resources and devices for professional purposes; and
- collaborate for professional purposes such as online professional communities.

However, they were *least likely* to be confident to use ICT to support teaching to:

- teach strategies to support students from Aboriginal and Torres Strait Islander backgrounds;
- manage challenging student behaviour by encouraging responsible use of ICT;
- develop digital citizenship to promote student demonstrate of rights and responsibilities in their use of digital resources;
- engage parents & families in child's school through ICT; and
- teach strategies responsive to diverse student backgrounds.
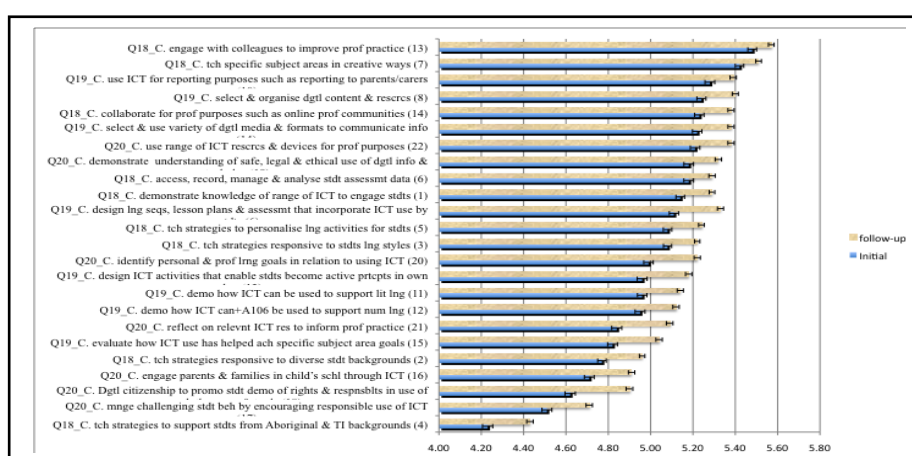
Figure 2. Average confidence of pre-service teachers to use ICT to support teaching (Q18-20 items arranged in ascending order; Scale 0-7 where 7 is the highest level of confidence)

Table 2 shows that the positivity of all responses increased significantly from the initial to the follow-up survey, with the threshold probability set at p<.002 (Bonferonni family-wise correction for 24 items).

Table 2. Nonparametric (Kruskal-Wallis) tests of initial vs. follow-up confidence ratings of 24 items about how confident pre-service teachers, as future teachers, would be to use ICT to support teaching[2]

Q18-20 Confidence ratings	Chi-Square	df	Asymp. Sig.
Q18_C. Demonstrate knowledge of range of ICT to engage students (1)	36.104	1	0.000
Q18_C. Teach strategies responsive to diverse student backgrounds (2)	67.906	1	0.000
Q18_C. Teach strategies responsive to students learning styles (3)	37.745	1	0.000
Q18_C. Teach strategies to support students from Aboriginal & TI backgrounds (4)	51.530	1	0.000
Q18_C. Teach strategies to personalise learning activities for students (5)	40.912	1	0.000
Q18_C. Access, record, manage & analyse student assessment data (6)	15.596	1	0.000
Q18_C. Teach specific subject areas in creative ways (7)	12.041	1	0.001
Q18_C. Engage with colleagues to improve professional practice (13)	12.133	1	0.000
Q18_C. Collaborate for professional purposes such as online professional communities (14)	32.801	1	0.000
Q19_C. Design learning sequences, lesson plans & assessment that incorporate ICT use by students (6)	68.341	1	0.000
Q19_C. Select & organise digital content & resources (8)	36.911	1	0.000
Q19_C. Use ICT for reporting purposes such as reporting to parents/carers (10)	14.861	1	0.000
Q19_C. Demonstrate how ICT can be used to support literacy learning (11)	43.356	1	0.000

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[1] Highest and lowest groups to break in scores included: e.g., 5.1, 5.0, & 4.7 (only 5.1 & 5.0 included).
[2] Wording of items abbreviated in both figures and tables to accommodate available space on page.

Q19_C. Demonstrate how ICT can be used to support numeracy learning (12)	46.638	1	0.000
Q19_C. Design ICT activities that enable students become active participants in own learning (13)	66.427	1	0.000
Q19_C. Select & use variety of digital media & formats to communicate info (14)	38.768	1	0.000
Q19_C. Evaluate how ICT use has helped teach specific subject area goals (15)	68.665	1	0.000
Q20_C. Engage parents & families in child's school through ICT (16)	55.170	1	0.000
Q20_C. Manage challenging student behaviour by encouraging responsible use of ICT (17)	53.660	1	0.000
Q20_C. Digital citizenship to promote student demonstrate of rights & responsibilities in use of digital resources & tools (18)	89.908	1	0.000
Q20_C. Demonstrate understanding of safe, legal & ethical use of digital info & technology (19)	25.151	1	0.000
Q20_C. Identify personal & professional learning goals in relation to using ICT (20)	65.759	1	0.000
Q20_C. Reflect on relevant ICT research to inform professional practice (21)	77.940	1	0.000
Q20_C. Use range of ICT resources & devices for professional purposes (22)	34.948	1	0.000

5.2 Pre-Service Teachers' Confidence about How ICT Supports Student Learning

In response to items which sought pre-service teachers' perceptions of the confidence to use ICT to support student learning, growth in confidence was evident for all items between T1 and T2, as shown in Figure 3.
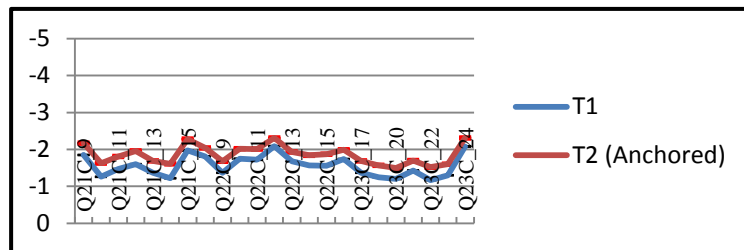
Figure 3. Confidence to facilitate student use (*TTF Project TPACK Online Survey* Items 21C, 22C & 23C *combined*)

In the initial survey, participants answered 24 items (Q21-23) using a 7-point Likert scale ranging from "Not at all confident" (1) to "Very confident" (7). Their responses from the initial survey were entered into an unconstrained factor analysis (PCA, Varimax rotation, .25 and above loadings visible, KMO shown). This factor analysis produced a single-component solution with all 24 items loading at .6 or above. A KMO of .951 and cumulative explained variance of 73% both supported the quality of this solution. Cronbach's Alpha was .985, a highly acceptable value. Responses from the follow-up survey were entered into a confirmatory factor analysis utilising Maximum Likelihood extraction of the single factor solution yielded a solution where all 24 items loaded at levels of .8 or above, KMO=.984 and 74% of variance was explained.

More generally, at the individual item level, the range of ratings extended from approximately 4.8, where a rating of 4 is equivalent to being moderately confident through to approximately 5.5, an average rating roughly equidistantly between ratings of moderate (4) vs. extreme confidence (7). As illustrated in Figure 3 below, participants were *most likely* to be confident that ICT would support student learning in relation to providing motivation for curriculum tasks, demonstrating what they have learned, developing understanding of world, gathering information and communicating with known audiences, and communicating with others locally and globally. In contrast, they were *least likely* to be confident that ICT would support student learning in relation to facilitate integration of curriculum areas to construct multidisciplinary knowledge, understand and participate in changing knowledge economy, synthesise their knowledge, acquire awareness of global implications of ICT-based technologies, and develop functional competencies in specified curriculum areas.
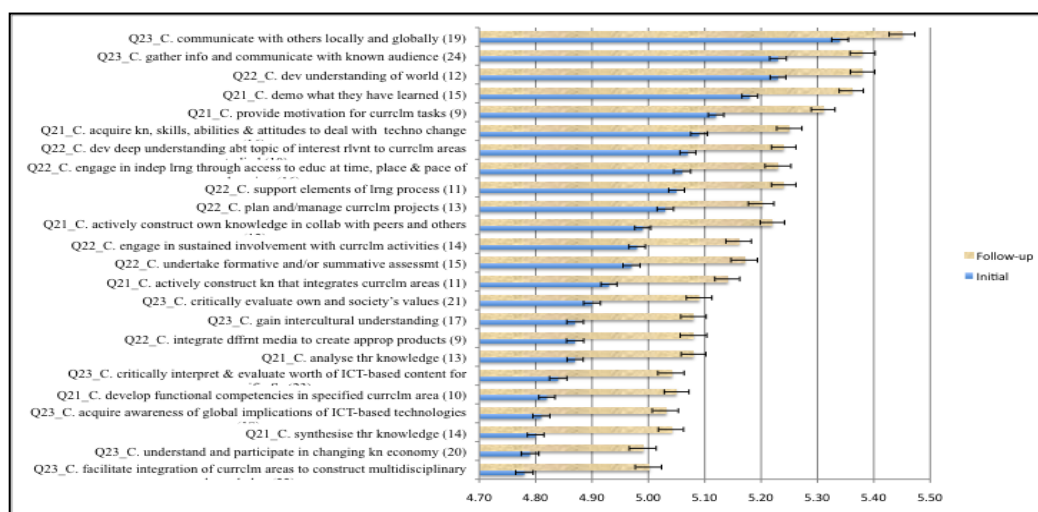
Figure 4. Average confidence of pre-service teachers to use ICT to support student learning (Q21-23 items arranged in ascending order; Scale 0-7 where 7 is the highest level of confidence)

As illustrated in Figure 4, when asked to rate 24 items for Questions 21-23, in terms of their confidence that each item would support ICT teaching, and with the average response per item plus standard error per occasion shown, the higher ratings on the occasion of the follow-up survey plus the non-overlapping error terms for initial vs. follow-up survey items are consistent with these differences being statistically significant. As further shown in Table 3, with the threshold probability set at p<.002 (Bonferonni family-wise correction for 24 items), the positivity of all responses increased significantly from the initial to the follow-up survey.

Table 3. Nonparametric (Kruskal-Wallis) tests of initial vs. follow-up confidence ratings of 24 items related to questions about how ICT can support student learning

Confidence ratings	Chi-Square	df	Asymp. Sig.
Q21_C. Provide motivation for curriculum tasks (9)	62.024	1	0.000
Q21_C. Develop functional competencies in specified curriculum area (10)	82.94	1	0.000
Q21_C. Actively construct knowledge that integrates curriculum areas (11)	72.675	1	0.000
Q21_C. Actively construct own knowledge in collaboration with peers & others (12)	74.798	1	0.000
Q21_C. Analyse their knowledge (13)	61.48	1	0.000
Q21_C. Synthesise their knowledge (14)	85.774	1	0.000
Q21_C. Demonstrate what they have learned (15)	54.675	1	0.000
Q21_C. Acquire knowledge, skills, abilities & attitudes to deal with techno change (16)	32.813	1	0.000
Q22_C. Integrate different media to create appropriate products (9)	55.039	1	0.000
Q22_C. Develop deep understanding about topic of interest relevant to curriculum areas studied (10)	50.482	1	0.000
Q22_C. Support elements of learning process (11)	54.714	1	0.000
Q22_C. Develop understanding of world (12)	35.03	1	0.000
Q22_C. Plan & manage curriculum projects (13)	38.265	1	0.000
Q22_C. Engage in sustained involvement with curriculum activities (14)	47.502	1	0.000
Q22_C. Undertake formative and/or summative assessment (15)	48.953	1	0.000
Q22_C. Engage in independent learning through access to education at time, place & pace of own choosing (16)	37.033	1	0.000
Q23_C. Gain intercultural understanding (17)	57.781	1	0.000
Q23_C. Acquire awareness of global implications of ICT-based technologies (18)	58.654	1	0.000
Q23_C. Communicate with others locally and globally (19)	13.798	1	0.000
Q23_C. Understand and participate in changing knowledge economy (20)	47.853	1	0.000
Q23_C. Critically evaluate own and society's values (21)	45.995	1	0.000
Q23_C. Facilitate integration of curriculum areas to construct multidisciplinary knowledge (22)	58.494	1	0.000
Q23_C. Critically interpret & evaluate worth of ICT-based content for specific Ss (23)	47.116	1	0.000
Q23_C. Gather info and communicate with known audience (24)	27.494	1	0.000

The findings reported here showed that the TTF Project, focusing on a 'collective wisdom' approach, using TPACK as the guiding conceptualisation, and attention being paid to the *Australian Professional Standards for Teachers ICT Elaborations for Graduate Teachers* (AITSL, 2011a), resulted in gains in the overall confidence of pre-service teachers to use ICT to support teaching and to support student learning. Furthermore, this research has identified specific areas of strong confidence, such as using ICT to engage with colleagues to improve professional practice, teach specific subject areas in creative ways, use ICT for reporting purposes such as reporting to parents/carers, selecting and organising digital content and resources, using a range of ICT resources and devices for professional purposes, and collaborating for professional purposes through online professional communities

Given the expected technological changes of new and emerging technologies, the TTF Project research and evaluation has also identified ongoing areas needing attention. Strengthening capabilities in the use of ICT to support teaching is required in developing strategies to support students from Aboriginal and Torres Strait Islander backgrounds, managing challenging student behaviour by encouraging responsible use of ICT, promoting digital citizenship which enables student demonstration of digital rights and responsibilities in using digital resources, engaging parents and families in their children's schooling through ICT use, and developing strategies which are responsive to diverse student backgrounds. In addition, strengthening capabilities is also required in supporting student learning, such as integrating curriculum areas to construct multidisciplinary knowledge, for future teachers to effectively understand and participate in changing knowledge economy, and to acquire awareness of global implications of ICT-based technologies.

6. CONCLUSION

This paper provided a summary of the TTF Project and established the importance of ITE programs in preparing future teachers to have the TPACK confidence and capabilities needed to support teaching and to support student learning. The literature review established the growing TPACK research base (e.g. Voogt et al., 2013) and the key themes (Tondeur et al., 2012) relating to teacher preparation for ICT use. Consistent with this literature, the TTF Project was guided by the TPACK conceptualisation. The TTF approach focusing on ITE programs and institutional leadership and collaboration within and between HEIs in Australia appropriately addressed key themes. themes identified at the teacher preparation programme level and at the institutional level.

Importantly, by adopting an *improvement* agenda, rather than responding to an *accountability* agenda, this paper has argued that the TTF Project research and evaluation findings have demonstrated that pre-service teachers' TPACK confidence and capabilities, which both support teaching and support student learning, were enhanced. Given the central importance of teachers in eLearning, continuing attention needs to be focused on TPACK in ITE programs, and the TTF research provides evidence of measurable improvements, which can promote more effective teacher preparation and, consequently, this can result in more effective eLearning by students in schools.

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Short Papers

THE COMPARISON OF INDUCTIVE REASONING UNDER RISK CONDITIONS BETWEEN CHINESE AND JAPANESE BASED ON COMPUTATIONAL MODELS: TOWARD THE APPLICATION TO CAE FOR FOREIGN LANGUAGE

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ABSTRACT

Inductive reasoning under risk conditions is an important thinking process not only for sciences but also in our daily life. From this viewpoint, it is very useful for language learning to construct computational models of inductive reasoning which realize the CAE for foreign languages. This study proposes the comparison of inductive reasoning under risk conditions between Chinese and Japanese based on computational models. The results suggest that risk conditions (quantitative conditions) have a significant effect on inductive reasoning in Japanese, while those conditions have no effect in Chinese. On the contrary, argument conditions (qualitative conditions) have a significant effect on inductive reasoning in Chinese, while those conditions have an only partial effect in Japanese. More research is needed to find the essential reason for this contrast, for example differences between cultural or social systems. However, it is important to consider this contrast when the present models of inductive reasoning are applied to CAE for Chinese and Japanese.

KEYWORDS

Inductive reasoning, risk conditions, Chinese, Japanese, computational models, CAE

1. INTRODUCTION

Inductive reasoning is an important thinking process not only for sciences but also in our daily life. From this viewpoint, it is very useful for language learning to construct computational models of inductive reasoning which realize the CAE for foreign languages. Additionally, there are many kinds of risks that affect the inductive reasoning in various situations. Therefore, the computational model has to include the adaptive mechanism for those kinds of risk situations. We have already constructed computational models in Chinese and Japanese which include such an adaptive mechanism (Zhang, Terai, Dong, Wang, Nakagawa, in press). However, for effective usage of those models in practical education, that mechanism has to process the naive differences between languages, for example, Chinese and Japanese. Therefore, it is important to compare the effects of risk context on inductive reasoning between languages, for example, Chinese and Japanese. This study proposes the comparison of inductive reasoning under risk conditions between Chinese and Japanese based on computational models.

At first, this study deals with one kind of inductive reasoning argument (e.g., Rips, 1975; Osherson, Smith, Wilkie, Lopez, and Shafir,1990), such as:

<div align="center">

The person likes steak.
The person doesn't like noodles.
The person likes pasta.

</div>

In this type of argument, its strength (the likelihood of the conclusion below the line given the premises above the line) depends mainly on the entities in each sentence (e.g., "steak" (the positive entity) , "noodles" (the negative entity) , "pasta" (the conclusion)) since these sentences share the same basic predicate (e.g., "The person likes~." and "The person doesn't like ~.").

However in real-world situations, even reasoning-based behavior that involves such a simple argument evaluation can entail some element of risk context. For example, the relatively straightforward situation of inviting somebody to dinner involves some risk. Even if you know that the person in question likes steak but not noodles, can you reasonably infer their reaction to pasta? If the person were a close friend, they would be likely to go to any type of restaurant with you. Therefore, in this situation, you would be fairly safe in inferring that the person "probably" likes pasta. On the other hand, when faced with the risk of inviting your boss, which could have more serious consequences, you might make a different inference, telling yourself how "unlikely" it is that the boss likes pasta. In these different risk contexts, the argument strength should be evaluated differently, which means that human ratings of the argument strength are by nature context-dependent. There is a study which discusses the risk effect on inductive reasoning in Japanese (Sakamoto, Nakagawa, 2007). However, the difference between different cultures in the reaction of risk context on inductive reasoning is not discussed in previous studies.

This study examines the impact of risk context on inductive reasoning in Japanese and Chinese. The outline of this study is as follows: At first, we conduct psychological experiments of inductive reasoning under two different risk conditions in Chinese, and then did the same experiments in Japanese. Secondly, parameters of computational models of inductive reasoning are estimated using the results of each experiment in Chinese and Japanese. Finally, we compare the effects of risk conditions between Chinese and Japanese based on the difference between parameters.

2. MODEL

We have already constructed the model based on Gaussian kernel functions, which produces the likelihood of a conclusion N_i^c, denoted as $v(N_i^c)$ represented as follows:

$$v(N_i^c) = a\text{SIM}_+(N_i^c) + b\text{SIM}_-(N_i^c)$$

$$\text{SIM}_+(N_i^c) = \sum_{j}^{n^+} e^{-\beta d_{ij}^+}$$

$$\text{SIM}_-(N_i^c) = \sum_{j}^{n^-} e^{-\beta d_{ij}^-}$$

$$d_{ij}^+ = \sqrt{\sum_{k}^{m} (P(c_k|N_i^c) - P(c_k|N_j^+))^2}$$

$$d_{ij}^- = \sqrt{\sum_{k}^{m} (P(c_k|N_i^c) - P(c_k|N_j^-))^2}$$

, where d_{ij}^+ and d_{ij}^- are word-distance functions based on the latent classes (denoted as c_k). d_{ij}^+ represents the distance between the conclusion entity N_i^c and the positive premise entity N_j^+, while d_{ij}^- represents the distance between the conclusion entity N_i^c and the negative premise entity N_j^-.

$P(c_k|N_i^c)$, $P(c_k|N_j^+)$, $P(c_k|N_j^-)$ represents the conditional probability of C_k, given N_i^c, N_j^+, N_j^-,

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respectively, estimated from a large scale language data in Chinese and Japanese. Each word distance function constructs Gaussian kernel functions, such as $SIM_+(N_i^c)$ and $SIM_-(N_i^c)$, when combined with nonlinear exponential functions and a parameter β. In this study, these Gaussian kernel functions are regarded as nonlinear similarity functions that reflect the retrieval assumption. $SIM_+(N_i^c)$ represents the similarities between the conclusion entity N_i^c and the positive premise entities, while $SIM_-(N_i^c)$ denotes the similarities between N_i^c and the negative premise entities. In the present model, parameter a means the strength of positive entity effect, while b indicates the strength of negative entity effect.

In this study, we consider the following hypotheses according to the present model and experiments. If participants are affected by each risk condition, in the over-estimated risk condition, they will emphasize the negative entity and parameter b will become bigger than parameter a, that is the index $|b/a| > 1$, while in the under-estimated risk condition, they will emphasize the positive entity and parameter a will become bigger than parameter b, that is $|b/a| < 1$. Totally, if the participants are affected by each risk condition, there will be a significant difference of the index $|b/a|$ between the two risk conditions.

3. EXPERIMENT

An experiment was designed like a game and played on the internet. We designed the same experiment in Chinese and Japanese and compared the effect of an over-estimated risk condition and an under-estimated risk condition.

3.1 Method

In the Japanese experiment, 38 Japanese undergraduate and graduate students participated, of which 20 were assigned to the over-estimated risk condition, with the remaining 18 being assigned to the under-estimated risk condition. While in the Chinese experiment, 33 Chinese undergraduate and graduate students participated, of which 18 were assigned to the over-estimated risk condition, with the remaining 15 being assigned to the under-estimated risk condition.

3.1.1 Task and Condition

Participants were told a cover story and were to suppose they were new employees of a consulting company and were participating in the company's new employee training. The experimental task was judging the preference of customers from the perspective of a new employee in the company. The game consisted of three parts. The first part was a practice session about judging the preference of customer A. The customer's preference was expressed by 26 inductive reasoning arguments and was rated on a 7-point scale. Unlike the usual inductive reasoning task, the money you gained or lost was according to the variation from the 'concocted' right answer from the previous experimental study. If a rating corresponded to this right answer, the participant received money. The right answer appeared in all three sessions. In the over-estimated risk condition, as the likelihood rating increased relative to the right answer, the reduction of money also increased. Conversely, in the under-estimated risk condition, as the rating decreased relative to the right answer, the reduction of money also increased. Money allocations for each condition are shown in Table 1.

Table 1. Allocation of Money in Each Risk Condition

		Over-estimation by 3 or more points	Over-estimation by 2 points	Over-estimation by 1 point	Corresponds to the right answer
Over	Japanese	-20000 yen	-15000 yen	-10000 yen	10000 yen
	Chinese	-2000 yuan	-1500 yuan	-1000 yuan	1000 yuan
Under	Japanese	0 yen	5000 yen	10000 yen	10000 yen
	Chinese	0 yuan	500 yuan	1000 yuan	1000 yuan

		Under-estimation by 1 point	Under-estimation by 2 points	Under-estimation by 3 or more points
Over	Japanese	10000 yen	5000 yen	0 yen
	Chinese	1000 yuan	500 yuan	0 yuan
Under	Japanese	-10000 yen	-15000 yen	-20000 yen
	Chinese	-1000 yuan	-1500 yuan	-2000 yuan

Each inductive reasoning argument has its correct answer, the condition of the money you gained or lost was shown on the screen as feedback according to the answer given by each participant. In the end of the practice session, the participant's total money was shown on the screen. The next two parts, formal session 1 and formal session 2, were the same as the practice session except for the inductive reasoning arguments about the preference of costumer B and costumer C.

3.1.2 Materials

The premise and conclusion statements all consisted of a combination of a predicate (Customer A likes '~') and an entity (e.g. basketball), such as "Customer A likes basketball." In the case of negative premises, the predicate involved a negative verbal form, such as "Customer A doesn't like Sociology." The positive and negative premise entities and the conclusion entities in each argument set were selected from the previous study, and the Japanese words were translated from Chinese words.

3.1.3 Procedure

We compare participants' reactions under two distinct risk conditions: in the over-estimated risk condition, the over-estimation of the ratings of customers' preference entail a money-decreasing risk, while in the under-estimated risk condition, the under-estimation of the ratings also entail a money-decreasing risk. Moreover, in order to compare the effect of the two risk conditions more deeply, each participant participated in both of the risk conditions. A participant assigned to the over-estimated risk condition participated in the under-estimated risk condition when the experiment of the over-estimated risk condition finished, and vice versa for a participant of the under-estimated risk condition. The same experiments were conducted in Japanese and Chinese on the internet.

3.2 Result and Discussion

The parameters a, b, and the index $|b/a|$ were estimated in each risk condition in Japanese and Chinese. In both experiments of Japanese, a significant difference is observed in the average of $|b/a|$ between two risk conditions ($p<0.01$). On the other hand, in both experiments of Chinese, no significant difference is observed in the average of $|b/a|$ between the two risk conditions.

Table 2. The Average of Parameters and the t-test between Japanese and Chinese (Exp is represent Experiment)

	Japanese						
	Over			Under			
	a	b	|b/a|	a	b	|b/a|	p-value from t-test
Exp1	2.601	-4.075	1.584	3.556	-3.177	0.915	0.0000
Exp2	2.665	-4.184	1.642	3.493	-3.128	0.906	0.0000

Chinese						
Over			Under			
a	b	|b/a|	a	b	|b/a|	p-value from t-test
2.242	-1.278	0.565	2.753	-1.298	0.476	0.020
2.475	-1.330	0.547	2.505	-1.239	0.490	0.146

Table 3. The Average of |b/a| and the t-test between Session 1 and Session 2 in Every Risk Condition between Japanese and Chinese (Exp is represent Experiment)

Japanese				Chinese		
		OVER	UNDER		OVER	UNDER
Exp1	Session1	1.765	0.920	Session1	0.794	0.680
	Session2	1.476	0.965	Session2	0.354	0.306
	p-value from t-test	0.031	0.393	p-value from t-test	0.0000	0.0000
Exp2	Session1	1.685	0.905	Session1	0.740	0.760
	Session2	1.404	0.971	Session2	0.365	0.308
	p-value from t-test	0.001	0.068	p-value from t-test	0.0000	0.0000

Additionally, we compared the difference between session 1 and session 2 in every risk condition. The parameters |b/a| of session 1 and session 2 were estimated in each risk condition of Japanese and Chinese. In both experiments of Japanese, no significant difference is observed in the average of |b/a| between the two sessions in under risk condition. On the other hand, in both experiments of Chinese, a significant difference is observed in the average of |b/a| between the two sessions in each risk condition ($p<0.01$).

Totally, there are very interesting contrasting effects of conditions in inductive reasoning between Chinese and Japanese. Risk conditions (quantitative conditions) have a significant effect on inductive reasoning in Japanese, while those conditions have no effect in Chinese. On the contrary, argument conditions (qualitative conditions) have a significant effect on inductive reasoning in Chinese, while those conditions have an only partial effect on inductive reasoning in Japanese. More research is needed to find the essential reason for this contrast, for example, differences between cultural or social systems. However, it is important to consider this contrast when the present models of inductive reasoning are applied to CAE for Chinese and Japanese.

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USE AND PRODUCTION OF OPEN EDUCATIONAL RESOURCES (OER): A PILOT STUDY OF UNDERGRADUATE STUDENTS' PERCEPTIONS

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ABSTRACT

Open education resources (OER) may be defined as any digital materials designed for use in teaching and learning that are openly available for use by educators and students, without an accompanying need to pay royalties or license fees. Hitherto, research on students' use of OER has been mainly limited to those in Western countries, mainly in the USA. Research on other students' use of OER such as those from Asian Pacific countries has been lacking. In this study, we attempt to fill this gap by exploring a class of Asian undergraduates' views about the use and production of OER. A total of 25 students who were enrolled in an education course at a university in Singapore completed a questionnaire. Results showed that half the respondents used OER to either quite or a great extent. The most common type of OER used was Youtube followed by iTunes (e.g., iTunes U). Respondents attributed more weightage to the reputation of an institution or organization rather than the individual creator with regard to the production of OER. Results also suggested that respondents were generally OER "lurkers" – individuals who tend to take free open education content for their own use but are not willing to produce these resources for others to use. The most significant barriers to producing OER were "lack of skills", followed by "lack of subject knowledge". The least significant barrier reported by the respondents was "lack of interest".

KEYWORDS

Open Educational Resources, OER, Student use, Student attitude, Student production, Questionnaire.

1. INTRODUCTION

An OER may be defined as any resource such as "curriculum maps, course materials, textbooks, streaming videos, multimedia applications, podcasts, and any other materials that have been designed for use in teaching and learning that are openly available for use by educators and students, without an accompanying need to pay royalties or licence fees" (Butcher, 2011, p. 5). OECD (2007 defined OERs as "digitised materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research" (p. 30).

The term "open educational resources" (OER) was first used by UNESCO in 2002 at its Forum on the Impact of Open Courseware for Higher Education in Developing countries, and has since then gained significant prominence in recent years throughout the world (Brown & Adler, 2008). The OER initiative originated in the late 1990s with the first major movement coming from the Massachusetts Institute of Technology which released 50 freely available courses through its OpenCourseWare initiative in 2002 (Goldberg & Lamagna, 2012). Since then there are currently over 300 universities throughout the world that engaged in developing open educational resources with more than 3,000 open access courses (OECD, 2007) such as MIT's OpenCourseWare, Open University's (UK) OpenLearn website, Indira Gandhi National Open University's (India) National Digital Repository of learning resources, Japan's Dohisha University, the Open University of Hong Kong, Carnegie Mellon's Open Learning Initiative, and Connexions which begun at Rice University to name a few.

Research on students' use of OER has been mainly limited to those in Western countries, mainly in the USA. The Usability, Support and Evaluation Lab at the University of Michigan (2010), for example, reported that 24.4% and 22.7% of students at the Ann Arbor campus and Dearborn campus respectively had heard of open courseware, looked at an open courseware site, used material from an open courseware site for

teaching, and published or help published open courseware material. About 49% and 44% of students at the Ann Arbor and Dearborn campuses respectively believed that using an open courseware site would be valuable to enhance their own knowledge about certain topics. However, students were less willing to help publish materials on an open courseware site (e.g., Open.Michigan). Only about 22% and 32% of students at the Ann Arbor and Dearborn campuses respectively reported being willing to do so.

Research on other students' use of OER such as those from Asian Pacific countries has been lacking. In this study, we attempt to fill this gap by exploring a class of undergraduates' views towards to use and production of OER. Specifically, the following objectives guided our investigation: (a) to explore students' perceptions of using OER and (b) to examine whether students wish to contribute to the development of these resources.

2. METHOD

A class of 25 undergraduate students majoring in Education at a large university in Singapore participated in the study. Prior to the study, ethical approval was first sought and gained from the university's human ethics committee. The undergraduate students' participation was completely voluntary. The main data collection instrument was an end-of-course questionnaire that consisted of both closed- and open-ended items. Some of the questionaire items were adapted from the Usability, Support & Evaluation Lab, Digital Media Commons at the University of Michigan (2010), and the Organisation for Economic Co-operation and Development (OECD, 2007). The following definition of OER was used in the questionnaire in order to minimize student confusion about how OER was conceptualized in this study: *Open educational resources are digitised materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research* (OECD, 2007, p. 30). Several examples of OER were also given in the questionnaire to help students better understand OER. These examples include: (a) Open course ware and content (e.g., MIT's OpenCourseWare, Tufts University's OpenCourseware Repository, MERLOT – multimedia educational resources for learning and online teaching), (b) Open access journals that allow an individual to read or download publications without charge, (c) Free images, videos or audios for use in teaching and learning (e.g., iTunes U, YouTube EDU), (d) Free learning management platforms (e.g., Moodle, SAKAI), (e) Interactive mini lessons and simulations about a particular topic, (f) Electronic text books (e.g., Flatworld Knowledge, WikiBooks, National Academics Press), and (g) Elementary school and high school (K-12) lesson plans, worksheets, assessments, and activities.

3. RESULTS

Of the 25 students, one failed to complete the questionnaire, resulting in 24 usable data. Figure 1 shows the results of the participants' views about their personal use and production of OER.
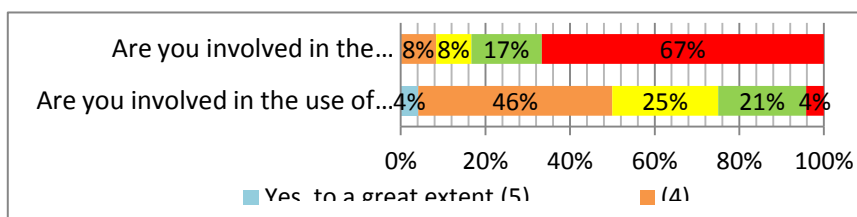
Figure 1. Personal use and production of OER

Half the respondents reported that they used OER to either quite or a great extent. When asked to describe the type of OER typically used, many participants (reflected in 33.3% of the comments) indicated that they accessed Youtube videos (see Table 1). Other types of OER used included google (e.g., google scholar, images), iTunes (e.g., iTunes U), open access journals, and e-books. The most frequently reported goal or purpose of using OER was to get more information and better understanding of a particular subject.

Table 1. Types of OER typically used

Type of OER	Number of comments	% of total comments
Google (e.g., images, scholar)	5	9.8%
Youtube	17	33.3%
Lesson plan ideas, activities, worksheets	5	9.8%
Online writing lab	1	1.9%
iTunes (e.g., iTunes U)	7	13.7%
Glogster Edu	1	1.9%
e-book	4	7.8%
Educational games	2	3.9%
Webquests	1	1.9%
Audio recording tool	1	1.9%
Open access journals	5	9.8%
Interactive mini lesson	1	1.9%
Wiki	1	1.9%

A majority of respondents (75%) reported that it was either important or very important for them to know which institution or organization created the OER contents, as shown in Figure 2. Respondents perceived that OER materials created by well-known and reputable institutions to be more trustworthy in their contents, compared to unknown or low-status institutions. Interestingly fewer respondents (55%) felt that it was important or very important to know the specific individual who created the OER materials. It seems that the respondents attributed more weightage to the reputation of an institution or organization rather than the individual creator with regard to the production of OER.
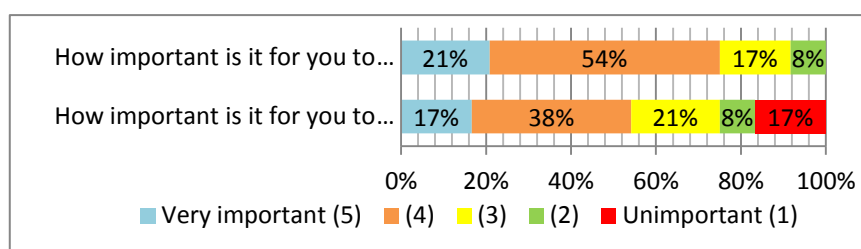
Figure 2. Personal use and production of OER

However, when asked to indicate if they were involved in producing OER on their own, a majority of respondents (67%) reported they never had (see Figure 1). In addition, a majority of respondents also reported that they were reluctant to help their professors publish materials as OER (see Figure 3). Only 33% of respondents agreed or strongly agreed that they would volunteer their time and energy to help theirs instructors produce OER contents. On the other hand, a vast majority (83%) agreed or strongly agreed they would encourage other students to use OER.
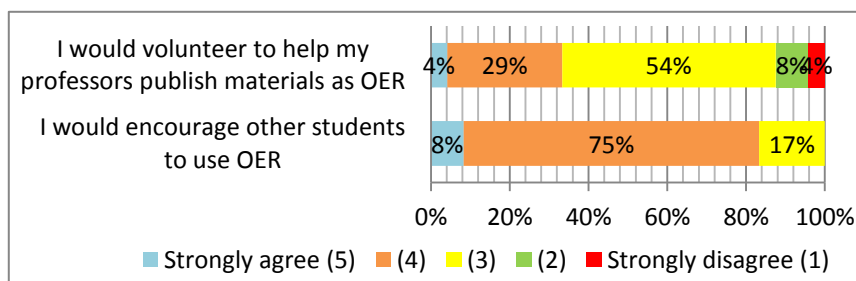
Figure 3. Personal use and production of OER

Overall, this suggests that many of the undergraduates in the current sample tend to be consumers of resources, rather than producers. They may be labelled OER lurkers or free riders, that is noncontributing, resource taking individuals.

The respondents were further asked why they were not involved in open education content production (see Figure 4).
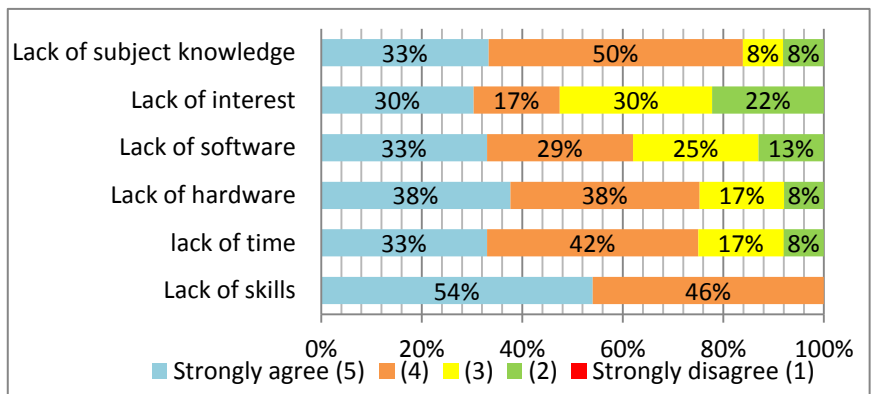
Figure 4. Personal use and production of OER

Figure 4 shows that the most significant barriers were "lack of skills", followed by "lack of subject knowledge". The least significant barriers reported by the respondents was "lack of interest". Our findings thus suggest that although respondents were interested to develop OER materials, many were hampered by a lack of skills (e.g., web design skills, video editing skills), and having a shallow understanding of the subject matter.

4. CONCLUSION

In recent years, the notion of open educational resources (OER) is increasingly being proposed as a way to allow a much larger percentage of people to learn, particularly in an informal way. Our study finds support for this. To sum up, only a minority of the respondents (4%) claimed that they did not use any OER materials. The majority of respondents reported using OER either to a small or a great extent. Different types of OER were accessed by the respondents of which Youtube video resources were the most frequently reported. We also found that a majority of respondents were not producers of OER materials. For future research, we intend to expand this research to examine other students' (e.g., graduate students), as well as faculty members' (e.g., professors, instructors) use of OER. We also plan to survey students' use of OER resources such as free open online courses (e.g., MOOC) that are offered by many reputable universities such as Princeton, Brown, Columbia, Duke, Stanford, and Johns Hopkins through online providers such as Coursera. Doing this would give us an understanding of how widespread a recognition the notion of MOOC has gained among our students in Singapore.

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TEACHING 21ST CENTURY COMPETENCIES: LESSONS FROM CRESCENT GIRLS' SCHOOL IN SINGAPORE

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ABSTRACT

This paper presents case studies of two teachers at Crescent Girl's School (an all-girls high school in Singapore) who implemented strategies learned through a teacher professional development program called 21st Century Learning Design (21CLD). Policymakers often state requirements for teachers to focus on 21st century (21C) competencies without providing them with the necessary pedagogical support and training needed to support students in developing these competencies. 21CLD fills this gap by offering concrete rubrics, definitions and examples in six "dimensions" that each relate to a 21C competency—collaboration, real-world problem-solving and innovation, knowledge construction, use of information and communication technologies (ICT) for learning, skilled communication, and self-regulation—to support teachers as they build these ideas into their lessons. In this paper we provide evidence of the influence of 21CLD on two teachers' instructional practice. The first case study describes a science teacher's experience using the 21CLD frame to revise a lesson to focus more deeply on developing students' collaboration skills. The second case study highlights a mathematics teacher's experience with developing and implementing a new mathematics lesson to develop students' real world problem-solving skills. These case studies highlight the valuable role that 21CLD has played in enhancing teachers' instructional practice by providing a common language and understanding of 21C competencies, and supporting a vibrant and dynamic professional learning community.

1. INTRODUCTION

Policymakers and educators value teaching 21st century (21C) competencies, such as collaboration and problem-solving, to develop a workforce ready for the 21st Century. However, many educators face the same challenge as the Crescent Girls' School (Crescent) in Singapore: how to translate broad instructional standards into classroom actions. *Specifically, how can teachers design classroom activities to support students in developing 21C competencies?*

In collaboration with SRI International, a non-profit research firm based in California, USA, Crescent adopted 21st Century Learning Design (21CLD), a teacher professional development program that examines learning activities developed by teachers through a lens of the opportunities they provide students to develop 21C competencies (Shear, et al. 2013). Based on decades of research in the learning sciences (Bransford, Brown & Cocking 2000; Sawyer 2006), the program offers concrete rubrics, definitions and examples in six dimensions: collaboration, real-world problem-solving and innovation, knowledge construction, use of information and communication technologies (ICT) for learning, skilled communication, and self-regulation. The method grew out of a multi-year global research program called Innovative Teaching and Learning (ITL) Research that used the analysis of learning activities and student work as a source of evidence in its rigorous investigation of innovative teaching and learning across 7 countries (Shear, Gallagher & Patel 2011). In ITL Research, the process of analysis provided valuable instructional insights to the teachers who were applying the dimensions, and the active collaborative format was a compelling alternative to traditional lecture-based professional development; this prompted the method's transition from research to instructional practice improvement (Shear, et al. 2013).

This case study describes the school-wide adoption of the 21CLD program, teachers' exploration of dimensions for collaboration and for real-world problem-solving and innovation, and its influence on two teachers' instructional practice at Crescent. It provides preliminary qualitative evidence of a successful attempt to bridge the gap between policy expectations and teachers' capacity to meet those expectations. Although we present preliminary descriptions of a limited set of cases, the results suggest the potential of such a professional development program and the need for broader research that examines 21CLD's influence on teacher and student outcomes.

2. CRESCENT'S EXPERIENCE WITH 21CLD

Crescent is an all-girls high school in Singapore serving 9th through 12th grade students. Crescent has a relatively long history working with 21C competencies. In 2007, a 21C competencies committee was formed to explore the theories and practice of 21C competency development. Crescent conducted a series of staff engagement and professional development workshops to co-construct a 21C competency framework. In the initial years, the focus was on the rationale for 21C competency development and the specific competencies that the school would like to develop. After converging on a total of 10 21C competencies (e.g., oral communication, collaboration, critical thinking, global awareness), subsequent years focused on the assessment of these competencies. Staff jointly developed rubrics to assess these competencies, and teachers of subject areas, which most naturally aligned to the specific competencies owned the task of assessing those competencies. For example, the Mathematics and Science departments owned critical thinking and problem solving, while the Humanities department owned Global Awareness. Each department was responsible for the design and deployment of performance tasks, which assessed these competencies, and teachers graded students on each 21C competency at the end of the academic year.

Upon review of these approaches in December 2011, and in response to findings from the ITL Research, Crescent decided to shift its focus to pedagogical practice and the design of learning activities necessary to develop 21C competencies. If the learning of 21C competencies was not taken into account in the design of learning activities, it would be challenging to see these competencies emerge from students upon assessment.

To this end, in collaboration with SRI International, Crescent adopted 21CLD as a framework for teacher professional development in the area of 21C pedagogies and learning design.

2.1 The 21CLD Workshop

The purpose of the 21CLD Workshop is to provide teachers with practical strategies for supporting students to develop 21C competencies. To meet this goal, teachers of all four grade levels and all academic subjects at Crescent participated in a 3-day workshop facilitated by SRI International in 2012 (82 teachers across all four grades). Consistent with 21CLD's frame of broad dimensions that are applicable across academic disciplines, Crescent's teachers collaborated in interdepartmental and multi-grade-level groups as they explored definitions of collaboration, knowledge construction, the use of ICT for learning, and real-world problem-solving and innovation, and applied them to a global collection of learning activities that served as strong and weak exemplars of the defining elements of each dimension. Each dimension seeks to answer a list of key questions:

- **Collaboration.** Are students required to share responsibility and make substantive decisions with other people? Is their work interdependent?
- **Knowledge Construction**. Are students required to construct and apply knowledge? Is that knowledge interdisciplinary?
- **Real-world Problem-solving and Innovation**. Does the learning activity require solving authentic, real-world problems? Are students' solutions implemented in the real world?
- **Use of ICT for Learning**. Are students passive consumers of ICT, active users, or designers of an ICT product for an authentic audience?

The workshop led teachers through four phases of exploration: learning the big ideas (the main constructs of each dimension), applying the rubrics to strong and weak exemplars of classroom lessons, strengthening the opportunities embedded in the learning activity, and considering the teaching strategies that will facilitate successful enactment. Each phase required not only grappling with the conceptual definitions and developing

a shared vocabulary, but also examining learning activities that instantiate these important constructs. When learning the big ideas for collaboration, teachers considered contrasting classroom activities to see if they require students not only to work together (a common interpretation of "collaboration"), but whether they are executing deeper collaboration competencies by taking shared responsibility for the work, and making substantive decisions about the content, process or product of their work. The rubric for real-world problem-solving and innovation considered whether the focus of the task is to address a defined problem, if the problem represents an authentic need that exists outside the academic context, and if students are required to enact their ideas or solutions outside the classroom. The workshop thus provided teachers with a common vocabulary for talking about 21C competencies, concrete rubrics that define deepening levels of 21C competencies, and a shared skillset for examining classroom artifacts in terms of the opportunities they provide for developing 21C competencies and creating new ones that afford such opportunities.

Following the workshop, Crescent launched several activities to enable teachers' continued engagement with 21CLD and its integration into the classroom. A 21CLD task force was responsible for developing and implementing pilot lessons focused on 21CLD dimensions. Teachers worked collaboratively to implement at least one lesson unit in their respective subject areas. The 21C competencies committee undertook the task of coordination across academic disciplines to track the deployment of 21CLD approaches. At the level of the middle management team (consisting of Heads of Department and individual Subject Heads), the discourse incorporated the language of 21CLD. The Heads of Department and Subject Heads subsequently took these conversations into dedicated professional development periods. The intent of these follow-up structures and processes was to keep the conversations around 21CLD fresh and relevant, and to maintain the momentum built during the 21CLD workshop. In November 2012, each department's instructional practices were peer reviewed through microteaching sessions and shared across staff.

The following sections describe the experiences of two teachers—one in a science classroom and one in a mathematics classroom—as they implemented a 21CLD dimension in classrooms.

2.2 Collaboration in a Science Classroom

Aimed at creating a more dynamic and student-centered learning experience for students to develop 21C competencies, chemistry teachers designed a series of lessons for 9th grade students on the topic of "Metals". This lesson unit was first designed and implemented in 2011 with the use of self-directed and collaborative learning strategies. After participating in the 21CLD workshop in June 2012, the team of chemistry teachers re-examined and refined the learning activities then executed the second iteration in 2013.

In the 2011 lesson, collaborative learning occurred when students participated in teacher-facilitated summaries of concepts or solved problems in small groups. At the end of the process, to allow for extension of knowledge, the students completed group projects wherein they applied the knowledge attained from the lesson packages and suggested a suitable material for the construction of an overhead pedestrian bridge.

Prior to the 21CLD workshop, teachers focused primarily on creating opportunities that allow the students to work in groups and engage in some form of sharing and discussion with peers. It was assumed that with such activities, collaborative skills would naturally develop in students. At that point, they had no means of measuring the quality of collaboration.

The 21CLD learning activities rubrics served as a tool for the teachers to measure the quality of collaboration involved during the activities and provided a common language for discussions. For example, they realised that requiring students to solve problems in a group, although a form of collaboration, allowed only a lower level of collaboration. Deeper levels of collaboration require students to make substantive decisions that go beyond the simple application of prior knowledge, and to produce interdependent work where the contribution of each student is necessary.

Therefore, to increase the level of collaboration between the students, teachers refined the original learning activities and implemented these in 2013. For example, rather than requiring students to simply discuss and apply their learning from the earlier lesson to solve questions selected from past year practice papers, teachers redesigned the discussion questions such that they guided students in constructing key understandings of the concepts covered in that particular lesson package. At the end of each discussion activity, the groups had to use key understandings to make decisions or decide on factors that would lead them towards making their choice in a suitable material for the construction of the overhead pedestrian bridge. Through participating in these activities, the members engaged in discussions to make substantive

decisions that eventually led them towards their final project. Students had to negotiate and manage differences in opinions amongst their peers to reach a consensus as each decision played a part in shaping their project. Furthermore, to enforce individual accountability, cooperative strategies such as the 'Jigsaw' method were employed to ensure each team member completed her work and played an essential role in contributing her 'area of expertise' to the discussion appropriately.

Preliminary observations of student interactions during the learning activities indicated a high level of engagement. As the lessons were designed to facilitate shared decision-making and students had to negotiate differences to arrive at shared substantive decisions, it was also observed that the group discussions proceeded at greater depth, with students bringing in key and relevant concepts to support their points in the discussions.

2.3 Real-world Problem-Solving in a Math Classroom

While the science classroom example presented a case of how the 21CLD framework was used to review and refine an existing lesson unit, the following mathematics' classroom example illustrates how teachers use 21CLD to design a new lesson unit.

In a 7th grade math lesson on ratio and rate, students worked in pairs to plan for an overseas trip to attend a concert. They researched hotels, air and ground transportation, concert tickets, and exchange rates. They conducted a comparative evaluation of the different options and used their knowledge of currency exchange rates to propose a justifiable budget in Singapore Dollars.

The design of this lesson focused on learning outcomes for building students' real world problem-solving competencies. The teachers designed the problem situation in a way that would elicit many possible solutions. In addition, to achieve real world problem-solving according to 21CLD frame, the authenticity of the problem situation was key. Students were given an authentic set of variables and constraints from which they could work. They found information from real sources, and they were required to work within such parameters to 'solve' their problem by designing a detailed travel plan they could actually implement.

During the lessons, the teacher observed students taking greater ownership of their learning. The authenticity of the problem context resonated with them, and the problem was presented with sufficient openness for students to make decisions about their own pathways to address the issues. Students appeared to relish the challenge and were very engaged and self-directed throughout the lessons.

The 21CLD framework transformed the mathematics teachers' approach to learning activity design. Previously, the design of learning activities was done co-operatively- teachers were assigned different sections or topics to design for, with little perceived need for discourse. 21CLD provided a common language for collaborative discourse. The framework became the basis for team discussions on the choice and design of learning activities. Using this framework, the team was able to design a 21C lesson activity that was poised to provide opportunities for students to hone their 21C competencies. Furthermore, the framework provided a common understanding of what constituted a certain level of competency in the learning activity.

2.4 Findings

The introduction of 21CLD gave the teachers a common set of standards that guided the lesson design process more effectively. With the rubrics, teachers found that discussions on lesson design were more focused, as they had a common language and an instrument to converge on when clarifications were required. This was in direct contrast to what happened previously, when teachers would have different interpretations of the learning activities and ascribe to varying design considerations. The 21CLD rubrics served as a tool to allow the teachers to reach a common understanding and decide the suitability of the activities whenever conflicts arose during discussions. Both cases highlight the value of 21CLD in resolving professional conflicts and differences in the co-design of lessons, and in establishing a set of standards and clear articulations for the effective design of lessons that develop 21C competencies. Furthermore, the teachers were able to make a conscious effort to think more from students' perspectives and assess the quality of the activities planned in developing the desired student outcome.

Hargreaves and Shirley (2009) describe lively learning communities as one of the key principles for teacher professionalism. Changing the conversation in an organization can have profound impact on its culture and day-to-day work of its people (Kegan & Lahey 2001). Having a common language and precision

regarding meaning of that language are crucial to the culture essential to effective schools (DuFour, DuFour, & Eaker 2008). With the use of 21CLD, significant changes have been observed in the daily professional discourse of teachers at Crescent. A definite shift in the culture has been facilitated as teachers acquired a common language with which to engage in professional conversations. The precision of the 21CLD language enables teachers to collaborate and engage with common clarity on the intended student outcomes and goals.

Although findings from these case studies suggest promising results, this initial research is limited. Findings are descriptive and based solely on self-reports of two volunteer teachers, so further work is required to establish the impact of this approach on teachers and students. In particular, future research at Crescent is expected to examine student outcomes as evidenced in student work and measured through performance assessments that determine whether the opportunities provided by the teachers produce the 21C competencies they seek to develop.

3. CONCLUSION

The 21CLD approach evolved from the research-based structural analysis of classroom artifacts into a professional development program aimed at translating the 21C rhetoric into actionable teacher practices. The workshop provides participants with a shared vocabulary and common understanding of important dimensions that are greatly valued in education while also enabling teachers to refine their teaching practice for developing students' 21C competencies. This case study at Crescent Girls' School in Singapore provides promising evidence of the changes resulting from 21CLD and suggests the need for further investigation into the influence of 21CLD on teachers and students. In other settings around the world, 21CLD has also been extended to other uses that deserve more rigorous research: for example, it has shown initial promise as an enabler for teacher pre-service training and a useful frame to inform policy conversations.

ACKNOWLEDGEMENT

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RESEARCH ON DEMAND ANALYSIS OF THE USERS OF THE SENIOR ENGLISH DIAGNOSTIC SYSTEM

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ABSTRACT

As the significance of learning English is becoming increasingly apparent, more and more English online practice systems are used by English learners. However, a thorough process of research and detailed analysis of user demand have not fully implemented before the design of these systems. As a result, these systems may suffer the defects of low availability and poor interactivity. In this paper, the author proposes the demand analysis description after discussion and communication with several English teachers and students in senior high school, which reflects the requirements of the two main user groups and lays a solid foundation for the design of the Senior English Diagnostic Practice System.

KEYWORDS

The English Diagnostic System, Demand analysis, Teachers and students in senior high school.

1. INTRODUCTION

Among various disciplines in senior high school, English is the subject which has the most remarkable level of network utilization. A growing number of Online Practice System of English Subject (OPSES) makes it convenient and efficient for students to improve their English level. And for most students in senior high school, they may confront different tests or exams in school. Therefore, designing a distinctive OPSES is in line with the needs of the time. However, if the demands in the process of English teaching and learning of teachers and students are not adequately analyzed before the design and implementation of the system, it is nearly impossible to create a successful OPSES which is strongly targeted and highly recognized. As a matter of fact, demand analysis is not only a vital aspect of making reliable and excellent products, but also a necessary prerequisite of manifesting the idea of 'humanized design'.

2. OVERVIEW OF THE SYSTEM

2.1 Background of the System

In China, the operational flow of most OPSES goes through the stream-lined steps as 'select a test->answer the test paper->submit the finished test->get the score->check the correct answers'. These OPSES would merely response to the users with information like the scores and the answers, yet would not give effective suggestions for improving their English. Besides, these systems fail to tell students the defects of English learning and are not conductive to help them construct complete English knowledge structure.

The English Diagnostic System (abbreviation for the Senior English Diagnostic Practice System) is a personalized and pertinent OPSES which aims at helping students get well prepared for the National College Entrance Examination (NCEE). This system offers the users with practical and stratified English practice tests. Most of these tests are consist of questions from previous NCEE or high quality practice exams of English, which shows the close relevance with the English syllabus of NCEE. Meanwhile, by using the practice system, students can acquire some valuable information, such as the types of questions and the knowledge points that may be covered in the future examinations and the weakness of their English learning. All these information will be beneficial for students to foster a goal-directed learning habit.

2.2 Purpose of the System

The English Diagnostic System can be used as a platform for doing homework or practice tests before the final examination of the school term. When instructing the test papers, the teachers can project the test papers in front of the classrooms.

2.3 Characteristics of the Users

Users of the English Diagnostic System are expected to be divided into three categories: English teachers, students in senior high school and the administrators.

English teachers are those who are teaching English in senior high school. By logging teacher end, they could gain rights to add or delete questions and tests or to check the transcripts of the students. Making teaching plans and paper-based tests according to students' weakness of English diagnosed by the system is also available. They are main users of the system.

The students in senior high school can take the online exercises and tests at the student end. At the same time, they can look up the transcripts of their own and the study advice in order to find their weakness of learning English and acquire the diagnostic information for future study. They are main users as well.

The school administrators or network managers may work as the administrators. When they log in the administrator end, they would have privileges to manage account distribution and information of teachers and students and the maintenance of the item pool.

3. DESCRIPTION OF DEMAND ANALYSIS

The definition of demand analysis is the process of understanding the requirements of language learners on language learning, and then setting learning plans according to the order of priorities. Developers had better understand the demands of users and then reflect their ideas in the system design. Demand analysis plays a key role in establishing the relationship between developers and users. Users of the English Diagnostic System are divided into three parts as mentioned. Due to limitation of length, the demands of the administrators will not be described in this paper. The descriptions below are analyzed and summarized after discussions and interviews with some English teachers and students in senior high school.

3.1 Demand Analysis of the Teacher End

The main functions of the teacher end include: editing and releasing test papers, building and managing the individual test paper library, checking the learning status and the transcripts of students, answering students' questions and assigning homework at the message board. As shown in Fig. 1 below.
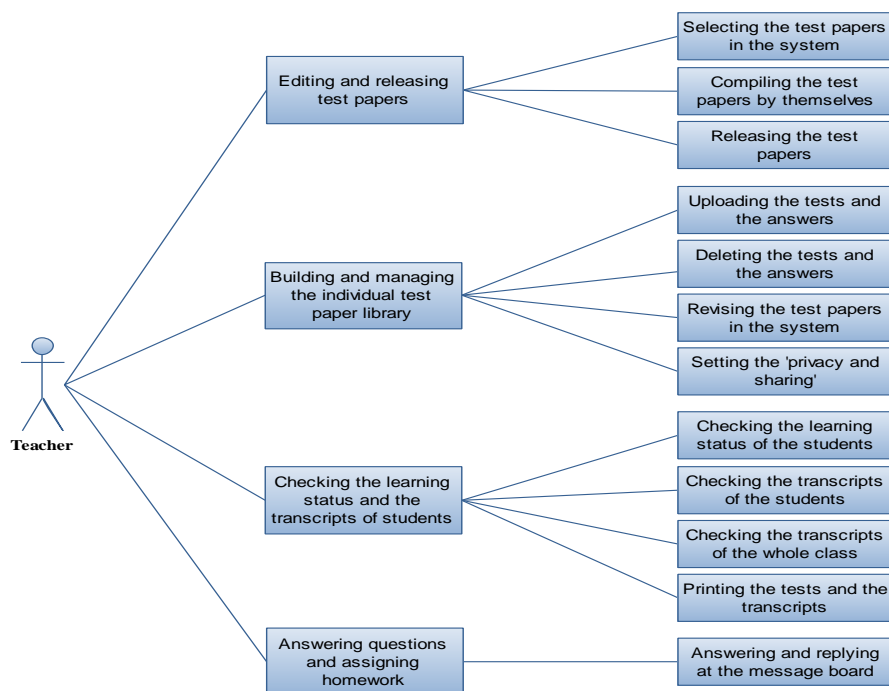
Figure1. Demand analysis of the teacher end

3.1.1 Editing and Releasing Test Papers

The teachers can log in directly at the home page of the English Diagnostic System. Every teacher will be assigned one teacher account and one student account. The purpose of giving a student account to teachers is to make it convenient for them if they want to see the effects of the released papers at the student end. These test papers may contain questions from the system item pool or questions from other English materials collected by these teachers. After editing and selecting questions and tests, the teachers may release the online test papers to their students.

3.1.2 Building and Managing the Individual Test Paper Library

Operations as uploading, deleting and revising tests and answers in the individual test paper library can be processed by the English teachers, but these tests and answers should not be input in the item pool of the system. The teachers must ensure a high consistency about the interface of editing, the output format of the test papers and the standard answers and the total score of each test paper. Besides, the teachers have right to set the 'privacy and sharing' to decide whether to share or reserve the questions and the tests in the library.

3.1.3 Checking the Learning Status and the Transcripts of Students

At the teacher end, the teachers can query the learning status of their students, detailed transcripts of a single student and that of the whole class. The contents of the learning status include: online learning time, names of all completed test papers, time of finishing and submitting some test paper and so on. Names of three latest submitted test papers, scores of all finished papers, score and rank of a single test, scores of every question type and knowledge point and the constructive study advice for learning English are things in the transcript of a single student. The contents of the transcript of the whole class are: names of all listed test papers, total scores, average scores and the ranks of the students in a single test, the detailed information about the scores on every question type and knowledge point and so forth. The system will list the scoring rate of each question type and knowledge point from high to low, and the numbers and percentages of students who have or have not reached the standard mastering level can be presented. In addition, the printing function of the test papers and transcripts is provided.

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3.1.4 Writing Notices and Answering Questions

The teachers are able to write notices, answer questions proposed by their students, and communicate with them upon English learning at the message board. Noting that teachers and students in senior high school do not require complicated operations on computer, so there is no need to add an online BBS forum or instant messaging software in the system.

3.2 Demand Analysis of the Student End

The main functions of the student end include: completing the tests and exercises assigned by the teachers, checking the learning status and detailed transcripts, Reading notifications and proposing questions at the message board. As seen in Fig 2 below.
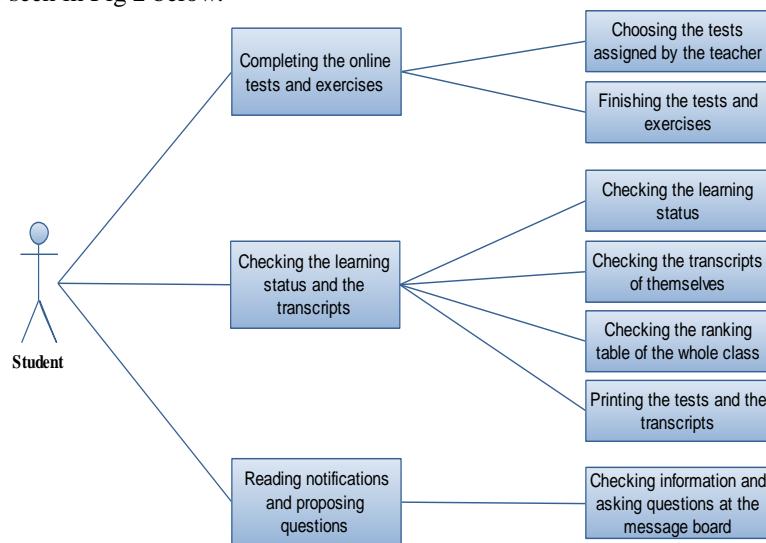
Figure 2. Demand analysis of the student end

3.2.1 Completing the Online Tests and Exercises

Each student can be assigned a student account. By logging in the student end, they can do tests and exercises in the online learning system. To most high school students, due to intense study pressure and limited time, they just need to finish the tests set by their English teachers. Certainly, the questions and the tests of previous NCEE and high quality practice exams in the item pool of the system are also available for extra practice. Besides, an innovative function which is called 'parental control' will be added in the system. The purpose of setting this function is to prompt students the time of doing the test. When the practice time is up, the system will send a message to remind the parents so that students would not waste their time in playing computer games or other forms of recreation.

3.2.2 Checking the learning Status and the Transcripts

The students can query their learning status and the transcripts of themselves. The details of the transcripts are similar with the contents can be checked at the teacher end as discussed above. To those who are good at learning English, they have already handled the homework well and have strong eagerness to do more practice. They could follow the study advice adhered in the transcripts and go to buy some paper-based tests or search other English learning materials through the internet.

3.2.3 Reading Notices and Proposing Questions

The message board is a good platform for maintaining positive interaction between the teachers and the students. At the message board, notices or explanations left by the teachers and questions proposed by the students could both be seen. Communication between the two groups is undoubtedly an indispensable activity.

4. CONCLUSION

Understanding of the demands of main users of a system and analyzing their expectations on the functions that a system can provide is an essential work for the design and implementation of OPSES. In this paper, the author introduces the English Diagnostic System in general at the beginning, and then combines the requirements of some English teachers and students in senior high school with his experience in system design and development. Finally, the description of demand analysis which can truly reflect the requests of the two main user groups is conducted, which lays a solid theoretic foundation for the design and implementation of an effective and popular OPSES for senior high school users.

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USING SELF-REFLECTION AND BADGES IN MOODLE-BASED MEDICAL ENGLISH REVIEW COURSES FOR ENHANCING LEARNERS' AUTONOMY

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ABSTRACT

English has become increasingly important for Japanese medical professionals in Japan. However, the curricula at medical schools in Japan are so extensive that the time allocated for English classes is usually very limited, which means those classes often do not have the depth or scope to improve the English communication skills of medical students to the level necessary for their future career. Therefore, language teachers are expected to not only improve English curricula but also offer effective and attractive review courses for students' autonomous study. The authors of this paper have created Moodle-based English courses to improve the English curricula by integrating 'blended-learning' in class. They also have started to provide ongoing access to a range of review courses to help their students' autonomous study. This paper outlines how the authors integrated a self-reflective framework and a badge function in the review courses they created. It also illustrates how the framework will help learners find the suitable course at the right level and how issuing badges will help motivate learners to engage with the module or the course they have chosen.

1. INTRODUCTION

In this globally connected world, English has become increasingly important for Japanese medical professionals. There is growing need for them to understand and use English at conferences and/or workshops and there are ever increasing opportunities to communicate with other medical staff and patients in English (Telloyan et al, 2008). Unfortunately, due to the existing extensive curricula of medical schools in Japan, English classes are usually scheduled only for the first 2 to 3 years of a 6-year-long programme of study. This limited exposure to English is insufficient to improve the English communication skills of students to the levels necessary for their future career. Therefore, language teachers at medical schools have been required to review their pedagogical approaches, strategically plan their English curricula, and organize how they should engage their learners to fully maximize the impact of the time allocated for English teaching.

Since 2008, the authors of this paper have been evaluating their current teaching practices and modifying the structure and content of their English classes to provide maximum benefit for their students. As part of this reflection, they have designed and deployed a range of Moodle-based courses, firstly to introduce the concept of 'blended-leaning' to students (Iwata et al, 2011), secondly to offer review courses and mobile learning content, expecting that they would help their autonomous study. While students evaluated the 'blended-learning' model in class as effective and motivating for their English study (Iwata et al, 2012), review courses have not been used as frequently as authors had expected. Clearly the courses needed to be reviewed and redesigned for learners to engage with them to constantly review and practice their skills to improve their level of English language. Through this reflection, the authors have started to create review courses which suit students' needs and levels and help motivate their self-study by investigating new strategies and techniques which:

(1)   will help learners identify and engage with the suitable level of information and in appropriate level of activities, and
(2)   will encourage learners to engage with the review materials identified and participate autonomously in practice activities.

The following sections outline how the authors integrated the self-reflective framework and a badge function in the English review courses they created.

2.   THE SELF-REFLECTIVE FRAMEWORK

The concept of reflection has been widely discussed in educational circles for a number of decades (Kreber, 2004: Brockbank & McGill, 2007). Reflective practice is thought to be dependent on individuals making meaning from their experiences through reflection (Sugerman et al, 2000).

The authors designed a self-reflective questionnaire to engage their students in reflection on their competencies or confidence in relation to defined language skills or standards, aiming at helping them in finding which skill or level is suitable for their review study.

2.1 Self-Reflective Framework

The self-reflective framework which consists of a series of questions relating to the objectives of the course and learners' competencies, is placed on the top of the Moodle course along with the course outline as shown in Figure 1. Learners are asked to reflect on the target skills and then respond to the questions. A sample framework for *Medical English Terminology (Level 1)*, which is designed by using Moodle 'quiz' function, is shown in Figure 2.

This framework provides learners with not only overall feedback, but also specific advice on which module(s) to review and which competencies they need to develop as illustrated in Figure 3.

Figure 1. Course outline and self-reflective framework   Figure 2. Self-reflective questions
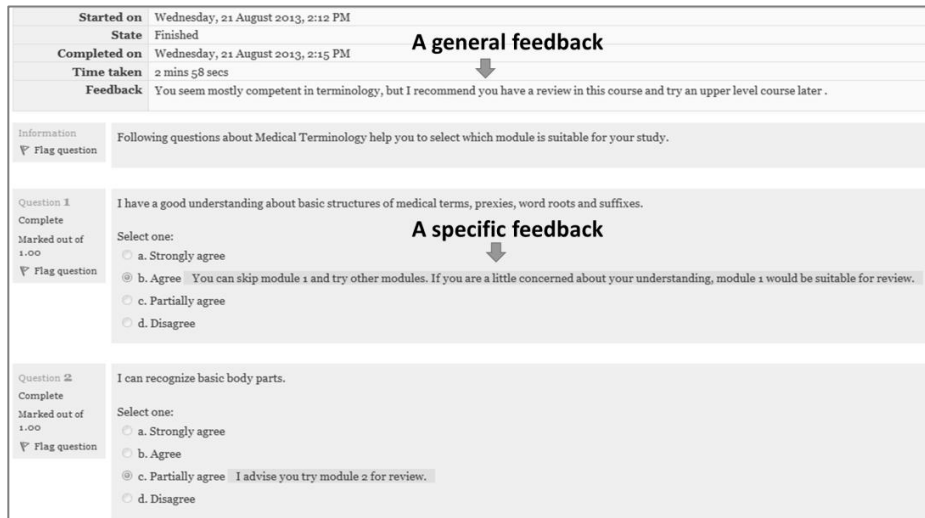
Figure 3. A feedback from the self-reflective questions for Medical Terminology course

In essence, engaging with this self-reflective framework assists learners in the creation of an individual and customized learning plan and it is expected to help them become self-regulated and autonomous learners (Clayton, 2011).

2.2 Awarding Badges

A portfolio can be regarded as the purposeful collection of a learner's work that can be structured to exhibit the learner's efforts and achievements over time (Kim, et all, 2010). Portfolios are increasingly seen to be a valuable tool for assessment of competencies and are used in many professions such as nursing, medicine, and teaching (McColgan & Blackwood, 2009). In accreditation environments, digital portfolios can provide a space where learners' evidence of their competencies and achievements can be stored and systematically evaluated (Fiedler, et al, 2009).

The authors implemented the idea of issuing 'badges' to students by using the badge function of Moodle. Each badge awarded acknowledges the successful completion of individual module/course. The badges learners have earned are designed to be displayed in a learner portfolio, which increases personal satisfaction and functions as a rubric to demonstrate to their teachers and peers what they have learned, rather than what was taught. It is anticipated that this use of badges will help them to be motivated to study autonomously.

Sample badges awarded for successful completion of some modules for *Medical English Terminology (Level 1)*, which is designed by using Moodle 'badge' function, are shown in Figure 4 and an email message the learner receives is shown in Figure 5.
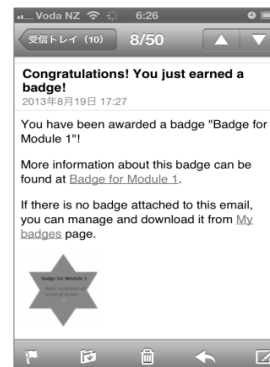

Figure 4. Badges a learner was awarded in the course

Figure 5. The message sent to a learner

3. CONCLUSION

This paper has presented an argument on the unique challenges Japanese English language teachers at universities are facing. It illustrated how the authors have applied a self-reflective framework and use of badges in their Moodle-bases English courses designed for their learners' review and self-study.

The self-reflective framework, where learners are able to make meaningful connections between their current skills/levels and the learning activities offered on available courses, is expected to help them identify which course/module is the most suitable for their self-study and help them work not only independently but also autonomously. The use of badges, which helps learners confirm their achievements they have had on the courses they studied, is expected to motivate them toward further autonomous study.

The authors are conscious that further investigation on how self-reflective frameworks actually help learners identify the skills required and the appropriate course/module level and how the use of badges helps them to be motivated to study autonomously is required. However, the authors believe further practice of the use of self-reflective framework and badges and development of measures for evaluating these practices would be valuable in monitoring the effectiveness of the review courses, enhancing learner autonomy and then finally helping them improve their English skills required for their future professions.

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INVESTIGATING THE USE OF SOCIAL MEDIA BY UNIVERSITY UNDERGRADUATE INFORMATICS PROGRAMS IN MALAYSIA

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ABSTRACT

The use of digital technologies in higher education has been driven by a number of underlying assumptions about the affordances of the available technology for social interaction and learning. This trend has not only been advocated by administrators who may argue for digital technologies as a catalyst for pedagogical change and engagement, but rather by the students themselves as they adopt new ways of collaborating and communicating within their social circles. Interacting using Social Media Technologies (SMTs) is a phenomenon in both business (Lygouriatis C (2013), AvantiKumar, (2012) and education (Davis, Deil-Amen, Rios-Aguilar, & Gonzalez Canche, (2012). The increase usage and employment of SMTs in personal, business and education is credited to the advancement of Internet broadband services, mobile devices, smart phones and web-based technologies. Informatics programmes are technological-oriented in nature, hence students and academics themselves would arguably be quite adept at using SMTs. Students undertaking Informatics programmes are trained to thrive in challenging, advanced technical environments as manifestations of the fast-paced world of Information Technology. Students must be able to think logically and learn "how to learn" as "knowledge upon demand" is one of the expected capabilities of Informatics graduates. This rapid change in knowledge and skill sets requires learners to not only be lifelong learners, but to be constantly connected to the field of computing science. SMTs may be the conduit that supports these needs. Despite being an Information and Communication Technology (ICT) hub and having advanced ICT Infrastructure nationally, the use of social media beyond young people in Malaysia for education purposes is still relatively new and little is known about the user experience, intentions, perceptions and acceptance of these technologies by students and academics. This study will investigate the perceptions, acceptance, usage and access to social media by students and academics in higher education in Informatics programs in Malaysia. A conceptual model based on Connectivisim and Communities of Practice (CoP) has been developed to inform the study in terms of how Social Media Technologies (SMTs) can play a role in building a virtual learning community in Higher Education Institution. A significant outcome of this study will be the development of a design framework for implementing social media as supporting tools for student engagement and teaching and learning of Informatics Programs in Higher education institutions in Malaysia.

KEYWORDS

Social Media Technologies (SMTs), Social Media, Connectivism, Communities of Practice (CoPs), Informatics Programs, Higher Education

1. INTRODUCTION

This paper presents a work-in-progress study that is examining how social media is perceived and used by both students and academics in the Malaysian Higher Education Context. Recent research highlights a mismatch between how university institutions perceive students of today use technology for both academic and everyday life and their actual use and thus more needs to be known about how university students use technology in order to better support effective decisions on the adoption of technology for higher education (Corrin L, Bennett S, and Lockyer L, 2010). With particular reference to the use of social media, very little work has been reported on student and academic engagements, their perspectives and perceived effectiveness of social media usage in higher education especially in the Malaysia context. A range of research has reported on students' perception and usage of social media and digital technologies to support their learning (Hrastinski and Aghaee, 2011, Margaryan, LittleJohn and Vojt, 2010, Bennett & Maton, 2010) but much of

this work has focused on quantitative research with students from universities in United States and Australia and with an emphasis mainly on student's perception and acceptance. Thus, there are calls for more research to examine how social media is perceived and accepted by students and academics for teaching and learning purposes (Shittu, Madarsha and Tunku Ahmad (2011). Further research is required to determine what benefits students may gain through the use of social software, faculty perceptions in integrating social software into the curriculum, student's demographic factors and usage hours of social software that affect their general performance, and effective methods of using social software to support student learning and engagement with their institutions. This proposed study seeks to address these questions.

2. SOCIAL MEDIA TECHNOLOGIES (SMTs)

A Social Media Tool (SMT) is generally a portable web-enabled tool, which is accessible through platform independent web browsers. It enables the sharing of collaborative activities not only in social but also in educational, and, now increasingly, in business contexts. It is believed that through these shared and networked activities, users will become creators of collaborative knowledge that forms a collective intelligence. Levy (1999) cited by Nielsen (2010) defined collective intelligence as "a form of universally distributed intelligence, constantly enhanced, coordinated in real time, and resulting in the effective mobilization of skills...No one knows everything, everyone knows something..."(p 1). Collective Intelligence is not something new but the capability of social media software to pull together all the knowledge harnessed through collaborative activities makes the process more accessible to learners.

Generally, Social Media Technologies (SMTs) can be grouped into seven categories; text-based, media sharing, social networking, mobile-based applications, virtual world & games, synchronous communications and conferencing applications, and mashups. All these tools have different functionalities and purposes to suit the needs of students in this digital environment with the tools giving students the ability to set up their own personal learning communities within the Internet environment which would allow them to stay connected in the topic of their interest. Students can take advantage of these various functionalities in their own personal learning communities. For example, students could use text-based applications such as blogs, wikis, and discussion forums for their individual or group assignments and projects. One of the popular micro-blogs commonly used is Twitter. Students could also use social networking websites such as Facebook, Ning, and more to get connected with their friends, family, and lecturers. Students are spoilt with choices and availabilities of these tools which they could harness and use not only for entertainment purpose but also for their academic purpose. In addition, most of these are now easily accessible via their smart phones and hand-held portable devices.

There has been an explosion in the use of social media across many contexts, e.g., marketing, advertising, recreation, banking, recruitment, education, etc). The continuous growth and expansion of the World Wide Web, the move internationally by many countries towards knowledge economies, the need for globalization and the advancement of new technologies are all factors that have led to the need to reconsider the current pedagogies and engagement mechanisms adopted for teaching and learning in higher education. Because students in the digital age are heavily exposed to various emerging technologies and the vast amount of information which they can access from anywhere at any time, the role of higher education institutions now might be to focus on helping students to re-configure their knowledge as well as produce new knowledge. As such, there is a need to innovate current educational practices and explore new learning paradigms that could address the learning needs for the 21st Century (Brown, 2006). Tapscott (2008) stated that "in education the net generations are forcing a change in the model of pedagogy, from a teacher-focused approach based on instruction to a student-focused model based on collaboration" (p. 11).

Despite the increase in the use of social media in education, very little research has been done to explore social media use in universities in the Asia-Pacific region. The studies have reported that generally in Asia Pacific countries, most educators are using social media as informal collaboration tools, mainly for social networking and communication purposes, rather than using it as part of the teaching and learning process. This study aims to develop a better understanding of where South East Asia, and in particular Malaysia is placed with taking advantage of the opportunities social media offer, it will be essential to understand the current use of social media and student and academic perception of this use. This study will explore this issue by considering the conceptual frameworks of Communities of Practice (CoPs) by Ettiene Wenger (1998) and

Connectivism proposed by George Siemen (2004), which have been popularly linked as a theoretical explanation for the use of social media, to propose a conceptual model (explained below) for social media implementation in higher education institutions.

There is a perception that social media applications have the ability to help students improve their learning by engaging them in informal learning activities and processes. Siemens (2004) described informal learning as one of the significant trends in learning. Cluett and Skene (2007) add that social software can be used to encourage critical thinking, team work, creativity and self-paced learning among students, and these skills in turn, help students to develop deep learning approaches. Bartlett-Brag (2006) argues that use of these emerging technologies can stimulate the capture of tacit knowledge from informal learning situations.

3. CONCEPTUAL MODEL TO GUIDE THE RESEARCH STUDY

A conceptual model that integrates the characteristics of Community of Practice Theory (CoP) developed by Ettiene Wenger (1998), and Connectivism (a proposed learning theory advocated by George Siemens (2004)) has been developed to inform the study in terms of how Social Media Technologies (SMTs) can play a role in building a virtual learning community in Higher Education Institution. The conceptual model also helped to guide the study by informing the coverage of the study, the type of questions to be asked and who the study should focus on.

Connectivism and Communities of Practice (CoPs) can be used to complement each other as both emphasize on social learning and learning through collective intelligence. Jo Bloggs (2005, para 6) in her blog writes "Wenger states that the collective is necessary simply because 'domains' are too complex for one individual to master while Siemens claims that the differing perspectives brought together by nodes in the same network are necessary for exploring ideas and attaining meaning from knowledge (Siemens, 2004)". Both Connectivism and Communities of Practice (CoPS) theories promote informal learning and consider learning experiences among peers as equally valuable as learning in the formal setting (Giesbrecht, 2007). In Connectivism, students formed many connections and actively participated in the network which makes up the learning community. Siemens (2007) added that learning is a continual process which can occur in different settings including communities of practice, personal networks and work place task.
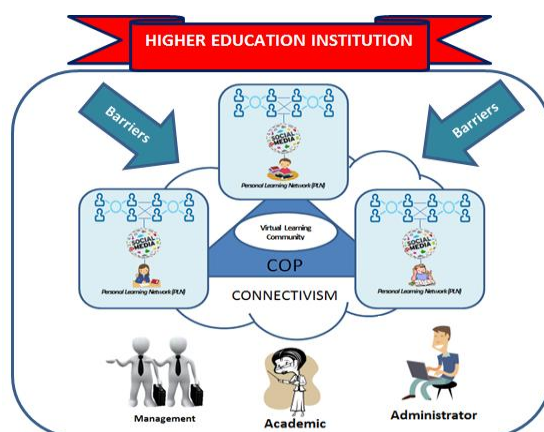

Figure 1. Proposed Conceptual Model

The conceptual model in Figure 1 above was developed to guide the research process and interpret the data from within the theoretical context. The conceptual model proposed draws from Community of Practice (CoP) as the building blocks of the virtual learning community for Higher Education Institutions. On the other hand, Connectivism helps students to build their own Personal Learning Network (PLN) which are interconnected to form the virtual learning community within the specific domain or area of study. This PLN is an informal learning platform for students in which they connect, interact and communicate with people, their peers, professionals, etc in their own personal learning environment. Each PLN might be connected to one or more than one virtual learning communities, within or outside the respective institution. These wide

connections of networks enable students to source vast amount of resources that could contribute to the knowledge development activities within each learning community. The effective sharing and sourcing of information in the entire network could be achieved through the connections supported and established via the use of Social Media Technologies (SMTs). SMTs are used as the tools to provide the environment for students to stay connected, to facilitate the growth of the network and to strengthen the community. The adoption of SMTs for teaching and learning activities will not be successful without the support from the top management, academics and administrators of the institution. Identification and clear understanding of the barriers that will refrain the formation of virtual learning community and the use social media are equally crucial to ensure a successful adoption of SMTs in higher education institution. Finally, the conceptual model will be mapped against the students reported interactions to help to understand their engagement process and to help to interpret the data collected.

4. RESEARCH STUDY METHODOLOGY AND CURRENT STATUS

As of April 2013, there are 20 public universities, and 62 private universities, University College, and colleges in Malaysia (www.visachannels.com). Based on the statistics provided by the Ministry of Higher Education Malaysia (www.mohe.gov.my), as of December 2011, there are 383 higher education institutions in Malaysia, and the total enrolments for undergraduate students is 1,049,885. There were 122,517 students enrolled in the Science, Maths and Computing Cluster.

A mixed-method research methodology using a quantitative-qualitative (Quant-Qual) model will be used. Quantitative data is being collected in the first phase in which surveys are being used to collect data from students, academics and administrators from both Informatics and non-informatics undergraduate programs to investigate their support, exposure and use of social media technologies for engagement, teaching and learning. For this study, 180 academics, 300 students and 18 administrators from across 6 different Malaysian higher education institutions (both private and public) will be asked to complete an anonymous survey. Data collection for phase 1 will take place from October to December 2013.

The second phase will involve the collection of qualitative data in which a sample of the same voluntary Informatics academics (30), students (30) and administrators (12) of the institutions will be interviewed to better understand their needs, usage and experiences in using social media technologies for their classes. Observations will also be conducted based on the undergraduate classes identified by the voluntary Informatics academics to better understand how social media technologies are being used for student engagement and teaching and learning. Phase two will be conducted from January to February 2014. The results of the qualitative and quantitative data collection will contribute to this study. A policy analysis framework will be used to examine the current policies being implemented in the higher education institutions sampled.

5. CONCLUSION

Higher education in the 21st-Century is in the process of change. Students in this generation are heavily exposed to digital technologies and the Internet. The extensive use of the Internet and social media has the potential to offer new types of student engagement and educational settings. The use of social media in higher education is becoming critical as the use of these tools and technologies has been part and parcel of current student's lifestyles. Higher education institutions should take this opportunity to harness these technologies that are already integrated into students' daily lives to design an innovative and creative education environment that will enhance and improve their learning experiences. Siemens (2007, para. 6) states: "… our institutions need to change because of the increasing complexity of society and globalization. Schools and universities play a dual role: accommodating learner's method and mode of learning and transforming learners and preparing them to function in the world that is unfolding". Research is showing that social media can be supportive of student learning, but there is limited knowledge on how it is being used and the outcomes of using it within educational settings. There is wide range of social media usage in educational settings now being reported, but many issues are still unexamined. Limited studies have been focusing on the educators' readiness, acceptance or refusal in integrating social media into their courses, the

perceived effectiveness of the tools and student outcomes for their learning. The central outcome of this research will be the development of a design framework that will be used as a guide for Malaysian Higher Education Institutions and Informatics academics to engage students using Social Media Technologies (SMTs) in creating effective learning communities for Informatics Programs.

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Reflection Paper

EDUCATIONAL ONLINE TECHNOLOGIES IN BLENDED TERTIARY ENVIRONMENTS: A REVIEW OF LITERATURE

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ABSTRACT

This is a review of the literature surrounding five popular media-rich educational online technologies (EOTs) currently being used by educationalists to support blended learning within tertiary environments. This review considers the following EOTs: 1) connective media, 2) interactive gaming, 3) virtual worlds, 4) web conferencing and 5) learning management systems (LMS), and provides educational stakeholders with an insight into the capabilities, current applications and observed benefits of using these technologies to facilitate student learning. As stakeholders across institutes focus on technology as a way to minimise costs, increase efficiencies and better meet student needs, this knowledge can support them in understanding, prioritising and applying new online tools in an effective manner. This review makes a contribution to the growing field of research concerning the integration of EOTs into blended tertiary environments.

KEYWORDS

Online, technology, education, blended, engagement, learning.

1. INTRODUCTION

Educational online technologies (EOTs) play a significant role in the delivery of online education, supporting the global increase in demand for higher learning, and contributing to opportunities for enriched student engagement. Within blended tertiary environments, online advances are improving traditional methods of delivery by fostering increased levels of "connectedness, community and collaboration", hallmarking the Internet as an important catalyst for growth in education (Bonk and Graham, 2006).

Educationalists have striven to respond "to the opportunities to harness" the benefits by developing their knowledge and application of rapidly evolving technologies (Gregory et al., 2010). In facilitating innovative EOT usage, those whose ideologies entail an adaptive approach to better learning (Tuapawa, 2013) are championing transformations towards the "future needs of learners and teachers" (Gregory et al., 2010).

This is a review of the literature surrounding five popular media-rich educational online technologies (EOTs) currently being used by educationalists to support blended learning within tertiary environments. This review considers the following EOTs: 1) connective media, 2) interactive gaming, 3) virtual worlds, 4) web conferencing and 5) learning management systems (LMS), and provides educational stakeholders with an insight into the capabilities, current applications and observed benefits of using these technologies to facilitate student learning. As educationalists across institutes focus on technology as a way to adapt to change, increase efficiencies and meet student learning needs, this knowledge can support them in understanding, prioritising and applying new online tools in an effective manner.

While targeted primarily towards educational stakeholders, this review also provides valuable information for business groups. As corporate leaders across all industries focus on online media as a way to gain competitive advantage, the use of emerging tools is "commanding organisations to assess and manage the impact these technologies may have on their business" (PriceWaterhouseCoopers LLC, 2013). Using this material can increase understandings towards the application of new tools, assist in EOT-based decision-making "within the context of …business goals", and support commercial growth (PriceWaterhouseCoopers LLC, 2013).

The following sections introduce the aforementioned technologies, selected at random to represent a cross section of EOTs currently being used to support blended learning within tertiary environments. The first section discusses *connective media*.

2. CONNECTIVE MEDIA

Connective media or "online social networks, [are] renowned for social discourse and relationship building…[and] have become the major online application" with "over 4.5 billion active users…in 2012". (Harasim, 2010, p.25). High-ranking social platforms such Facebook, which "by 2012…had 1 billion users" (Harasim, 2010, p.25), MySpace, Youtube and Twitter enable students to "practise their identity" and "seek to make connections". Designed to connect people together, these mediums have demonstrated "significant potential for supporting learning…" (Kear, 2011). Providing social affordances not dissimilar to physical learning environments, these sites have facilitated an "innovative means of expression" and have acted as a "source of entertainment" by providing spaces where students can communicate freely with friends or acquaintances and affiliate with groups having similar learning interests (Goodman, 2012). Participation in collaborative learning environments including technologies such as social sites, wikis, blogs and instant messaging has fostered sociability and social identity and presence through community-driven learning that for many students "feels real" (Kear, 2011). The next section discusses *interactive gaming*.

3. INTERACTIVE GAMING

Interactive games are being utilised within blended learning environments to support student engagement. Games and simulations have yielded "better attitudes toward learning when compared to traditional teaching methods" (Vogel et al., 2006). "People enjoy a challenge…[and] executing the actions…" states Adams (2010), "it's fun to fly a plane, shoot a rifle, design clothing, build a castle, or sing and dance." When gameplay, the primary source of entertainment, is incorporated into a blended programme of learning, students are challenged to approach a problem and improve their skills in a fun and entertaining manner. "Key findings from a review of 89 research papers providing empirical data on the application and effectiveness of computer-based games indicated that the effects of computer-based games on learning were positive (Ke, 2008). Similarly, the outcomes of a meta-analysis where trainees were taught through the use of gaming activities indicated that "simulation games [were] effective for transferring learning in many key areas" (Kapp, 2012). Other studies focusing on online games have yielded promising results for the importance of pedagogy (Harasim, 2012). The next section discusses *virtual worlds*.

4. VIRTUAL WORLDS

Virtual worlds, or three-dimensional immersive environments are also being utilised within learning environments to support student learning. "Virtual worlds" are considered by some as "the foremost in. adaptability" providing opportunities to tailor environments to "ensure realistic interaction and imagery" which promotes full "emotional and intellectual engagement in any scenario" (Visual Purple, , 2012). In other environments, virtual world technologies have facilitated rich real-time interaction, unique experiential learning scenarios, wider reach across remote regions, and learnable interactive interfaces (Tuapawa and Skelton, 2012). Notably, virtual worlds have been heralded as ideal vehicles for andragogic experiential learning (Salt et al., 2008). Experiential learning within a virtual world has enabled students to benefit from being "exposed to different ways of learning, not only books or lectures, but by more practical and immersive ways" (Gregory et al., 2010).

Empirical studies have indicated that collaboration within a virtual world has contributed to higher levels of dynamicity. After teaching nine university courses, Professor Calongne from Colorado Technical University, commented on how collaboration within a virtual world promoted an experience that was "lively, engaging and rich with social networks, interaction, and expression" (Calongne, 2008). The Virtual Worlds

Working Group (VWWG), stated in a case study and analysis of 21 Australian institutions using virtual worlds that the simulative characteristics of the virtual world encouraged greater sharing of ideas and collaboration in an engaging online medium (Gregory et al., 2010). Successful uses have leveraged "opportunities for visualisation, simulation, enhanced social networks, and shared learning experiences", creating "a mix of content and activity to support" all learning styles, "auditory, visual, and kinaesthetic" (Calongne, 2008). The next section discusses *web conferencing*.

5. WEB CONFERENCING

Web conferencing enables "a group of users to enter a shared virtual 'room' that supports synchronous interactions through a variety of modalities". In an effective way, this technology has been able to "provide an increased sense of co-presence, ...offer new possibilities for concept representation" and create real-time collaborative opportunities (Bower et al., 2011). Shared features such as whiteboards, screen sharing, chat functionality, voting and file sharing are among those which "we use…to connect, share, educate, interact, and build trust" (Safko, 2012). Although lacking "the spatial component found in... 3D virtual environments... these [technologies] are powerful tools that [have] enabled participants... to engage in a variety of meaningful ways" (Annetta et al., 2010). Web-based platforms such as Adobe Connect have the potential to "improve online learning by enriching...synchronous interactions in audio, video, and text formats, encouraging student collaborations, increasing both social and teaching presence of an online course, providing students with instant feedback...boosting student motivation to learn and self-efficacy on online learning..." (Wang et al., 2013). The next section discusses *LMS*.

6. LEARNING MANAGEMENT SYSTEMS

Many institutions utilise integrated electronic learning environments, such as Blackboard, to efficiently administer and support the delivery of online programmes of learning. The basic functions of these usually commercial and customised learning management systems (LMS) cover student administration, class management, class resource management, courseware delivery, asynchronous and synchronous conferencing, document exchange and access to support services (Gooley and Lockwood, 2012). "Few educational technologies are as widely adopted and implemented as course management systems" (West et al., 2007). A LMS is "an excellent vehicle for training, evaluating and tracking results" (Brown and Johnson, 2007). A key advantage is that a centralised learning environment ensures consistency in delivery and evaluation and easy design and deployment for customised training modules.

7. CONCLUSION

This review has considered five popular media-rich technologies currently being used by educationalists to support blended learning within tertiary environment. These are connective media, interactive gaming, virtual worlds, web conferencing and LMS. Connective media is fostering student social identity and online presence. Interactive gaming is improving student attitudes towards learning and augmenting learning strategies. Virtual worlds are providing immersive scenarios for enriched and authentic activity. Web conferencing tools are offering real-time collaborative opportunities with varied functionality for meaningful engagement, and LMS are enabling consistent online course delivery mechanisms. These online tools are improving traditional methods of delivery by fostering increased levels of connectedness, community and collaboration. Stakeholders who continue to develop their knowledge and application of emerging EOTs will contribute towards improved learning opportunities for current and future students. Business organisations too can benefit by using this material to increase their understanding and application of online tools within a commercial context. Other EOTs not discussed, but which are influencing online delivery includes mobile applications and Web 3.0 technologies.

Further research by the author will attempt to 1) develop an appropriate classification system to help guide tool selection and categorise the extensive range of EOTs, and 2) conduct an investigation towards resolving the disparities that exist between stakeholder needs and EOTs within blended tertiary environments.

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Poster

HOW TEACHERS USE AND MANAGE THEIR BLOGS? A CLUSTER ANALYSIS OF TEACHERS' BLOGS IN TAIWAN

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ABSTRACT

The development of Web 2.0 has ushered in a new set of web-based tools, including blogs. This study focused on how teachers use and manage their blogs. A sample of 165 teachers' blogs in Taiwan was analyzed by factor analysis, cluster analysis and qualitative content analysis. First, the teachers' blogs were analyzed according to six criteria (total posts, article category, links, page score, index score, and influence score). Then, important factors that influence teachers' use of blogs were summarized using factor analysis. Finally, cluster analysis was used to divide the sample into groups of similar blogs. Four groups were identified: the general group, the outstanding group, the high-impact group and the high-knowledge management/sharing group. Further content analysis of these four teacher groups will provide suggestions for teachers and teacher educators on more beneficial uses of blogs.

KEYWORDS

Blog, teacher community, content analysis, professional development, cluster analysis

1. INTRODUCTION

Regarding the analysis of the feature and application of blogs, as for the functions, Herring, Scheidt, Wright, and Bonus (2005) analyzed the nature of blogs. Their study analyzed the presence or absence of article archives, badges, images, comments, email contact with the host, advertisements, search functions, calendars and message boards. The results showed that over half of the blogs sampled included an article archive, badges and images. Researchers also analyzed the headers and footers of these blogs and found that the information most frequently included in the header was the date, and the information most frequently displayed in the footer was the time.

To summarize the above, the studies explored the basic features of blogs, the content of knowledge-interactions, and the blogging purposes. Regarding the overall shape of blogs, knowledge-sharing characteristics of the bloggers can be analyzed to determine hidden patterns and clusters. There is little research on these aspects, which could allow us to understand blogs from another perspective. Therefore, in this study, we adopted factor analysis and cluster analysis to understand Taiwanese teachers' use of blogs.

The specific purposes of this study are 1) to use factor analysis and cluster analysis to understand potential grouping and behavioral patterns in the use of blogs by teachers in Taiwan and 2) to use content analysis to analyze blogs, including their features and content, in each group, and two research questions are addressed:

2. METHOD

2.1 Sample

The subjects of this study are the blogs of teachers in Taiwan at kindergarten through university levels. The aim of the study was to understand recent patterns in teachers' blog use. Before analyzing these patterns, researchers must understand the functions and features provided by the blog service providers (BSPs) that the teachers utilized. These functions and features will be taken into consideration during further analysis.

2.2 Procedure

During data collection, the researchers first performed a brief analysis of the BSPs used by teachers. The researchers then searched for teachers' blogs on these BSPs that met the criteria of this study. After collecting the data, the researchers first performed a criterion analysis and then used factor analysis to identify important factors influencing teachers' use of blogs. This study then divided the teachers' blogs into groups based on the results of a cluster analysis. After grouping, this study used content analysis to understand the distinguishing features of each group of blogs.

3. RESULTS

Research Question 1: Can the Characteristics of Blogs Effectively Divide Them into Unique Groups?

This study conducted a preliminary analysis on a total of eight indicators. BSP and teaching level are classification indicators and are not included in the factor analysis. This study used the number of links, the number of categories, the total number of posts, index score, influence score and page score to analyze the teachers' blogs. Based on these six items, this study used factor analysis, together with the largest variation orthogonal axis, to find common factors among these indicators. Analysis of the principal components was performed by retaining the original information in an attempt to identify a linear combination that could explain the variables. Rather than using more original factors, the goal of this analysis was to identify a few main components that could be used to explain the variables. The eigenvalue of each item must be greater than 1.0, and the factor loading value must be greater than or equal to 0.40.

The factor analysis yielded two items that can be used to describe teachers' blogs (see Table 1). Factor I includes the page, influence and index scores, and Factor II includes the numbers of links, categories and published posts. Because the items of Factor I are closely related to the impact of the blogs, this factor is referred to as Impact. Factor II includes items that the bloggers used to manage and share their knowledge content; this factor is referred to as Knowledge Management/Sharing (KM/KS).

Table 1. Factor Loadings and Eigenvalues

Analyzed items	Impact	Knowledge Management /Sharing
Page score	.974	.069
Influence score	.973	.065
Index score	.845	.254
Article category	-. 061	.767
Links	.144	.595
Total posts	.162	.556
Eigenvalue	2.813	1.175
The percentage of variance explained	44.358	22.096
Cumulative percentage of variance explained	44.358	66.454
KMO coefficient	.687	

This study used the K-Means grouping method to perform cluster analysis, where the input data are the factor scores resulting from factor analysis. Since two factors were identified above, the high and low values of each factor will generate four possibilities. Therefore, group sizes of two, three and four will be considered for cluster analysis. It was found that if this study divided the sample into two or three groups, there were too many blogs in each group, and the division was inefficient to explain the sample characteristics. Taking into account the high and low status for each factor would produce four possibilities, and thus this study used four groups for analysis. Grouping analysis results are summarized in Table 2.

Table 2. Summary Table of K-Means Cluster Analysis

	Clusters			
	Group 1	Group 2	Group 3	Group 4
Impact	-. 11	3.97	10.67	-. 08
KM/KS	-. 24	.99	-. 01	2.44
Number of blogs	148	2	1	14

The factor scores are standardized and, as a result, their values range between -3 and 3. A scale for the factor scores can be formed by dividing the factors into 11 equal parts. After the scores are converted into a scale, this scale can be used to describe the characteristics of each group.

4. CONCLUSION

Based on our findings, we offer the following suggestions for teachers and teacher educators. Authors of education-related blogs may refer to the characteristics of the four groups when deciding how to operate their own blogs. Moreover, teacher-trainers could use our findings to formulate ICT-Integration training. These courses would then help teachers make better use of blogs for teaching or professional development. For example, the trainings could conduct blog-visiting/sharing activities based on the result of our grouping. The bloggers in the general group can learn from bloggers in the other three groups about improving their knowledge-management/sharing skills and promoting their impact. They can learn about the management of blogs from excellent examples and thus improve the visibility of their own blogs. They can also attract more readers by improving their writing. Better influences and knowledge-sharing may also improve the depth and breadth of knowledge-sharing in the teacher community.

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