Virtual collaborative teaching: What value does it bring?

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The study presented in this paper evaluates the success of a virtual learning session that involved international collaboration. Following a service science based approach teaching and learning is viewed as a value co-creation process that occurs during a teaching and learning event; success is associated with the level of perceived participant satisfaction with the value of the session. The evidence presented suggests that students were satisfied with the way the virtual collaborative session went, and that new knowledge was created as a result of the session itself and the assignment accompanying it. The work contributes towards the understandings the dynamics of value co-creation in a teaching and learning context.

Keywords: Virtual collaboration, value creation, student satisfaction

Introduction

It is predicted that in the future traditional universities will be gradually replaced by universities that will offer technology mediated, universally accessible and inexpensive education, deployed on a mix of commercial platforms (Kortesoja, 2012). Already there is a shift towards developing student-centred educational frameworks (Rust, 2002) supported by contemporary information and communication technology (ICT) Rogers, 2000).

The Internet–based services known as Web 2.0, or “socially-based tools and systems referred to collectively as social software” (Lee & McLoughlin, 2008) are an integral part of contemporary ICT. They include tools such as wikis, blogs, voice boards, Google +, and podcasts, and were developed in the last decade as part of the Semantic Web – the Web that supports distributed collaboration and social interaction (O'Reilly, 2007). The next generation services (Web 3.0) is about to become part of mainstream ICT (Hendler, 2009). Web 2.0 and Web 3.0 have already triggered changes in social behaviour related to communication and learning (Lee & McLoughlin, 2008) and are often referred to as social media (SM) tools (Kaplan & Haenlein, 2010).

In education, SM can be used to give students a sense of community and belonging to a social network as they provide ample opportunities for collaboration. Once integrated with instructional design frameworks SM will be able to support the development of student centered learning and teaching methods (Beldarrain, 2006). They are of special interest to courses that follow a constructivist approach towards learning (Ullrich et al., 2008), for example courses that focus on participatory learning and collaboration (McLoughlin & Lee,
and on constructing knowledge through social interaction within a collaborative space (Kato & Katnii, 2001).

Active collaboration is already embedded in online learning which facilitates and supports learner-instructor or learner-learner interactions in synchronous or asynchronous mode (Katz, 2002; Lapadat, 2004). However SM provide users with added control and interactivity options where collaboration is enhanced through peer-to-peer communication and real-time learning (Wheeler, 2009) that involves all participants in the teaching and learning process (Sendall, et al., 2008). With social networking platforms able to support both virtual and face-to-face classes it is likely that collaboration will move towards a virtual form (Grabner-Kräuter, 2009), for example through creating a virtual personal learning space that encourages collaboration and activity based learning (Gillet et al., 2010).

The study presented in this paper evaluates a virtual learning session that used Skype™ to facilitate international collaboration in a live classroom, creating a virtual collaborative learning space. The paper is organised as follows: First the literature on SM and their use in education is briefly reviewed, followed by a description of the research design and methodology. The next two sections present and discuss the findings based on data gathered in 2012 and in 2013. The study limitations and directions for further work and research are highlighted in the concluding section.

**Social media and education**

Rogers (2000) identifies three levels of technology adoption in education. At the first two levels technology is used for improving personal productivity, then as an ‘add-in’ to traditional teaching. At the highest level a paradigm shift starts occurring, where the new technology becomes an integral part of the teaching and learning model and necessitates a shift of focus from teaching to learning, and the adoption of synchronous and asynchronous communication technologies.

Current research results indicate that students may benefit from using SM in teaching and learning contexts as they may experience positive cultural and societal influences (Taylor et al., 2012). Indeed SM platforms and tools are already adopted as educational technologies at least at the first two levels of Roger’s framework. For example a current survey of faculty members recruited from about 1000 U.S.A. colleges and universities found that more than 80 percent of the respondents used SM personally (Blankenship, 2010). More than half integrated some SM tools in their face-to-face classes. The survey found also that students were prepared to use SM as part of their learning experience as they were already engaged in interpersonal social networking.

Williams and Chinn (2009), Patel (2010) and Johnson and Jay (2012) highlight a broad range of SM use contexts across industries and organizations. With respect to education SM are seen as a means to enhance student learning experiences by creating a student-centered environment where students construct their own knowledge, and engage students with active learning. Improving student engagement is becoming increasingly critical. According to PRNewswire (2010) about half of all tertiary level students do not complete their degree in
six years or less due to lack of engagement; SM may help improve student engagement by involving students in collaborative and constructive discussion with instructors and peers.

One of the SM technologies available at present is Skype™. It is easy and affordable and widely used: there were 31 million Skype™ users as of January, 2012 with 35% of small businesses using it as a primary communication channel [i]. Not much of the research on the use of SM in education has focused on using Skype™ in the classroom. The exploratory study presented here below partially addresses this gap. It investigates student experiences from a collaborative learning session that used Skype™ and associated technologies to create a virtual learning space. The overall objective of the study was to gauge student satisfaction and perceived learning based on the assumption that student satisfaction offers a measure of the success of the teaching and learning approach.

Research design and methodology

A value creation perspective grounded in the service science discipline provided an insight into what may make a virtual collaborative successful. In service science a ‘service’ is broadly defined as an interactive process where participants and entities operate together to create value for mutual benefits (Spohrer & Maglio, 2008; Vargo et al.,2008). Viewed as a service teaching and learning becomes a value co-creation process where value co-creation is expected to occur through collaboration and interaction (Jokela, 2012). Value co-creation through interaction and social collaboration is a defining characteristic of SM (Lee & McLoughlin, 2008) therefore SM tools may be particularly well suited to technology supported education design

Research approach

In this study it was proposed to create value by adopting a session design that stimulated knowledge exchange in interactive and flexible mode (Johnston et al., 2005; Swan, 2001) as follows. Three presenters took part in each session, one presenter attending virtually using Skype™. Students were asked to familiarise themselves (before coming to class) with prescribed material related to the topic of the session. They were expected to get actively involved in discussion with the presenters and with each other during and after the interactive presentations. The following research question addresses perceived satisfaction with the session design:

RQ1) Were students satisfied with the pedagogical design of the session?

The associated evaluation of acquired knowledge (a formal assessment) included a problem solving task aimed to demonstrate that students had acquired new knowledge (thus indicating that the expected value co-creation process had successfully occurred). The following research question that addresses perceived satisfaction with learning was formulated:

RQ2) Were students satisfied with the learning that occurred during the session?

Prior research in technology supported learning has shown that student satisfaction is also influenced by student familiarity with the technology and/or how easy it is to be used. With respect to collaborative virtual learning Resta and Laferrière (2007) specifically recommend
to use tools and techniques that are feasible for use in the virtual classroom. A third research question was formulated (to gauge how successful the implementation of the technology was).

**RQ3) Were students satisfied with the technical design of the session?**

**Research model**

In order to investigate the research questions it was assumed, following Wixom and Todd (2005) that satisfaction with outcomes and process (object based attitudes) is positively related to perceptions of usefulness and value, and ease of use (behavioural beliefs). A research model representing the three constructs related to student satisfaction was developed: the perceived value of the session design for learning (SD), the perceived overall session usefulness for learning (SU), and the perceived session easiness for learning (SE – easy to use technical design). The model links the constructs and shows the assumed relationship between satisfaction and success (Figure 1).

![Research model diagram](image)

**Figure 1: Research model**

**Data gathering**

The data gathering tool (a questionnaire) was modelled in part on the Technology Acceptance Model (TAM) (Chuttur, 2009; Legris et al., 2003). TAM was chosen as it has extended and empirically validated in numerous studies related to information technology success and critical success factors (Malhotra & Galletta, 1999; Venkatesh & Davis, 2000; Venkatesh et al., 2007) and has been adapted to study technology supported learning adoption (Park, 2009; Saadé &Bahl, 2005; Sun et al., 2008).

The TAM constructs perceived technology usefulness’ and ‘perceived technology ease of use’ were used to develop questions related to SE and SU, respectively. More specifically the questions about SE were based on the assumption that ease of use is influenced strongly by
past experiences with the technology. It was assumed that participants had formed certain expectations about how well technology should support the learning activity (Venkatesh, 2000). With respect to SU, the focus was on the virtual collaborative session as a whole rather than on the technology used. The rationale behind this assumption is that the study investigates successful learning rather than successful technology adoption; a similar approach is followed in (Liaw, 2008).

The questions investigating the session’s pedagogical design were developed with input from (Swan, 2001) and (Coppola et al., 2001). The questionnaire included as well a question intended to measure overall satisfaction (intention to participate in similar sessions in the future – FU). The responses were measured on a 5-point Likert scale (Figure 2). Three open ended questions provided an opportunity for further comments.

<table>
<thead>
<tr>
<th>#</th>
<th>QUESTION</th>
<th>Str. Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Dis-agree</th>
<th>Str. disagr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I felt comfortable with the collaborative teaching format used in class (SD)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>I felt comfortable with the live online presentation as part of the collaborative teaching class (SD)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>I felt comfortable with the design of the collaborative teaching class focusing on research, practice and problem solving (SD)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>I learnt a lot form the presentations made in the collaborative teaching class (SU)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>I was able to ask questions and clarify the points made by the presenters in the collaborative teaching class (SD)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>I was satisfied with the technical set up of the collaborative teaching space (SE)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>I was satisfied with the technical quality of the collaborative teaching class (SE)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>I found it easy to follow the presentations made in the collaborative teaching class (SE)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>I found it useful to be able to hear speakers from different backgrounds present on the collaborative teaching class topic</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>I found the assessment (as part of the collaborative teaching class) useful for my learning (SU)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>I will be happy to participate in collaboratively taught classes in the future (FU)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

| 12 | Add more: your overall impressions                                      |            |       |         |           |             |
| 13 | Add more: your suggestions for improving the format                      |            |       |         |           |             |
| 14 | Add more: on anything else                                              |            |       |         |           |             |

Figure 2: Research instrument (questionnaire)

Study setting
In order to gather sufficient data from the envisaged small population of enrolled students, the virtual session was run twice (in 2012 and in 2013), with modifications in the session design made in 2013 based on feedback obtained in 2012. The same questionnaire was applied in both sessions.
Participant characteristics
Two groups of postgraduate students (enrolled in “Cloud Computing”) took part in the study—16 in 2012, and 20 in 2013. The course is part of a Master’s programme at the Auckland University of Technology. In both groups the mix of students was culturally diverse, with four international and 12 domestic enrolments in 2012, and five international and 15 domestic students in 2013. This distribution is typical for the students taught at the case university where in 2011 approximately 13% of the all enrolled students were international and coming from more than 80 different countries [ii]. Around 40% of the students in each group did not have significant experience as ICT professionals.

Session design
In both runs (2012 and 2013) the virtual collaborative session included presentations on security issues in cloud computing made by three presenters (the two authors and an invited guest speaker) and including both an industry-oriented, and a research perspective. Two New Zealand based presenters (the first author and an invited guest) were present in the classroom with the overseas based presenter (the second author) used SM (Skype™ and, Pamela Pro) to deliver and disseminate the presentation and participate in the class discussion. The students were able to see all presenters in real time, to ask questions and to receive real time responses. The 2012 session was recorded and made available later. The following changes were introduced in 2013: first the presenter from overseas was shown on a big screen with an improved sound quality. Second a different local guest speaker was invited.

Assessment
The assessment protocol in 2012 included an assignment to be completed in class as an individual activity. The assignment was formally assessed and contributed towards the students overall course grade. The activity was a problem solving exercise based on a pre-assigned reading (chapters 8 and 23, Buyya et. al, 2011) that referred to security issues with storing data in the cloud. The assignment aimed to test student understanding of how the theory (security protocols and digital identity management tools) and the practice (cloud data storage) worked together in the real world and how the risks identified in the literature could be mitigated. In 2013 a slightly modified version of the assignment was given as a homework activity, with students enabled to communicate with each other and with the presenters (asynchronously) while working on it.

Findings
This section presents in detail the findings from the data gathered in 2012, and includes a summary of the data gathered in 2103.

The 2012 study
In 2012 all 16 enrolled students took part in the session and were asked to complete the questionnaire. The number of the returned questionnaires was 15. The data were analysed with respect to the mean values of the responses to the questions in the three categories SD, SU, and SE. The outcomes are presented below.

Student satisfaction with session design (SD)
Questions 1, 2, 3 and 5 aimed to gauge student satisfaction with the design of the session, with focus on collaboration, virtual presence, research/practice mix, and interaction. These variables refer to the way the learning content was delivered and the provisions for interaction, knowledge building and value co-creation through collaboration, including virtual collaboration; the process aims to equip students with skills and knowledge that can be applied to a realistic information security scenario related to a cloud computing data storage solution. Students liked the collaborative effort and the opportunities for interaction but were slightly less satisfied with the other two components of the design, with the research/practice mix being having the lowest average (Figure 3).

![Figure 3: Mean values - satisfaction with session design (2012)](image)

**Student satisfaction with learning (SU)**

Questions 4, 9 and 10 aimed to gauge student satisfaction with the learning that occurred as a result of the session, with focus on the ‘learning’ usefulness of the presentations, the presenters’ differing perspectives, and the formally assessed problem solving activity. These variables refer to the learning content and the expected ‘learning’ value: presenting students with a range of perspectives on cloud computing security that exposes them to the risks involved and the range of security issues arising, and giving students an opportunity to apply the knowledge acquired to solving a practical problem. The results show that while students found the presentations useful and informative for their learning they found the formally assessed class activity less useful (Figure 4). It has to be noted that five students did not manage to complete the activity in class as they had not done the required prior reading and ran short of time.

![Figure 4: Mean values - satisfaction with learning (2012)](image)
Student satisfaction with technical quality (SE)
Questions 6, 7, and 8 focused on set up, quality and easiness to follow. They aimed to gauge student satisfaction with the quality of the technical design of the session, as influenced by their expectations about how well the technology should support the interactions and the content delivery - two important components of the value co-creation process. Students were satisfied with the technical performance of the software/hardware and found the session easy to follow, however the session set up was found less satisfactory (Figure 5).

Using what was feasible at the time the overseas presenter was projected onto a small computer screen, and students had to come forward in order to be able to see and listen (Figure 6); this may have inconvenienced some of them and influenced negatively their perceptions of the set up.

Figure 4: Mean values - student satisfaction with learning (2012)

Figure 5: Mean values - satisfaction with technical quality (2012)

Figure 6: Students watching and listening to the virtual presenter (2012)
Individual student satisfaction
With respect to individual respondent satisfaction, all means per student were above the neutral point (Figure 7). No outliers were found (Dixon’s q-test was applied). The lowest mean was 3.07, the highest was 5. The observations included a total of four ‘disagree’ responses, with no strongly disagree responses. Questions 7 and 10 had each one ‘disagree’, while question 6 attracted two ‘disagree’ answers and had the lowest mean across the sample (3.87). Notably the disagree responses were distributed amongst two students only: one had the lowest mean across the sample, the other one had with third lowest mean (3.67). The distribution of the ‘disagree’ answers across the sample was found statistically significant (p <2.5%).

![Figure 7: Mean value distribution for individual students (2012)](image)

Overall satisfaction
The mean of the responses to Q11 that asked about hypothetical further participation was 4.07 showing good overall satisfaction. However a very limited number of responses to the open ended questions were received (Figure 8). The comments provide further support for the effectiveness of the session design (responses 12-13 and 12-15).

<table>
<thead>
<tr>
<th>Question-Response</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-Jan</td>
<td>Very good</td>
</tr>
<tr>
<td></td>
<td>It was good to gain knowledge from learned people from various backgrounds</td>
</tr>
<tr>
<td></td>
<td>It was informative on security aspects of cloud computing by the two presenters and the class discussion was helpful</td>
</tr>
<tr>
<td>13</td>
<td>Students should be encouraged more to participate with the guest lecturers. This will create positive impact on both students to work more in close with industry people and get practical hands on knowledge rather than not so usable bookish knowledge</td>
</tr>
<tr>
<td></td>
<td>This should also be introduced in Information Security class</td>
</tr>
</tbody>
</table>

![Figure 8: Responses to open ended questions (2012)](image)

The 2013 study
Fourteen out of the 18 students who attended the class completed the questionnaire. The summary in Figure 9 shows the 2013 data mean values, grouped as per the categories used in the 2012 data analysis.

<table>
<thead>
<tr>
<th>Question</th>
<th>Satisfaction – session design (SD)</th>
<th>Satisfaction – learning (SU)</th>
<th>Satisfaction – technical quality (SE)</th>
<th>Overall satisfaction (FU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>4.21(4.20)</td>
<td>4.00(4.13)</td>
<td>4.07(3.87)</td>
<td>4.14(4.07)</td>
</tr>
<tr>
<td>Q2</td>
<td>4.29(4.13)</td>
<td>4.29(4.13)</td>
<td>4.23(4.07)</td>
<td></td>
</tr>
<tr>
<td>Q3</td>
<td>3.86(4.07)</td>
<td>3.85(4.07)</td>
<td>4.15(4.00)</td>
<td></td>
</tr>
<tr>
<td>Q4</td>
<td>4.00(4.13)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 9: A summary of the 2013 data (Likert scale questions)**
The figures in brackets show the corresponding 2012 mean value for the purposes of comparison. It can be seen that the mean values for the two years relatively close, with a slight decrease in Q3 and Q10, and an increase in all questions in the SE category.

Four students provided answers to the open ended questions; overall students were satisfied with the session, offered suggestions for improvement (Figure 10).

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
</table>
| Q12      | -All good. Nothing to add up. May be a separate session  
-I liked the overall concept of the class. Having read the 2 chapters prior to the class I was hoping for some further in-depth explanation on the chapters. The TAC and SKS examples in the chapter was just represented in the slides. As I haven’t had exposure to this type of technology since I learnt about public/private keys 10 years ago in undergraduate I just felt it needed to be explained more to us. The exercise is proving a valid experience for me as I have via research already improved my understanding of information cards.  
-It was a good learning experience. Thanks.  
-A good class with an informative and clear speaking guest. He had much knowledge on the subject and used good examples.  
-good  
-It is better to arrange the table in a some other way to see everybody. I feel lab environment is not suitable. some sort of distractions. (with big screens ??) |
| Q13      | -may be a separate session.  
-Maybe some interactive examples to help explain the content so the students can pick an answer to a situation based on their understanding and the class can then talk about why it maybe right or wrong.  
-more examples and real case scenarios to understand the topic  
-a clear and a bit more louder voice and at times becomes difficult to hear |

**Figure 10: Summary of responses to the open ended questions (2013)**

**Discussion**
The findings show that there was a significant satisfaction level with the virtual collaborative session (overall mean across all questions 82% in both years). The result compares well with
the overall student satisfaction across the graduate computing programmes across the school (76%), and across the university (78%) [iii]. The mean of the responses to the question about future participation in similar sessions (81% in 2012, 83% in 2013) is also comparable to the mean of the responses to the question asking whether the respondent would recommend their course to others (84% across the university).

The findings indicate that students were comfortable with the collaborative teaching format and felt positive impact on their learning. With respect to the research questions guiding the investigation it can be noted first that students were satisfied with the pedagogical design of the session, and perceived the approach (presenting different perspectives) as valuable and contributing to their knowledge. They also valued the opportunity to interact with all presenters, including the virtual one; the comments suggest that the session could benefit from being made even more interactive. Second students were satisfied with their learning. Finally student satisfaction with the quality of the technical which was lower compared to the other two indicators, rose in 2013 once the quality of the Skype connection was improved.

The overall satisfaction remained high in both years even though in 2012 their expectations about the quality of the technology were not met at the highest level; the results confirm Hartshorne and Ajjan’s (2009) observation that perceptions about the facilitating Web 2.0 technology did not influence significantly participant intention to use.

The findings of the study are aligned with the other reported results about student perceptions of value and satisfaction with technology supported learning that identify the positive influence of the instructor’s expertise, the opportunity for self-regulated and collaborative learning, and the clarity of the course structure as critical factors (Paechter et al., 2010). In our study we placed a significant emphasis on the session design, deployed collaborative teaching as a strategy and included instructors from different backgrounds in the teaching team. The findings confirm the importance of instructor expertise and course design as value contributing factors; the variation in expertise may explain the lower mean of the answers to Q3 in 2013 (Figure 9). However an opportunity for self-regulated learning (as it included a formally assessed activity) was not provided and as a consequence students were less engaged in co-creating learning value than anticipated. Notably the change of the assessment (from a class to homework activity) did not improve student satisfaction with assessment in 2013 (Figure 9, Q10). In summary the evidence suggests that a significant level of student satisfaction was generated and that students had built new knowledge as a result of the session itself and the work on the problem solving activity. Students perceived their experience with the virtual collaborative session as valuable (worth repeating).

Conclusion

This study explored the success of a virtual collaborative session supported by an SM tool. The session’s learning objective was to give students a deeper understanding of cloud computing and the security issues associated with it by virtually utilizing a SM tool. A value co-creation approach was applied to model the process. Overall the results suggest that the virtual collaborative session successfully engaged students in a knowledge construction/value co-creation process.
The work contributes towards understanding the dynamics of value co-creation in teaching and learning. However it has a number of limitations. First data were collected from small samples due to the limited enrolment. Second the research design did not include explicitly factors that have been found to influence success and value perceptions in previous work such as lecturer and student individuality. Despite the limitations highlighted the findings provide a useful starting point for further development of the collaborative aspects of the virtual environment including improving the session design to offer more opportunities for collaboration, active learning and engagement supported by a wider range of SM tools; we are considering introducing a group assignment so that students can share their ideas and work as a team towards a ‘best’ solution. As the approach is applicable across academic subjects, in the longer term more such sessions and in a number of courses could also be developed. Directions for further research include developing a research model to allow a more in-depth investigation of the factors that contribute positively (or negatively) to the process of value creation and co-creation in the virtual collaborative teaching and learning environment.

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**References**


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