Disaster Week: A case study immersing first year engineering students in a disaster context to measure communication skills

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CONTEXT

Communication is vitally important in any engineering role, a fact which students studying engineering do not tend to appreciate until near the end of their diploma or degree.

This paper will focus on a first year module, Technical Literacy which is composed of 50 % communication and 50 % drawing. Because Technical Literacy is internally assessed students place more emphasis on the drawing, losing focus on the communication aspects.

This paper will discuss the immersion of first year New Zealand Diploma of Engineering students (NZDE) in a five day intensive disaster scenario (modelled from Saemundsdottir, Matthiasdottir, Audunsson, & Saevarsdottir, (2012)) to actively measure an individual student's communication skills.

PURPOSE OR GOAL

The purpose of the change in practice was twofold; to enhance the relevance of engineering communication with the students, as well as creating an immersed context to encourage completion of course material.

APPROACH

Both quantitative and qualitative data will be used to analyse the change in teaching practice.

Qualitative data in the form of student questionnaires during the disaster week and individual reflections once the week was completed will be used to summarise student perceptions of the scenario to enhance communication skills.

Quantitative data in the form of student completions will be compared with previous years. Final (communication) marks will also be compared though this is incidental to the research.

ACTUAL OR ANTICIPATED OUTCOMES

Student completions of key objectives within communication rose (final statistics yet to be given)

Communication tutors who help run the course were satisfied that the quality of the work was at least on a par if not better than previous years (final marks yet to be determined)

The importance and self-awareness of communication skills within engineering students has increased as evidenced in student reflections.

SUMMARY

Students enjoyed the disaster week scenario, being placed in a highly intense environment with students they do not normally work with. Students successfully managed the scenario submitting components for assessment as the week passed. Completions of assessment were very good, as well as increased student perceptions of the role of communication within an engineering environment. Disaster week was counted as a success by all involved (engineering/communication tutors & students) and will run again next year.

KEYWORDS

Engineering Communication, Problem Based Learning, Blended Learning, Group Work

Introduction

Background

This paper will focus on a change in teaching practice within the module Technical Literacy, a first year, first semester paper that is part of the New Zealand Diploma in Engineering. This module is internally assessed, made up of 50% communication and 50% technical drawing. Engineering students studying the civil, electrical or mechanical streams are required to take this course as part of their diploma.

To pass the module a student is required to achieve a mark of 50% or higher. This 50% can be achieved from any part of the course. Theoretically, a student could get 100% in the drawing component and miss the communication part entirely and still pass the course or vice versa.

From previous editions of this course, it was found that students placed more emphasis on the drawing component as it is easily quantifiable and readily identifiable, with the students' only taking part in the communication aspects to get to the 50% mark. After this they tended to lose interest. Tutors of this course spent much of their energy chasing up students to hand in work, as the communication aspect of report writing and presentation delivery is important in later modules of the Diploma.

To increase the awareness of communication skills, and to improve completion of assessments, the communication part of the course was redesigned. Rather than the more traditional two hours per week, where students would learn about communication outputs, a blended classroom model (Torrisi-Steele, 2011), was created where a one week block was incorporated into the programme for all students to attend. During this week the students were immersed in a disaster scenario which enabled them to complete 30% of the assessment. To accompany this, class times were available before the disaster week and after the disaster week to aid students with their writing skills. Students were not required to attend any other first year class during this timetabled week. To complete the assessment for the Technical Literacy course a 20% technical report was required within another module (Harris & Bigham, submitted to this conference). This meant there was no addition of time into this course from previous teaching years.

The aim of this one week block course is to provide a project in which engineering students are motivated to communicate to creativily solve a problem (Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palincsar, 1991). The blended classroom has therefore incorporated project based learning (Zhou, 2012).

Project Based Learning

Engineering education tends to be a deductive process, starting with theory then moving into application. Engineering communication is no different with application following a taught process. By reversing this to an inductive approach, a "need to know" scenario can be created for a student to solve in which relevant theories/processes are then discovered and applied for a successful outcome (Prince & Felder, 2006). Project Based Learning is one such inductive learning model.

Project Based Learning is a classroom facilitation model which is based upon learning around projects, problems, scenarios or a combination of all of them. Projects are defined as complex tasks or problems that students are required to investigate to make informed decisions, which will then culminate into a realistic product or presentation (Thomas, 2000, Prince & Felder, 2006). There are many advantages of a project as a learning tool for engineering education as it includes authentic content and assessment, while creating an avenue for student driven and creative outcomes (Zhou, 2012). Coupling this project based learning with engineering as well as communication adds the benefits of cooperative learning, reflection, and transferrable adult skills (Thomas, 2000). As well as the critical

thinking skills that a project can draw out, it also has the ability to motivate the students, by providing interest, value, variety and challenge (Blumenfeld et al, 1991).

In implementing a project for the first time, barriers can appear that can be difficult to minimise (Graham, 2010). The main barriers for this change in teaching practice at this institution come in the form of convincing fellow staff members the applicability of this method with seemingly traditional content (such as communication, maths and physics), the experience of the tutors and the time intensity for both students and tutors.

For further information regarding Project Based Learning, refer to Thomas (2000) who provides an overview of the research within the area while Graham (2010) provides case studies of incorporating project based learning in the UK and Australian tertiary institutions.

Disaster Week

The change in teaching practice toward Project Based Learning was modelled from a paper and presentation by Ingunn Saemundsdottir at the CDIO conference in Brisbane, Australia in 2012. The paper was entitled Facing Disaster: Learning by doing at Reykjavik University (Saemundsdottir, Matthiasdottir, Audunsson, & Saevarsdottir, 2012), where Saemundsdottir et al, created an optional learning situation for first year engineering students to help increase their skills in communication by learning by doing. The main goal of this learning situation was to motivate students in their engineering disciplines by helping them become acquainted with the engineering faculty, their fellow students while also providing variation to the daily teachings. The learning outcomes for this situation revolved around collecting and interpreting data, presenting on findings, and understanding and experiencing teamwork.

This activity evolved to meet the learning outcomes of technical literacy while also meeting assessment requirements. Like Iceland, New Zealand is tectonically and volcanically active and a volcanic eruption can create many opportunities for engineers to communicate with each other and the public.

On Monday 7 April, 2014, students arrived to an area that had been cordoned off with danger tape to mimic a civil defence response site. This area was organised into twelve groups with six people to a group (figure 1). Groups had been decided by the tutor prior to student arrival to ensure a mix of engineering disciplines, and full and part-time students. Students were required to introduce themselves to each other, and wear name badges as this may be the first time they had met.

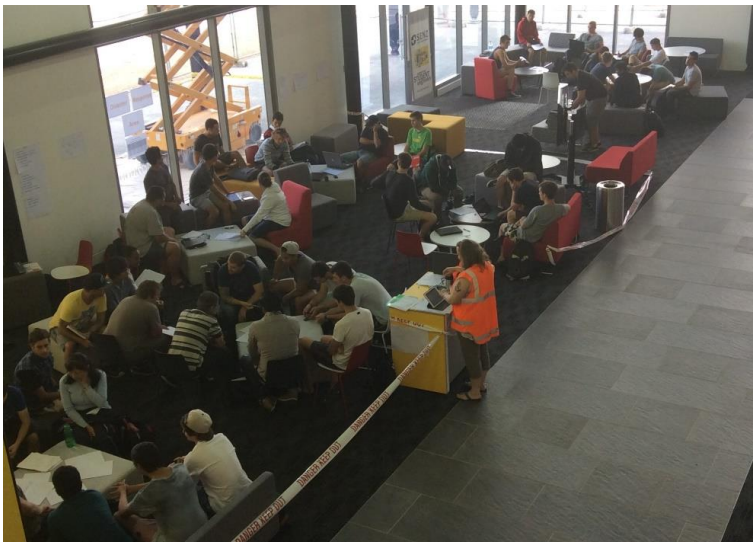

Figure 1: Students were placed into groups and placed in an open environment to simulate a disaster response unit.

Each day was divided up into two sections. The first half of each day (from 9.00 to 1.00 p.m.) students were required to complete directives from the civil defence team (the tutors). This was to give students an opportunity to gather information and data and make decisions with the support of the other groups and tutors to help. The morning activities would be part of the portfolio (worth 10 %) that students would hand in at the end of the week. The afternoon session from 1.00 to 3.00 p.m. was time dedicated to the students to work on their end of week presentation. This presentation was worth 20 %.

At 3.00 p.m. an update was given to the students which comprised of a summary of the daily activities, outcomes from those activities, and a current situation update.

Any information from the day was also placed within a Learning Management System (Moodle), on a special page dedicated to the disaster response team.

Day 1

At 9.00 a.m a briefing was given to the students, explaining that a volcanic eruption had occurred in Auckland. Mount Rangitoto was showing signs of volatile activity, and as a precaution all residents of Auckland were on standby to be moved. Part of a short video from YouTube of a fictional Mount Rangitoto eruption was shown to create the scene. As part of the scenario, one suburb was particularly at risk due to climatic conditions, hence the main effort of the civil response team was to be concentrated on this area initially, and relocation to Hamilton was being discussed.

Each group was then to research what the community should do in this event and create a transcript for a television and radio interview as well as a newspaper article. This was part of the students assessed portfolio. Students were also asked to create a video which was uploaded to YouTube to demonstrate their announcement. This video was not part of the assessment but was to help them practice their speaking skills for the main presentation at the end of the week.

Day 2

The volcanic eruption had progressed to ash clouds and the at-risk suburb was being evacuated. Students were required to investigate what was needed for temporary relocation and create business e-mails to at least six clients around Hamilton for help. There was the assumption because of the situation that the e-mail was a follow up to a phone conversation outlining the need for the resources. This was part of the portfolio for marking.

Day 3

The volcanic eruption had subsided and the risk for a worsening eruption was low (as per volcanologists report). Groups were to investigate the effect ash-fall had on power, roading, water, wastewater and facilities. Groups were to explain how they would investigate the situation and start a clean-up. This information was primarily for the end of week presentation.

Day 4

Chances of a major volcanic eruption are low, and ash fall is at a minimum. Relocation was successful but have been asked to wait at temporary location for at least one more night. Groups are now required to write a business letter to key parliamentary ministers, the mayors of Auckland and Hamilton as well as the Ministry for the Environment Chief Executive to outline the key decisions that were made during the week, showing how they have successfully handled the situation. This was part of the student portfolio.

A practice run through of student presentations was also expected during this day.

Day 5

Students gave their presentation as part of their groups. The scenario was a briefing of the disaster situation and the decisions that were made which they were giving to the Civil

Defence Minister. Students were expected to dress professionally because of the importance of the presentation (figure 2).

Figure 2. Student presentations of disaster week

At the completion of the disaster week, students were to create a reflection of the experience. This reflection was the last task for the portfolio.

This week accounted for 30% of the student marks for Technical Literacy as a whole (10% portfolio, 20% presentation).

Methodology

The main purpose of the change in teaching practice was to increase the communication assessment completions. Quantitative data in the form of completions of previous years to the 2014 cohort can be collated and comparisons made.

Also, while incidental to the main goal, a mark breakdown can also be investigated to ascertain whether there is an improvement in communication marks between years. This may indicate greater engagement though with a change in assessment practices as well as teaching practice, this will be difficult to prove.

Qualitative data was taken in the form of student surveys throughout the week and a reflection. The student survey had two purposes; to ask the student how they would improve the week for future editions, and also to ascertain what effect the scenario had on raising the emphasis of engineering communication.

The reflection was part of the communication portfolio to hand in. This was designed around the communication within the group and how the student believed it went, problems that arose, and how they were dealt with.

Results

Completions and Pass Rates

Table 1 shows that the written assessment completions increased each year. This written assessment comprised of the project (Trudy Harris, 2014), and the portfolio from Disaster week. The Oral assessment completion improved to 93 % for the 2014 cohort. For perspective, the yearly cohorts are similar in size, and there are no statistical differences between the yearly marks of other compulsory papers (such as engineering mathematics).

Table 1: The completions per assessment for the last four occurrences of this module

	Completions 2011	Completions 2012	Completions 2013	Completions 2014
Written Assessment	85 %	87 %	91 %	95 %

Oral assessment	83 %	72 %	84 %	93 %

Table 2 shows the pass rate (more than 50 % in this assessment item) each year for the communication part of technical literacy (of those that completed). Both the written assessment and the oral assessment have stayed consistent over the years.

Table 2: The percentage of students passing each assessment (not including non-completions)

Pass Rate Year	**2011**	**2012**	**2013**	**2014**
Written Assessment	98 %	80 %	84 %	84 %
Oral assessment	100 %	100 %	87 %	98 %

Survey results

The survey asked the students 4 main questions. A summary of the questions and the main themes can be found below.

1) What did you enjoy about the use of the disaster context to relay communication skills?
    - It closed the gap between theory and practice
    - It gave students an opportunity to express themselves
    - The scenario covered a wide range of communication skills e.g. letter writing, presentations, e-mails
    - Created an interesting, urgent and immersive context
    - Learnt about teamwork, working as a group and improved skills in communicating
    - The different learning mode and variety over the traditional classroom.

2) What did you not enjoy about the use of the disaster context to relay communication skills?
    - The time frame wasn't long enough and it was too intense over a long period of time
    - It was difficult to manage the time and work commitments (part time students)
    - There was no choice in group members
    - The group sizes were too big
    - Information being drip fed over time and verbal
    - Not enough engineering relevance

3) Did the students find it beneficial to complete 30 % of the assessment in one week?
    - Yes - 41%
      These students enjoyed getting a lot of work out of the way quickly, and thought that it was an effective culmination of management, communication and engineering skills.
    - No – 23 %
      These students believed there was not enough time in the week, in particular the extra pressure on the part-time students
    - Maybe – 36 %

These students believed it was great to get the marks out of the way and perfect for the portfolio but believed the time frame was too short for the oral presentation

4) What improvements would you make to disaster week if it was run again?
    - Create a separate time for the presentation
    - Provide Information in multiple forms
    - Choose own groups and allow more flexibility for the faster finishing individuals/groups

Reflection results

As part of the portfolio, students were asked to comment on the communication aspects that they believe occurred within their team. In most cases students were positive about the team environment and how they communicated. Only a handful of students believed they did not get any benefits from the week.

The final reflection question asked the students what they believed was the most important communication lesson learned from the scenario.

The answers to this question are meaningful to this research question as it helps to show the increased awareness that students have on communication. The following are the main themes that are discussed by students.

- Everyone in the group needs to be listened to, have opportunities to speak and be respected
- Meetings are important to manage time effectively, and record information
- Communicate often (e-mail, face to face, facebook)
- Teamwork is crucial and more effective than an individual's work
- The job/task is the most important, knowing this helps reduce conflict
- Roles within a group are essential, especially the leader

Incidentally, the regular communication tutors noted they were not chasing students to hand in material very much to complete their part of the course. The engineering team manager also noted that she was not approached at all this year regarding the marks for technical literacy. While this is anecdotal evidence, it shows that students placed more importance on these tasks and handed them in. Whether this was because they enjoyed the scenario, or that they were just here to do the work, it shows that the students had immersed themselves within the context.

Discussion

Just like Saemundsdottir et al, (2012), Disaster week was counted as a success by everyone involved. The scenario produced an intense situation which forced the students to work together to solve many problems, and then to communicate those solutions in a variety of ways. Table 1 shows that completions of work increased to 95% for the written work and 93 % for the oral presentation which shows an increase in motivation in handing in assessments from previous years, This increase ensures that most students have completed a written report, portfolio and presentation for feedback. This concurs with the work of Blumenfeld et al (1991). Table 2 shows that apart from 2011 (the first year this course was offered), written assessment and presentation marks were consistent. This is pleasing as it shows that summatively it has been consistent between years. This shows that more students have passed the communication part of technical literacy than previous years. Also with more completions, there is more chance of success with the addition of the drawing component to their mark.

The survey results are very encouraging and show the students took the week seriously and immersed themselves within the context. Students recognised the different forms of

communication that existed and the importance of each. Students embraced the context which increased their enthusiasm in completing and submitting each communication activity.

The following two student comments outline the benefits of the scenario:

> *"A disaster implies 'sudden chaos, sudden response'. In the field of communication, a disaster connects everybody from the public to the authorities"*

> *"The scenario was really good. Heaps of communication challenges were given. It makes us practice and improve from our mistakes"*

Improvements from what the students didn't like revolved around the intensity/time involved, and the group dynamics. These both turned up in the positives as well, but to a lesser extent. The intensity was part of the scenario, in that the disaster created a sudden emergency that needed to be addressed, and further delving into the responses (from question's 3 and 4) show that the students' main concern was there was not enough time to produce a quality presentation. Because this was the first time Disaster Week has been run, and assessment presented in this way there was uncertainty from the tutors view as to how this final presentation would work. After the presentation, the tutors involved were happy that the level of quality was as good as it had been in previous years (anecdotally) and that this was the best time to run the presentation. The thought is if it was to be put off another week (as students have suggested) the presentation, and the group meetings will invariably become less important as other classes come to the forefront of the student mind again.

Because of this, a main learning from the tutor's point of view is to ensure that there is a clear expectation that students complete presentations each afternoon and a structure is given to the students to help them complete this.

This solution may also aid in the group dynamics as it will provide a structure that will help guide the groups in their "presentation time". Part of communication skills involves how to work in a team, so a session before the week begins to help students understand the different types of roles within a team and how to work with conflict will help to increase the groups' effectiveness during this disaster period.

It was clear from the reflection that students recognised the importance of group work and how they needed to adapt to work within a team. It was pleasing that though there were many cultures within the class environment the reflections still had similar themes. The following comment shows how a student's confidence increased within the project environment. This was not the only student to comment on the ability to be able to share their views now and feel safe in doing so.

> *"Though English is my second language I did this task very well. My confidence level is increase now. Firstly I avoided talking with others but now I communicate with my other class members. It was good experience for me. I enjoyed a lot. I learnt how to make plans and how to give presentation in front of others"*

All the collected data showed that the use of the project over the week was beneficial as it increased motivation (Blumenfeld et al, 1991) to hand in communication assessment, as well as student driven where students could be creative (Zhou, 2012). The reflections show that students learnt a lot about communication skills that they may not have in a traditional learning environment.

Conclusion

The use of a highly intense civil defence scenario involving a volcanic eruption in the Auckland area and the subsequent relocation of a suburb and ash clean up provided a

meaningful communication context for the students to immerse themselves in over a one week period. This week accounted for 30% of the student mark.

Student completions increased from previous years for the communication aspect and enjoyment of the scenario was apparent. Students were appreciative of the range of communication skills needed and were more aware of the importance communication has in effective teamwork and task completion.

Disaster week will continue to run in future editions of the course, with a similar scenario, though with changes occurring as part of student feedback.

This scenario has the ability to grow in scope, be reactive, and include any number of students while the assessment methods can cover a wide range of activities. By running as a block midway through the semester it leaves students more time to focus on other courses when it nears exam time (and are not being asked to hand in communication projects during this time). While this was a beneficial teaching and learning environment with positive outcomes, future recommendations include:

- Involving and encouraging more engineering staff to be involved. As this is a first year course there is an opportunity to involve second semester and second year staff that the students will meet in the future.
- Involving students from other modules to broaden the communication skills needed. This will also increase the range of activities that can be completed. The final assessment portfolio can be tailored for each module as can the oral presentation.
- Adding more engineering context/practice to do with the natural disaster
- Incorporating guests as speakers/assessors to add authenticity

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