Curriculum restructuring overnight: Teaching large first-year classes after a major earthquake

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Abstract

On 22 February 2011, the second day of the first semester, a devastating magnitude 6.2 earthquake struck the city of Christchurch forcing the campus of the University of Canterbury to close for several weeks. Here, we report on the sudden curriculum and assessment overhaul that needed to be implemented using two large, first-year introductory courses as case studies. We discuss the reasoning and justifications behind these changes, as well as the logistics of this process. We draw conclusions based on student feedback and assessments and formulate lessons learnt.

Introduction

On 22 February 2011, on the second day of the first semester of the academic year, a major magnitude 6.2 earthquake struck Christchurch around 1 pm. While the region had been geologically active since the magnitude 7.1 Darfield earthquake in September 2010, the February earthquake was particularly devastating because its epicentre was located close to the city at a very shallow depth. 185 people were killed and the city was severely damaged, with the eastern suburbs, the central business district, and the power, water, and sewage infrastructures heavily affected. On the campus of the University of Canterbury, which was evacuated relatively smoothly, we were fortunate not to have any fatalities or other serious casualties.. However, because of the violent nature of the earthquake, all university buildings needed to undergo invasive inspections and assessment for structural damage and recertified for occupation by civil engineers, a very time-consuming process. In the space of 20 seconds, we had lost our entire built-up teaching infrastructure for the (then) foreseeable future.

The university decided that teaching would continue, and we were asked to be creative in our solutions. Fortunately the IT infrastructure had survived intact, including the Learning Management System (LMS), and teaching switched overnight to the virtual realm. We could not access any non-electronic teaching materials left on campus until the respective buildings were deemed safe again. Though the building recertification process prioritised teaching spaces, we were informed to not count on having building access for the remainder of the semester, and were asked to plan to teach the entire semester in an online environment. The university secured a large number of tents for face-to-face teaching, but these could, of course, not fully replace all teaching spaces.

In this publication, we report on how two large first-year courses adapted to the new teaching and learning environment. We discuss how we tried to remain true to the learning outcomes of the courses as much as possible. We outline our reasoning behind the changes based on educational psychology, pedagogy and logistics. One of these two courses was a large, introductory first-year course in Antarctic studies, which was coordinated by Daniela Liggett, and normally features many guest lecturers and in-class assessment tasks. We use this course to highlight changes in lectures and assessments. The other was a large first-year course in geology that is very laboratory-intensive. The laboratories are being coordinated and taught by Kate Pedley. We use the geology course to highlight changes in a laboratory environment.

We emphasise that ours is a story of teaching, not of learning. At the time, we did not set out to measure impact on learners; we were simply in survival mode. What we did do is collaborate, share our ideas and combine disciplinary knowledge with academic development knowledge. We aimed to use lessons from educational theory to make informed choices for pedagogy and to make changes that would have the highest (theoretical) likelihood for student success. We hope that our experiences can inform others in preparation of teaching during a disaster, both at the individual teacher level and for strategic resilience planning at the university level (e.g. Seaton, Seaton Yarwood & Ryan, 2012; Archie, 2015)

Courses in this study

Antarctic studies

ANTA102, “Antarctica: The Cold Continent”, is a large (n~100) elective course in first year, drawing a wide variety of students, both from within the College of Science and elsewhere on campus. Because of the multi-disciplinary nature of Antarctic studies, ANTA102 covers a broad range of topics, taught by a team of ten instructors. Overall academic responsibility lies with the course coordinator, who is typically also one of the instructors (Daniela). Course coordination is not a trivial task given the number of people involved, the wide range of topics, curricula and assessments. The course assessment consisted of internal (in-class) assessments (40% of the grade) and a final comprehensive written exam (60% of the grade). The internal assessments target transferable skills such as group work and critical thinking on problems touched on during the block of lectures preceding the respective internal

assessments. In addition, there was one practical session in which students examined different types of rock found in Antarctica and discussed their significance. The exam would assess the students' critical thinking skills and their understanding of the topics covered throughout the course with short-answer as well as essay-type, i.e. open-answer, questions.

Geological sciences

GEOL111, "Planet Earth, an introduction to Geology", is a first-year course that is mandatory for majors in geology and that is a popular elective for students in the College of Science. GEOL111 is also a multi-disciplinary course, which attracts a wide variety of students across campus. Around 200 students were enrolled at the time of the earthquake. A team of five staff teach the various topics and lead the fieldtrips, with a senior tutor (Kate) responsible for teaching the practical lab components.
Prior to 2011, assessment was divided into two main components:

1. A three-hour final comprehensive exam worth 50% of the final grade.
2. Internal assessments worth 50% of the final grade consisting of
    a. Short-Answer Test (15%) focussing on students understanding of the key terminologies and concepts and also requiring students to draw and label key diagrams
    b. Practical Test (35%) lasting 2.5 hours using the skills and knowledge the students have covered during all the lab sessions for the course.

While assessment is individual, students are encouraged to work in groups or pairs during all practical lab sessions and fieldtrips.

Psychological considerations underpinning the changes in pedagogy

In considering changes for the courses, we were guided by two concerns. The first was that both students and instructors would be suffering from what was commonly referred to as "quake brain", which is a colloquialism for a specific form of post-traumatic stress that occurs after the traumatic experiences natural disasters bring along. Lui et al. (2009) show that "quake brain" has serious psychological as well as physiological implications resulting from an alteration of brain function after a traumatic event. Symptoms of "quake brain" can include an inability to focus on tasks, concentration problems, and irritability (Carey, 2011). Unquestionably, having quake brain is not conducive to learning, or to teaching. In addition, many students and staff had numerous other demands on their time and energy resulting from the effects the earthquake had on their personal lives. This meant that available working memory (see e.g. Good & Brophy, 1995) and attention span for learning would be more limited than under normal circumstances.

The second concern was related to the online environment. As the online environment of the Learning Management System is far less personal than face-to-face class time, the sense of belonging – as in belonging to a class room, learning environment or social (learning) network –, an important factor in student intrinsic motivation (Deci & Ryan, 1985) would be diminished. A study by Lee, Choi, and Kim

(2013) examined students enrolled in online courses and found that those students who had dropped out of a course had lower levels of academic locus of control and metacognitive self-regulation skills than those who persisted in the course. It is not uncommon to see higher dropout rates in the online world than in comparable classes that are campus-based (see e.g., de Freitas, Morgan, & Gibson, 2015).

To avoid cognitive overload on students (and staff), it was important to provide considerably more structure, through scaffolding (see e.g. Bransford, Brown & Cocking, 2000) and "chunking", in a course than we would normally do. We set out to more explicitly clarify the academic tasks (Doyle, 1983) that students had to perform and to offer closer supervision and progress monitoring. Our approach was guided by the motivational framework of Subjective Task Value developed by Eccles et al. (see e.g. Eccles, 2005 and references therein) and by the work of Deci and Ryan (1985) on intrinsic motivation. We also aimed to provide sufficient extrinsic motivators for students to stay on track and complete the course. In the next section, we discuss a number of the changes we made.

Changes in teaching

Live online interactive lectures in ANTA102

It was anticipated that the fragmented nature of the ANTA102 class (with its many different lecturers and components) would present a challenge in terms of active student participation online. It was opted to therefore give live online lectures using the Adobe Connect Pro web-conferencing system, which allowed students to log in at the time of the lecture and participate as if they were in the classroom. The application integrates video lectures with PowerPoint presentations, the use of an integrated whiteboard and the possibility for students to ask questions either by using a microphone or typing them into a chat box. For technical and course logistics reasons, students were encouraged to use the chat box for questions and comments. Surprisingly, there was significantly active use of this chat box to make comments or ask questions. It was suspected that this was due at least in part to the fact that students did not have to raise their hand and voice the question in a large class environment, but could type their questions and comments almost anonymously.

Restructure of ANTA102 LMS presence

The course website on the LMS was redesigned to facilitate the online learning. Students had easy, often one-click, access to the live lectures discussed above. Other resources included recordings of the lectures already presented, lecture notes, recommended readings, links to related online resources that were publicly available and to previous exams. All materials and resources were hyperlinked to reduce the time and effort students had to spend searching. Furthermore, weekly to-do-lists were set up for the students to monitor their own progress and to ensure that they kept well on track with their course work. Drawing on Deci and Ryan's (1985) work on intrinsic motivation, clear and feasible goals with small achievable milestones were set and communicated to the students to foster feelings of competence and autonomy.

Online groups in ANTA102

All students were assigned groups within the LMS to create a mini online classroom environment. This allowed for regular interaction between students wherever they were. These groups that were task-focussed and had to collaborate on course assessments. The formation of study teams was encouraged by the course coordinator and helped some of the students to talk about their experiences, to prepare for the exam and to share resources. The latter was meant to overcome bandwidth problems that some students encountered due to not having broadband access or not having a sufficiently high download capacity.

Discussion sessions in ANTA102 and GEOL111

Both courses were allocated three lecture hours per week in tents. One of those hours was converted to discussion sessions, rather than lecture. The discussion sessions built on the lectures but also gave students the opportunity to talk about their concerns, progress with their course work, or address any questions they had for the course coordinator who attended each of these discussion sessions. We wanted to give students room to share their experiences, reflect and get to grips with the changed university life, inspired by a colleague in Sociology who had done something similar. In the first lecture she was able to give in one of the lecture tents, she started by inviting students to talk to each other for a while about what had happened in the past weeks. The resulting conversation was difficult to cut off after 10 minutes, so great was the need for students to be able to talk things through with their friends and peers.

Despite the difficulties under which these sessions were held (no desks for the students, no heating, no microphones or any electronic lecturing equipment), the students clearly appreciated the opportunity to get together and talk to the instructors and the course coordinator directly. Most of these discussion sessions were filmed and made available to those students who had left the city. In case a class could not be videotaped, the course coordinator asked students to share their summaries of the class on the LMS forum.

Podcasts in GEOL111

The use of discussion sessions meant that content had to be covered elsewhere. Audacity software was used to create podcasts on a laptop in the lecturers' homes, and these podcasts were then shared with the students via the LMS. The podcasts were typically quite short (6-10 minutes) and covered a single or very few concepts. This was done for two reasons. Firstly, the file size was limited to allow the students to download or stream the podcasts and avoid pressure on the university's bandwidth. Many students did not have broadband access, but were instead using dial-up or their mobile devices. As mobile phone towers in the city had been damaged, Civil Defence urged people to use large-bandwidth applications on mobile devices for emergencies only. Secondly, the podcasts were kept short to avoid cognitive overload for students who had enough on their minds. Smaller, more easily manageable chunks of content would have a lower bar for engagement.

Online rock identification in GEOL111

The Department of Geological Sciences was fortunate to be one of the first departments to be allowed back into their building. Teaching labs (six repeat sessions of 2.5 hours per week) were able to be resumed in the regular lab room in the fourth week of term, missing only two lab sessions. For the first two missing practical labs a set of rock and mineral samples were able to be retrieved from the lab room, using these to record a video at the instructors home using a basic personal digital recorder and tripod. In this video Kate talked to a PowerPoint presentation on a computer screen behind, then showed the students the samples and zoomed in on their features. Students were provided with colour photos of the rocks and minerals so they could make notes on these as they followed the presentation and filled in the exercises in their lab manuals. During one of the discussion sessions, those samples were also brought in, so students could then have a brief look also in person at what they had been seeing online. This was relevant as the videos were relatively low resolution, so it was easy for students to miss details important for correct rock identification.

Changes in assessment

ANTA102

As noted earlier, ANTA102 used a number of in-class assessments. It turned out to be impractical to change the entire assessment structure for the course on short notice, and obviously the assessments could not be taken in-class anymore. It was decided to reduce the number of internal assessments from four to two. This was in part recognition of lost time when the university was closed immediately following the quake, and in part a redesign of the assessments, making them more time-intensive than in-class assessments which were ordinarily taken during the time of one lecture.

The slightly larger assessments allowed staff to:

1. Encourage communication and collaboration between the students, combining group work with individual work and including peer review of students judging each other's contribution to the group work;
2. Break them down into smaller pieces (milestones) to reduce student cognitive load and to monitor engagement;
3. Allow students a bit more flexibility regarding their time-management; and
4. More explicitly promote critical thinking and creativity through the selection of cutting-edge topics for the group project.

The first assessment due at the end of term 1 required the students to use their understanding of Antarctic geology to critically reflect on one of three pertinent questions and produce a group report on this question. Out of the three questions offered, the majority of groups picked one that asked them to critically examine the proposition of moving the Christchurch CBD to Antarctica in order to escape a future magnitude 7 earthquake or a volcanic eruption.

New student groups were formed at the start of term 2 and asked to submit two multiple-choice questions each on a list of topics in the course. Careful research of the questions was incentivised by

telling the students that some of the best and most suitable questions would be used in the second assessment task, which was an online multiple-choice test. This was done to give students more autonomy in the course, and promote more engagement with the material.

GEOL111

The GEOL111 assessments underwent a number of changes. The final exam (worth 50%) was reduced from 3 hours to 2 hours to decrease the cognitive load on students. The Short Answer Test (worth increased from 15 to 20%), which had been a 50-minute in-class assessment in previous years, was converted to two online multi-choice quizzes, one in each term, worth 10% each. The Practical Test weighting was reduced to 20% down from 35% to reflect the fact that students had less hands-on time in classes following the earthquakes and were therefore covering less material. The final 10% of the assessment consisted of 10 weekly quizzes held through the LMS and based solely on the accompanying week's practical lab class.

Effects of the changes and lessons learnt: ANTA102

Lecturers and the course coordinator reflected on the changes made after the semester. In addition, student feedback that was collected on, and as part of the group assessment turned out to be as much on the general changes to the course and the impacts on learning and the learning environment. Besides open-ended feedback on the group work experience, the students were asked to rank 8 parameters on a 1-to-10 scale (with 10 being the best rating). These 8 parameters were: time management, cooperation, collegiality, effectiveness of communication, efficiency, productivity, friendliness in the group, and balanced contribution.

Things that went well

Overall, the nature of online communication encouraged students to speak their mind in various online forums and wikis, which provided useful feedback to inform just-in-time teaching decisions. Furthermore, meeting in person, even if it was in an informal setting in cold, relatively dim tent spaces in the University's parking area, provided much-needed opportunities for the students to get together and share their stories. Human contact after a disaster appeared to be truly important, and if the teaching and learning that occurred during those meetings was not necessarily always 'scholarly', it was certainly of an educational and emotional nature. Recording and running live online lectures, rather than simply offering previous recorded lectures from previous years, was invaluable because it gave the students a feeling of connectedness in time, despite the disconnectedness in space, and afforded them the opportunity of asking questions and receiving instant responses.

The group assessment was a risky experiment at first-year level, which went surprisingly well. Student performance in ANTA102 was actually better than in previous years. According to the marking staff, the quality of essays was better than typically seen in first year, which can partly be attributed to the fact that the essays were a team effort. The student feedback across all groups was almost uniform in its acknowledgement of high levels of collegiality, cooperation and friendliness in individual groups. As a student commented, "[a]s well as being one of our first assignments at university it was good to have

help from fellow students." Group work was recognised as offering the opportunity to share the workload and bounce ideas back and forth, of being able to constructively critique and proofread each other's work, all of which increased the students' confidence, which is nicely highlighted by the following quote from one of the feedback questionnaires:

> There were many benefits of working as a team, firstly the shared workload was advantageous, secondly, shared ideas (bouncing ideas) improved the quality of the final report, finally critical analysis allowed us to both produce a concise report and develop our own personal essay writing skills. We found this group report also boosted our confidence and provided motivation for deadlines. The report improved our knowledge on the environment and climate of Antarctica, and find more detail on our specific phases and then teach the other group members our new knowledge.

Things that didn't go so well

The main issue faced in ANTA102 is that online student groups had "ghost" students in them. The LMS automatically enrols students in the course if they are registered for it in the student management system. While this tends to work well in normal circumstances, a number of students had gone on exchange abroad or simply did not have access to the internet, or even electricity. In addition, the university had extended the deadline for course withdrawal by a month, which meant that students who never intended to be part of the class could still be in the system for a long time. These effects combined created some logistical issues with the groups and uncertainties for students in the groups, and certainly resulted in some frustration within those groups with ghost members.

Aside from the issue of ghost students, the lack of meeting space on campus, or even in town, which was still largely cordoned off, represented a great challenge to the students. The weekly class meetings were insufficient to give assignment groups and opportunity to meet, and from the student feedback collected it was understood that in-person meetings were considered as a key to success and that the students themselves thought that they "… could have been more productive if [they] had time face to face".

Despite having grown up in the digital age, the majority of the ANTA102 students commented that it was easier to communicate face-to-face, and that electronic communication could not replace the personal contact. With a number of students having been displaced by the earthquakes or having moved back into their parents' homes outside Christchurch, some groups struggled to get their work off the ground as they could not meet in person. Electronic communication in a timely fashion proved to be difficult for those students without reliable access to the internet, which also resulted in unbalanced workload in some groups. Productivity was hampered by the fact that team members had different disciplinary backgrounds, different methods and speeds of working and different ways of communicating, but none of these aspects is surprising for anyone with experience in working in multi-disciplinary teams. For first-year students in the aftermath of a live-changing disaster, however, experiencing the challenges of teamwork must have made for a very difficult and steep learning curve.

To begin with the communication lacked in Group G due to group members not responding, having internet difficulties and being on other course fieldtrips. This was soon rectified after our first face-to-face meeting/discussion. We found all group members had a lot in common and the friendliness of the group was very high, this sometimes affected the productivity of the group as we sometimes side tracked and bonded.

Effects of the changes and lessons learnt: GEOL111

The biggest effect of the changes made to the course is the LMS platform. There is now a robust and very structured website that provides students from year to year with all the information they require during the course, easy access to lecture recordings, access to regular online assessment, a tailored, interactive glossary for the course, and easy communication between and amongst teaching staff and students. Restructuring how the assessment is weighted has also had a significant effect in that from the students' point of view it is less stressful and in more manageable “chunks”. From the teaching point of view it helps make sure that students are more engaged throughout the course.
Making the practical revision quizzes a permanent online assessment (currently worth 10% of the overall course assessment) has proven both enjoyable for students and an important learning tool given that they must be done weekly in conjunction with the labs. Prior to the earthquakes staff found it frustrating in labs that students had done no study or revision between each weekly class and therefore had forgotten most of what was taught the week previously. This meant that a significant time was spent in each lab having to remind students of material so that they could carry on with the next step, as each lab builds on previous ones. Students generally do very well at these quizzes (averages around 70-75%) so it helps their overall course grade.

In the last years, staff have reverted back to the original format of the Short Answer Test as it was judged that the online format did not achieve the learning goals for this part of the course. The average grade for the Short Answer Test after the earthquake was very high (~77%, as opposed to a usual average of around 50-60%) due to the fact that the online system did not allow for the submission of labelled diagrams, which undergraduate students generally find rather difficult, but which is a necessary part of being a field geologist.

Since 2011 the time available for the Final Exam has increased again to 3 hours, but the exam weighting has been reduced to 40%. This is a direct result of feedback from students that a final exam weighted 50% was considered as very stressful with too much depending on this one final piece of assessment. The Practical Test, which is currently worth 30%, has largely remained unchanged in format.

Things that didn’t go so well

Teaching a large component of a course online was more difficult than expected. Many students did not have (reliable and fast) internet access, and smart phones were not yet as ubiquitous as they are today. Students found navigating the online site difficult and had trouble attempting the weekly online quizzes.

Staff were able to book a computer lab on campus for the online Short Answer Tests to remedy part of this issue. Communication with the students was also difficult as many students did not check their emails and were slow to catch on to what was happening and expected with the course. It was decided not to run any lab sessions in week 4 of term to allow students to catch up on earlier work. To do this, one of the revision lab sessions that would normally have in the week prior to their Practical Test in the last week of the semester was dropped. More revision material was added on the LMS to support this. Extra informal tutorials were also offered but it was found that many students did not do the revision online and in their own time, when they would have done it in class. In addition, the weekly online quizzes were reopened to give the students another chance to attempt the ones given so far. The timing coincided with the move back into the building, and thus also gave the teaching staff some time to reopen the regular lab space to allow the “normal” practical schedule to resume.

General lessons learnt

From the experiences in ANTA102 and GEOL111, as well as conversations with colleagues teaching other courses, we can distil the following generic lessons learnt about teaching during a natural disaster.

- In-person contact is invaluable; students and teachers need the company of fellow human beings to talk through the events.
- Use teaching spaces only for those activities that really require them; non-interactive, traditional lecture does not require a scarce teaching space. Lab work on the other hand needs the teaching space.
- Low-bandwidth online activities are important to ensure that as many students (not just in our courses, but university wide) can participate in learning activities.
- Be careful with group assignments; while they may help students more connected to their fellow students and the course, the logistical problems with group work are exacerbated.
- Flexibility is key; the unexpected will happen, and we found it best to just "roll with it". We found our students to be very forgiving, with a strong sense of "we are all in this together". They knew we were trying our best to help their learning, and responded accordingly.

Impact on learners and teachers

Impact on learners of our practice is very difficult to establish. Simplistically, we can say that what we did was better than no teaching at all. Long-term effects of our practice on student performance, retention and completion are almost impossible to ascertain. There are simply too many variables. The Christchurch earthquake was not a singular event, but part of the larger Canterbury earthquake sequence which lasted about two years in total. The cumulative effect of these events on student performance, retention and progression likely far outweighs what we did in our classes in the aftermath of the February earthquake. Hence ours is a story of teaching, rather than learning, during the earthquake.

It should also be noted that any data gathering for research purposes to measure effects of our changes would have run into severe ethical issues, given the amount of trauma in the population. The Civil

Defence national controller had imposed a social science research moratorium from February 2011 until May 1 2011 for that exact reason. Large educational research projects, such as the Ako Aotearoa funded *Transforming Tertiary Science Education* (Kennedy et al., 2013), which was in full swing on the UC campus at the time, suspended operations during this period.

In terms of academic development, we noticed a certain feeling of liberation in some teaching staff, a freedom to experiment with teaching techniques, and try new things they would normally not have done (as readily). In fact, in 2012 the College of Science held a reflection day on what we learnt from our teaching during the quakes, and what we could / should continue to do in the future.

One element to not underestimate is the effect that a disaster has on the mental state of both learners and teachers. We all had a lot on our minds – damaged houses, safety of friends and family, and the never-ending uncertainty about when the next earthquake would strike and what its magnitude would be. However, despite all this, there was a strong feeling of "we are in this together" between teaching staff and students. Our students seemed to genuinely appreciate the efforts to help them continue their studies. As teachers, we were impressed and heartened by the perseverance, dedication and commitment our students showed. This was not just in relation to their studies, but also in the tremendous volunteer effort the students put in to assist the city.

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