**Civil Engineering Students' Perceptions of Emergency Remote Teaching: A Case Study of New Zealand**

**Abstract**

University A, as an institution, had developed strong educational resilience during and after the 2010-11 earthquakes. Due to the Coronavirus Disease 2019 (COVID-19) pandemic, New Zealand went into a nationwide lockdown on 25 March 2020. As a result, all university educational facilities were shut down, and teaching and learning had to be migrated online. Within this unique context, this research aims to (1) investigate civil engineering students’ perceptions about the benefits and challenges of online learning during the lockdown period, (2) identify significant factors that contribute to effective online teaching and learning, and (3) provide the implications of this research for future emergency remote teaching (ERT).A survey was designed and administered to measure students' perceptions of online learning during the lockdown. A total of 192 completed responses were collected from both undergraduate and Master civil engineering students. In addition to typical online learning challenges (e.g., administrative/instructor issues, social interactions, motivation, and technical problems), students also experienced unique challenges, such as social and emotional isolation, anxiety, depression, and uncertainty. Future research directions were recommended to better understand ERT by linking it to the Community of Inquiry framework and enhance tertiary education institutions’ resilience to handle a future crisis.

**Keywords**: Emergency remote teaching, Community of Inquiry, COVID-19, Higher education, Civil engineering, Survey, Distance learning

# 1. Introduction

The Coronavirus Disease 2019 (COVID-19) pandemic is changing the landscape of global higher education. It has had an enormous impact on teaching and learning, creating many uncertainties regarding border control, campus access, and student enrolment. Online learning is not new, but teaching and learning in the COVID-19 crisis are unique to both students and lecturers. Due to the pandemic emergency, lecturers were forced to switch campus-based courses to online learning within a very short time window. As instructional designers, they are required to adjust the instructional plan, syllabi, teaching activities, content, and assessments to accommodate distance delivery. The abrupt transition and adjustment are difficult, since its success depends on several factors, such as online teaching skills, technical support, resources, to name a few. Transforming some courses, like lab-based ones, to online mode is by no means straightforward. In addition, lecturers have to manage uncertainties, as the shift might be temporary in nature.

On the other hand, students have to set up a new environment to sustain learning. This transition can be challenging and [miserable](http://dict.youdao.com/w/miserable/#keyfrom=E2Ctranslation). Due to campus closure, students were forced to learn from home with families or roommates. Some may enjoy the new environment (Shim et al., 2020), but others suffer from increased stress and anxiety (Petillion and McNeil, 2020). Students are likely to face economic, emotional, and physical challenges in their learning. They may not be mentally and financially ready for the emergent transition. Many found online classes during the Pandemic are "emotionally and mentally draining" (Chen, 2020).

The Pandemic created a pressing and crisis circumstance in which teaching can be termed as "*emergency remote teaching*" (ERT) (Hodges et al., 2020). Given the fact that what works in the classroom does not necessarily work online, shifting teaching and learning materials online does not automatically create an effective learning environment. A short transition time window does not allow careful design and preparation of typical online courses (Bessette et al., 2020). In addition, due to the sudden changes in the context, pedagogical strategies and practices that are effective in traditional online learning may not be working in the emergent circumstance (Adedoyin and Soykan, 2020; Hodges et al., 2020).

Unlike traditional well-planned online learning, some tertiary education institutions were forced to shut the campus down, and instructors had to switch classes to online learning within a short time window. COVID-19 has created an uncertain future, and the global higher education sector is exploring new ways of teaching. In the shadows of uncertainty, it is significant for higher education institutions to reflect on how to design and implement pedagogical treatments to improve online learning during an emergency.

# 2. Case Study Background and Context

To stop the spread of COVID-19, the New Zealand government closed all borders and entry ports to all non-residents on 20 March 2020. The Government introduced a Four-level COVID-19 Alert System to manage the outbreak within New Zealand. As the alert level was moved to Level 4, the country went into a nationwide lockdown. Under the lockdown, all educational facilities were shut down, face-to-face classes were suspended, and teaching and learning and assessment had to be migrated online.

The case study investigated the learning experience of civil engineering students at the University A, New Zealand. University A teaches on a semester basis, with the first semester beginning in mid-February and ending in mid-June, and the second semester beginning in mid-July and ending in mid-November. The university provides strong support for online learning. Before the lockdown, Semester one courses had already started for about one and a half months. As the situation was evolving rapidly, instructors were given a short period of time to move teaching and learning materials and activities online. This transition was by no means straightforward. With a narrow preparation window, much content had to be re-developed and delivered based on technologies (e.g., Zoom and lecture recording software). Although the country moved back to Level 1 on 8 June, all examinations were still conducted using an "open-book and open-web" method. A chronology of events relevant to this case study is given in Table 1.

Table 1. A chronology of events relevant to COVID-19 in New Zealand and Semester one

|  |  |
| --- | --- |
| Date | Event |
| 17 **February** 2020 | Semester one started. |
| **28 February 2020** | The first COVID-19 case was reported in New Zealand. |
| 20 March 2020 | The Government closed the country's borders to all but New Zealand citizens and permanent residents. |
| 21 March 2020 | The Government introduced a four-level alert system to help combat covid-19. The country was at Level two. |
| 23 March 2020 | The Government announced the country moved to alert level three, effective immediately. |
| 24 March 2020 | Lectures ended; Mid-semester break began. |
| 25 March 2020 | New Zealand moved to alert level four, and the entire nation went into self-isolation. |
| 20 April 2020 | Lectures resumed online. |
| 28 April 2020 | New Zealand moved into alert level three.  |
| 29 May 2020 | Lectures ended for semester one. |
| 08 June 2020 | Semester one examination period began. The country moved to alert level one, but all examinations were conducted online.  |

The civil engineering department at the University A offers four-year Bachelors degrees in Civil Engineering and Natural Resources Engineering (similar to environmental and agricultural engineering programmes elsewhere). The four-year Bachelor's degree is typically the highest degree for engineering students before employment. Students must pass an Intermediate Year of study before they apply to enter specific engineering degrees. The Intermediate Year is followed by three years of study towards specific engineering degrees (Year 2, Year 3, and Year 4). The Civil and Natural Resources Engineering degrees are common in Year 2, with differences in Years 3 and 4. There are roughly 190 Civil Engineering and 30 Natural Resources Engineering students each year. We will refer to all students from this point as ‘civil engineering’ students. Students have no curriculum options in Years 2 and 3, which creates a strong cohort nature to their education. Course sizes are roughly 200 students per course in Years 2 and 3. Half of Year 4 is for specialized optional courses with a size of 20-120 students per course, one quarter is in an integrated design course in a small group of 6-8 students, and one quarter on a research project in pairs of students. Roughly 10% of the Bachelor students in the two degrees are international students. Teaching methods are similar to those in other OECD (The Organisation for Economic Co-operation and Development) countries with a mixture of lectures, tutorials, and laboratories. Increasing use of online materials had led (pre-Covid19) to almost all lectures recorded for student use and partial use of online methods for quizzes, discussion fora, etc. Students were well adapted to the use of an online learning platform in all courses.

The department also offers a number of Masters degrees over a wide range of specializations for both part-time and full-time study. The degrees are mainly delivered with coursework and in some cases research courses. All Masters courses are taught in block mode, which operates such that students do most of their learning through the online learning platform, but attend two 2-3 day ‘blocks’ each semester. Although developed to facilitate remote and part-time study, even local Masters students are taught through the block-mode method. Masters courses vary significantly in size, but the majority have 10-30 students. Roughly 70% of Masters students are international students. These courses are also tightly tied to online learning, though the methods used pre-COVID-19 varied greatly between courses.

University A as an institution had developed strong educational resilience before COVID-19, and is widely recognized for such (Dabner, 2012; Richardson et al., 2015). The 2010-11 earthquakes caused significant damage to all university buildings. In the immediate aftermath of the February 2011 earthquake, the university was closed for months, and teaching (after a time closed for reorganization) in tents in carparks. Civil Engineering students in 2011 were taught in the buildings of a nearby church, with lectures, tutorials, and computer laboratories adapted to odd surroundings.

From 2012-2018, the university went through a complex repair and new construction phase, with all staff and most students accustomed to disruption, alternative workspaces, and ad-hoc methods for delivery of teaching. The Department staff were shifted out of offices for 18 months for repairs, requiring another set of improvisational changes in teaching. Repair of lecture rooms took two years without overlapping with staff displacement, and lectures were shifted to a teachers’ education campus 2 km away. Education was frequently adapted during the 2011-2018 period to the changing circumstances. For example, courses were designed around unavailability of large lecture rooms one year, and unavailability of student study and computer tutorial areas in another year.

Although these students had all left before the 2020 pandemic experience, many of the staff remained. More importantly, the institutional memory of the 2011-2018 experience could be seen as a unique preparation for adaption to pandemic. ERT requires a number of administrative tasks: rewriting course syllabi, changing student timetables, arranging and communicating new information, negotiating new rules with higher administration over special considerations for students, etc. While not frictionless, the transition required in the Department because of the pandemic could be seen smootherrequiring less effort and generating less stress compared to peer institutions.

The March 2019 mosque shootings in Christchurch (Every-Palmer et al., 2020) were another shock for students and staff. The university proved itself well-positioned to quickly develop methods to deal with trauma and stress without impacting negatively on teaching. Perhaps uniquely, University A had institutional culture and training suited to resilience, adaptation and stress management before the COVID-19 experiences of 2020.

Within this unique context, the work aims to (1) investigate civil engineering students’ perceptions about the benefits and challenges of online teaching and learning during the COVID-19 lockdown period, (2) identify significant factors that contribute to effective online teaching and learning, and (3) provide the implications of this research for future emergency remote teaching. This research adds to our understanding of ERT practices and how students perceived the impact of COVID-19 on their education. This research is the first to consider student surveys from New Zealand, and one of the few research efforts to focus on future emergency remote teaching frameworks and practices.

# 3. Literature Review

## 3.1 Online learning: models, benefits, and barriers

There has been intense research interest in online learning for decades. Anderson (2004) claimed that quality online learning is knowledge, community, assessment, and learning-centred. These four lenses constitute a foundational framework for Anderson to develop a model of online learning. In Anderson’s model of online learning, interactions among students, teachers, and content are valued. Six modes of interaction, as well as the four lenses of learning, are critical to creating an effective online learning environment.

Borrowing the phrase of ‘community of inquiry’ from Lipman (2003), Garrison et al. (1999) developed a process model of online learning also called Community of Inquiry (CoI). The CoI framework entails three overlapping elements—social presence, cognitive presence and teaching presence. Social presence was defined by Garrison (2009) as “the ability of participants to project their individual personalities in order to identify and communicate with the community and develop inter-personal relationships.” It is based on the components of “emotional expression, open communication, and group cohesion”. Garrison et al. (2001) described cognitive presence as “the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse.” Teaching presence was defined as “the design, facilitation, and direction of the social and cognitive processes for the purpose of realizing the relevant learning outcomes” (Anderson et al., 2001). It consists of the elements of design and organization, facilitating discourse, and direct instruction. These three interrelated elements can enhance or inhibit the quality of the online learning experience (Garrison et al., 1999). Picciano (2002) investigated the impacts of social presence on learning performance and found that students perceiving high social presence scored highest than the medium and low social presence groups.

CoI has been widely recognized as a useful theoretical framework and tool to design and examine online learning (Garrison et al., 2007). Numerous education scholars applied CoI to design and improve the online learning experience (Archer, 2010; Kumar et al., 2011).

Ample research has been conducted to identify the strengths and weaknesses of online learning. Typical benefits of online learning include, but are not limited to, flexibility (Petrides, 2002) and convenience (Poole, 2000). With decent web-based technologies, online learning can facilitate deep reflection on the subject (Petrides, 2002). However, online learning suffers from several significant limitations, such as a lack of a sense of community and/or feelings of isolation (Vonderwell, 2003). Muilenburg and Berge (2005) conducted an exploratory factor analysis study to identify underlying constructs that comprise student barriers to online learning. Eight factors were identified: (a) administrative issues, (b) social interaction, (c) academic skills, (d) technical skills, (e) learner motivation, (f) time and support for studies, (g) cost and access to the Internet, and (h) technical problems. The study suggested that a lack of social interaction was the most severe barrier as perceived by students overall. Song et al. (2004) conducted a survey study which aimed to investigate student’s perceptions of the strengths and weaknesses of online learning. Results suggested that lack of community, difficulty of the learning goals/ objectives, and technical problem were the main barriers.

## 3.2 Emergency remote teaching

Emergency remote teaching was defined as “a temporary shift of instructional delivery to an alternate delivery mode due to crisis circumstance” (Hodges et al., 2020). ERT is also called “crisis teaching” and “Quaranteaching”. ERT should be distinguished from quality online teaching as it involves a sudden, abrupt, and unplanned transition from a face-to-face classroom environment to a distance education model (Aguliera and Nightengale-Lee, 2020). Most instructors have had to complete the transition without sufficient time, preparation, support, and training. By contrast, when designing quality online teaching, they have adequate time and instructional design support. Instructors can focus on relationship building and social learning by choosing and implementing a “right” combination of digital tools and applications.

Research on the concept of ERT is still in its infancy. Whittle et al. (2020) proposed a conceptual framework to guide the development and investigation of ERT environments. The framework consists of four nonlinear and iterative steps: inquire, classify, design, and evaluate. The framework highlights how crises can result in changes in the four elements that constitute a learning environment identified by Sawyer (2006): the people in the environment, technologies, architecture and layout of the room, and the physical objects within the social and cultural environment.

Donaldson (2020) suggested that it is important to build a digitally enhanced community of practice during the emergency transitions to ERT. In addition, Craig et al. (2020) explored how Net.Create, a web-based collaborative social-network-analysis tool, supported student social interactions and content engagement during the COVID-19 period. Aguilar (2020) developed an approach for evaluating educational resources for the emergency transition to teaching online. Two key criteria were introduced: source and implementation. The author claimed that expecting educators to have rich knowledge of technology, pedagogy, and content knowledge is difficult.

Since the COVID-19 Pandemic, many studies have reported students’ learning experience and evaluated the impacts of COVID-19 on higher education while examining different pedagogical aspects. For example, Shim et al. (2020) analyzed South Korean college students' experiences of ERT as a result of COVID-19 utilizing thematic analysis. Results indicated that students generally enjoyed the home learning environment and found online learning flexible and time-saving. However, several barriers were identified, including technical problems (network instability), lack of interactions and a sense of belonging, and distraction. Petillion and McNeil (2020) reported chemistry students’ experience of ERT at the University of British Columbia’s Okanagan campus. The study revealed several challenges, including issues with motivation and engagement, personal scheduling, faculty communication, and increased stress and anxiety.

 Eurboonyanun et al. (2020) evaluated the effects of COVID-19 on assessment scores. They found that open-book examination had a significantly higher mean score in both multiple-choice questions and essay examinations, but a significantly lower mean score in short answers, compared to traditional written assessments. Naji et al. (2020) proposed a conceptual model of students' readiness to transition to emergency online learning. The model consists of four factors, including (1) initial preparedness and motivation for online learning, (2) self-efficacy beliefs about online learning, (3) self-directed learning online, and (4) support.

Various researchers have surveyed students' perceptions and experiences of the COVID-19 crisis. For example, Aboagye et al. (2020) conducted a survey study and identified that a lack of technologies was the most challenging issue for students. Demuyakor (2020) found that Ghanaian international students in China also had technical issues (e.g., slow internet) during a COVID-19 shift to online learning. Aristovnik et al. (2020) conducted a large-scale survey study of students' perceptions of the impacts that the COVID-19 crisis had on their learning experience. A sample of 30,383 survey responses was collected from 62 countries. The survey study focused on student satisfaction with the transition to online learning and the impacts of the COVID-19 Pandemic on students' social and emotional life. Results suggested that students appreciated the support provided by teaching staff and universities. However, deficient computer skills and perceived high workload were the main challenges. As a vulnerable group, international students had unique challenges during the COVID-19 crisis. Bilecen (2020) discussed the challenges facing international students, such as social exclusion, xenophobic attitudes, discrimination, and verbal assaults.

In addition to the students' views, Barton (2020) surveyed the instructors' on the impacts of COVID-19. Results indicated that instructors had to reduce or eliminate particular learning outcomes, for example, field activities, because of the COVID-19 Pandemic. ERT activities were perceived to be of low quality by instructors.

There have been many reflections on teaching and learning during the Pandemic within the higher education community. Case studies of how instructors adapt to the crisis were reported. For example, Fung and Lam (2020) reported a case study of how COVID-19 impacted chemical engineering courses that were delivered in a flipped classroom format at the National University of Singapore. Crawford et al. (2020) compared higher education responses to COVID-19 among 20 countries and found that the responses by higher education providers have been diverse, from no responses to rapid. The International Association of Universities (IAU) conducted a survey study on the impact of COVID-19 on Higher Education at both the global and regional levels (Marinoni et al., 2020). The project received 576 responses from 424 universities based in 109 countries. The survey results suggested that COVID-19 had significant impacts on teaching and learning. Access to technical infrastructure, competencies and pedagogies for distance learning were the main challenges. Enforced online learning also offered opportunities to explore blended learning and a mix of synchronous and asynchronous learning.

COVID-19 created unprecedented challenges. Thus, Hodges et al. (2020) argued that it is essential to distinguish emergency remote teaching from well-planned online learning. They pointed out that in an emergency shift toward online teaching, a "careful design process" is absent in most cases. Online learning infrastructure usually takes time to identify and build. In the middle of an emergency transition, it is impossible to set up an effective online system overnight. The benefits and challenges of ERT have not been thoroughly investigated. Only through documentation and analysis of a number of case studies in distinct settings will we strengthen our ability to reach conclusions in response to Covid-19 of value to those who are confronted with similar situations in the future.

# 4. Methods and materials

## 4.1 Survey

The survey consists of four sections (see Appendix A). The first section collected the participants' background demographic information. Questions in the second section asked participants' perceptions of online teaching and learning benefits during the COVID-19 lockdown period using a 5-point Likert scale. Questions of benefits were designed based on Paudel (2020) with modification. Seven potential benefits were included. Participants were allowed to provide other benefits.

Section 3 was focused on the challenges of online teaching and learning. Questions in this section were designed based on an eight-factor framework of student barriers to online learning tested by (Muilenburg and Berge, 2005). The questions cover eight main aspects: administrative/instructor issues, social interactions, academic skills, technical skills, learner motivation, time and support for studies, cost and access to the Internet, and technical problems. Fifteen potential challenges were included, each evaluated with a 5-point Likert scale. Similarly, participants were allowed to provide other challenges they were facing during the period.

The last section asked participants to select the main factors that contribute to effective online teaching and learning. Questions in this section were designed based on the contributing factors identified by Bangert (2006). There are five factors to be selected: a supportive online environment, student-lecturer interaction, student-student interaction, active learning, and prompt feedback. Participants could select multiple choices and were given an opportunity to provide other factors. Participants were also asked why the factors they selected were important to them. The survey was created using Google Forms. Survey participants were recruited through group emails. Both civil engineering undergraduate and taught master students from the university received a non-personalized email inviting them to participate in the survey study. Participants received the participant information sheet explaining the procedure and the objectives of the study. Participants were informed that the Educational Research Human Ethics Committee, University A approved the research project and that the online survey was anonymous.

The survey was open in September 2020 and closed in December 2020. The survey was sent to 656 email accounts, and 192 completed responses were collected. The response rates at different academic levels are presented in Table 2. Among the 192 responses, 37 were completed by international students, and 155 were conducted by domestic students. Among these 37 international students, 23 were Masters students, and 14 were undergraduate students.

Table 2 Distribution of the survey responses

|  |  |  |  |
| --- | --- | --- | --- |
| Academic level | Number of Complete Responses | Number of Students Receiving Survey | Response rate |
| Domesticstudents  | International students |
| Year 2 | 38 | 4 | 200 | 21% |
| Year 3 | 55 | 5 | 227 | 26.4% |
| Year 4 | 46 | 6 | 169 | 30.8% |
| Masters | 23 | 15 | 60 | 63.3% |
| Total | 162 | 30 | 656 | 29.2% |

## 4.2 Data analysis

Descriptive analysis of the survey data was first conducted to analyze survey questions that are measured using the 5-point Likert scale. Mean and standard deviation of participants' attitudes towards the benefits and challenges were computed. In the analysis, the Likert scale questions were converted to numerical values, where "1" corresponded to 'strongly disagree', "5" corresponded to 'strongly agree', or equivalent with the value "3" corresponding to the neutral value, in which participants neither agree nor disagree.

Initial data analysis indicated that the data distribution was not normal. Therefore, the nonparametric Kruskal-Wallis H Test was used to compare group (i.e., Year 2, 3, and 4, and Master students) differences. Kruskal-Wallis H Test is a rank-based nonparametric test that determines if there are statistically significant differences between two or more groups (Feir-Walsh and Toothaker, 1974). Before the Kruskal-Wallis H Test was performed by using SPSS (Field, 2013), three assumptions were checked and met: (1) dependent variables are ordinal or continuous, (2) independent variables consist of two or more categorical and independent groups, and (3) observations are independent.

A combination of framework analysis (Smith and Firth, 2011) and interpretative approach (Elliott and Timulak, 2005) was applied to analyze the comments made by students. First, to conduct a framework analysis, the eight-factor framework (i.e., administrative/instructor issues, social interactions, academic skills, technical skills, learner motivation, time and support for studies, cost and access to the Internet, and technical problems) of student barriers to online learning tested by Muilenburg and Berge (2005) were used as frameworks to code the comments. Second, considering that students may experience unique challenges during the lockdown period, grounded theory was also applied to critically review the qualitative data, determine appropriate coding, and generate new theories.

# 5. Results

## 5.1 Benefits of online learning

Table 3 presents students' views on the benefits of online learning during COVID-19 lockdown. The majority of students agreed that online learning was flexible. Students could watch and pause the lecture videos according to their own schedules. These online learning materials were particularly helpful for those students who were stuck overseas (could not go back due to travel ban) and full-time employed (e.g., some master students). Another benefit was that students could repeat the content they did not understand. In addition, lecturers could record and upload smaller videos (e.g., about 15 minutes) to help students concentrate on learning.

There was a mixed view on the importance of flexibility. Some students tended to adapt to online learning quickly. Others preferred a more stable and structured university schedule. As the responses to Q3-7 suggested, the perceived level of self-discipline among all participants was almost evenly distributed. Participants showed a mixed view of their ability to customize the learning environment to their needs during the lockdown. This could be explained by the different personal and family constraints (e.g., have to take care of kids, live with a big family, etc.) facing the participants. Another significant benefit is that students did not have to travel between campus and home, which could be costly and time-consuming.

Table 3 Results of survey questions related to online learning benefits (n = 192)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number | Survey Statement | Mean | Standard deviation | Strongly agree(%) | Agree(%) | Neutral(%)  | Disagree(%) | Strongly disagree(%) |
| Q3-1 | Online learning was flexible. | 4.19 | .734 | 32 | 59.9 | 3.5 | 4.1 | 0.6 |
| Q3-2 | The flexibility provided by the online environment was important to me. | 3.72 | .976 | 20.3 | 44.8 | 23.8 | 8.1 | 2.9 |
| Q3-3 | I could learn at my own pace. | 3.85 | .980 | 26.2 | 47.7 | 11 | 15.1 | 0 |
| Q3-4 | The cost of online learning was relatively low. | 3.26 | 1.198 | 14.5 | 34.9 | 22.1 | 19.2 | 9.3 |
| Q3-5 | I could customize the learning environment to suit my needs | 3.58 | 1.049 | 19.2 | 39.5 | 23.8 | 14.5 | 2.9 |
| Q3-6 | I could review course materials repeatedly. | 4.22 | .746 | 37.8 | 48.8 | 10.5 | 2.9 | 0 |
| Q3-7 | I had the self-discipline needed for online learning | 3.52 | 1.207 | 22.7 | 35.5 | 20.9 | 12.8 | 8.1 |

A Kruskal-Wallis H test showed that there were statistically significant differences in Q3-3 (χ2(3) = 8.411, *p* = 0.038), Q3-6 (χ2(3) = 14.156, *p* = 0.003), and Q3-7 (χ2(3) = 11.715, *p* = 0.008), among students at different academic levels. Dunn's pairwise tests were then carried out for six pairs of groups. There was strong evidence (p < 0.05, adjusted using the Bonferroni correction) of differences between Year 2 and Year 4 students in Q3-3, Q3-6, and Q3-7, and between Year 3 and Year 4 students in Q3-6, as shown in Table 4. Year 4 students had more positive perceptions of self-paced learning, reviewing course material repeatedly, and self-discipline.

Table 4 Significant differences in responses to questions on the benefit of online learning.

|  |  |  |
| --- | --- | --- |
| Survey Statement | Sample 1-Sample 2 | Adj. Sig.a |
| Q-3-3 I could learn at my own pace. | Year 2–Year 4 | .034 |
| Q3-6 I could review course materials repeatedly. | Year 2–Year 4 | .003 |
| Year 3–Year 4 | .034 |
| Q3-7 I had the self-discipline needed for online learning | Year 2–Year 4 | .004 |

Note: Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

The Kruskal-Wallis H test also showed that there was a statistically significant difference in Q3-3 (χ2(1) = 5.727, *p* = 0.017) between domestic and international students. International students had a significantly higher self-perceived ability to learn at their own pace than domestic students.

## 5.2 Challenges of online learning

In general, civil engineering students experienced significant challenges during the COVID-19 period. Participants hold a view that the Pandemic negatively impacted their academic performance (mean: 3.56, standard deviation: 1.205). Regarding the efficiency of online learning to achieve learning objectives, participants’ view was close to neutral (mean: 3.13, standard deviation: 1.097).

5.2.1 Administrative/instructor issues

Civil engineering students perceived barriers related to the quality of course materials, delay, and lecturers’ skill of online teaching. Regarding the quality of online learning materials, 23.8% of participants agreed or strongly agreed that online learning materials were of low quality, with 31.4% being neutral. This issue can be attributed to two main reasons. First, given the emergency of lockdown and tight time window shifting to online, lecturers’ were rushed to upload learning materials without careful preparation. Second, lecturers were not trained to teach online. Over 53% of participants deemed that lecturers lacked online teaching skills, with 24.4 % being neutral. The results are reinforced by the comments made by participants. For example, participants stated that:

*“The quality of the materials online depended on the lecturer/course! Most were excellent and others were useless. Again, some lecturers were better at teaching online than others. Also, the learning interactions/expectations depended on the lecturer!”*

*“Lecturers would often record lectures that were of the slides only and with monotone voices so it was really hard to concentrate and take anything in. I much prefered being able to see the notes and the lecturer and having the option to speed up the lecture or slow it down.”*

5.2.2 Social interactions

Lack of interactions (i.e., student-student and student-lecturer interactions) was another main challenge that students experienced during the lockdown. Regarding student-student interactions, over 80% of participants agreed or strongly agreed that there was a lack of communication/interactions among students, with 16.9% being neutral. In addition, over 59.8% hold a strong view that the interactions with lecturers were limited. Lack of interactions caused isolation among students. Only 14.5% of participants disagreed that online learning was isolated.

In addition to the survey items, participants made additional comments to strengthen their views. Some examples are provided as follows:

*“I struggled as I benefit greatly from working with others.”*

*“Civil Engineering students in particular work together very often on assignments and homework and lecturers know this, but didn't account for this deficiency during lockdown which made learning harder.”*

*“It was difficult being away from my peers, which made some subjects challenging to discuss ideas.”*

*“One of the main benefits I have found from Masters level study has been the interaction between other students during the block courses and the learnings you can pick up from others experiences. The online learning really lacked any way for this to happen.”*

5.2.3 Learner motivation

Survey results suggested that lack of motivation to learn in an online environment was another significant issue. Over half of the participants agreed that they lacked personal motivation for online learning, and 63.2% pointed out that the online learning environment was not motivating. As a participant stated:

*“Motivation being key, if you fall behind, your mates don't check up on you. It's so common for friend groups to all be checking up on each other when doing in perosn lectures. Online, this decreased. A lot of people I know suffered without the University structure.”*

5.2.4 Technical problems

In general, only a small proportion of participants experienced Internet issues (i.e., access and cost). However, there were more participants who were concerned about the required technologies for teaching, assignment, and exam. For example, students lacked printing and scanning equipment at home, which made submitting online assignments and exams difficult. In addition, being off-campus, students had to request remote access to some software that was required in courses. The process was time-consuming and was not always successful.

5.2.5 Unique challenges of online learning during lockdown

Arguably, those challenges identified above may be common in all types of online learning. However, a number of challenges unique to online learning during the lockdown were also identified. The results of the qualitative analysis revealed that students suffered from mental health issues, like social and emotional isolation, anxiety, and depression. These issues were attributed to several reasons. For example, some students were concerned with their families who were also affected by COVID-19. A participant mentioned that she/he lost her/his part-time job due to the lockdown, which caused significant financial stress. For traditional online learning, the home could be an appropriate space to learn. However, learning from home was challenging due to the distractions from families or roommates.

Another challenge unique to the COVID-19 period was uncertainty. Participants raised two main types of uncertainty. The first type is policy uncertainty. International students who were stuck overseas due to the border ban were concerned about policy uncertainty regarding when the border would be re-open. Re-opening campus to students was another concern. A participant stated that:

*“It was not communicated effectively that university would be re-opening prior to lockdown being lifted. As such, I had travelled to help family into a region with no internet access and limited phone service. As such, the ability to get any work done was not possible. I then had to break lockdown in order to make it back to an online test that was scheduled during level 4.”*

Another type of uncertainty was related to curriculum and routine. The Pandemic caused significant disruption in students’ (also lecturers’) normal routine. Some students may enjoy the flexibility. However, many suffered from the unstable routine and uncertain curriculum.

5.2.6 Differences among groups

A Kruskal-Wallis H test showed that there were statistically significant differences in Q5-1 (χ2(3) = 13.465, *p* = 0.004), Q5-8 (χ2(3) = 8.702, *p* = 0.034), and Q5-12 (χ2(3) = 11.125, *p* = 0.011), among students at different academic levels. Dunn's pairwise tests indicated that the differences in Q5-1 between Year 4 and Year 3 students and between Year 4 and Year 2 students were statistically significant, as shown in Table 5. Year 2 and 3 students perceived more negative impacts on COVID-19 on their academic performance than Year 4 peers. In addition, Year 2 students had a significantly lower perception of the quality of learning materials compared to Year 3 students. Year 2 and Year 4 students had a more negative perception of lecturers' online teaching skills than Master students..

Table 5 Dunn's pairwise tests of online learning challenges

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Survey Statement | Sample 1-Sample 2 | Test Statistic | Std. Error | Std. Test Statistic | Sig. | Adj. Sig.a |
| Q5-1 The pandemic had negative effects on my academic performance. | Year 4-Year 3 | 27.521 | 9.320 | 2.953 | .003 | .019 |
| Year 4 –Year 2 | 37.613 | 11.578 | 3.249 | .001 | .007 |
| Q5-8 Materials online were of low quality. | Year 3-Year 2 | 30.868 | 11.025 | 2.800 | .005 | .031 |
| Q5-12 Lecturers or instructors are not trained to teach online. | Master-Year 4 | 30.932 | 10.299 | 3.003 | .003 | .016 |
| Master-Year 2 | 32.523 | 11.915 | 2.730 | .006 | .038 |

Note: Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

 Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

The Kruskal-Wallis H test also showed that there was statistically significant differences in Q5-3 (χ2(1) = 6.570, *p* = 0.010), Q5-12 (χ2(1) = 7.560, *p* = 0.006), Q5-13 (χ2(1) = 4.063, *p* = 0.044), and Q5-15 (χ2(1) = 15.415, *p* = 0.000) between domestic and international students. Compared to domestic students, international students had a significantly lower level of self-perceived motivation for online learning. In addition, international students perceived more negatively technology access and Internet cost.

## 5.3 Factors that contribute to effective online teaching and learning

Table 6 shows the frequency and percentage of the contributing factors in all survey responses. Among the five factors, "student-lecturer interactions" was most common, which was followed by "a supportive online environment" and "student-student interaction". Student-lecturer interactions are associated with two other important factors: prompt feedback and a supportive online environment.

Table 6 The frequency of the contributing factors

|  |  |
| --- | --- |
| Contributing factors | Frequency (percent of 192 responses) |
| Student-lecturer interaction | 124 (64%) |
| A supportive online environment | 117 (60%) |
| Student-student interaction | 102 (53%) |
| Active learning | 85 (44%) |
| Prompt feedback | 82 (42%) |

Participants suggested other contributing factors, including sufficient technical support, clear expectations, high course material quality, and compulsory attendance.

# 6. Discussion

This study reports a case study of civil engineering students’ perception of ERT during the COVID-19 Pandemic. ERT can be seen as a unique type of online learning since it entails common online learning components. At the same time, it should be noted that ERT has a different goal than typical online education. The former often aims to provide reliable, temporary, fast, and durable access to instruction and instructional assistance (Mohmmed et al., 2020), while the latter focuses on the learning experience process and outcomes (Anderson, 2004).

There were significant differences in perceptions of the benefits and challenges of online learning between academic years. In general, Year 4 students had significantly more positive perceptions of online benefits than Year 2 and 3 peers. It seems that Year 4 students were more disciplined, adaptable and independent. This could be explained by the fact that Year 4 students were more cognitively and socially mature compared to their counterparts. In addition, there were statistically significant differences in the perceptions of "quality of learning materials" and "lecturers' online teaching skills" between academic years. These significant differences were mainly lecturer-related. International students had a significantly higher self-perceived ability to learn at their own pace than domestic students. The difference may suggest that international students are more independent but requires future research. Compared to domestic students, international students had more challenges regarding technology access and high internet cost. These perceptions may be caused by the fact that the living costs in New Zealand may be quite different from their home country.

## 6.1 A Community of Inquiry perspective

CoI was adopted as a conceptual framework to interpret and discuss the results of this case study with respect to not only the three main elements (i.e., cognitive, social, and teaching presence) but also the dynamic relationship among the presences. It is apparent that, in general, there was a lack of social presence during the lockdown period. Lack of student-to-student and student-to-lecturer interactions is the main themes identified in this study. This can be attributed to several reasons. First, civil engineering students value peer-to-peer interactions, and they may have taken it for granted before the lockdown. A strong sense of isolation emerged during the sudden transition because students were not prepared to adapt their social presence during online learning. Social presence is a significant antecedent to collaboration and critical discourse (Garrison, 2011). Working together on group projects, assignment, and tutorials supports critical thinking, develops interpersonal skills, and investigates tacit bodies of knowledge. Thus, a decrease in social presence had negative impacts on students’ cognitive processes. This was reflected in the fact that students became less motivated to attend lectures, ask questions, and interact with learning materials.

Note that cognitive presence, as well as social presence, was impacted by declined teaching presence (Ke, 2010). As aforementioned, when moving towards online due to the lockdown, lecturers’ priority was to continue to deliver teaching. A compromise between fast online delivery and instructional design quality had to be made. Within a short preparation time window, some of the design, facilitation, and direction of social and cognitive processes were inevitably ignored. The results indicated that students expressed their concerns over the quality of online learning materials, lecturers’ online teaching skills, and poor organization of online tutorials.

Learning happens at the intersection of the three presences. In the intersection between social and teaching presence, lecturers had significant challenges to re-set up a positive climate to encourage social interactions, not to mention that both social and teaching presence were undermined by external factors within the crisis context. Given the time constraints, lecturers’ performance in selecting content and regulating learning inevitably deteriorated. The intersection between teaching presence and cognitive presence directly affects the relationship between social presence and cognitive presence.

## 6.2 Uniqueness of ERT

It is important to understand the dynamic relationships among the three presences within the pandemic context. This study suggests that ERT entails unique challenges from the student perspective. First, students experienced double-isolation. At one level, students were isolated from their peers and lecturers. A sense of isolation at this level is similar to typical online learning. At another level, students’ daily life was also isolated, as they were forced to stay home and remain in their “bubble”. Such a sense of isolation at the second level adds significant complexity to the online learning experience and effectiveness. The sense of isolation could easily escalate to anxiety and depression when they found the external environment unsupportive and adverse (e.g., worry about their families’ health). This posed significant barriers against social and cognitive presence. Note that cognitive presence consists of an iterative and cyclical process, moving through a triggering event, exploration, integration, and resolution phases (Garrison et al., 2007). In addition to the impacts of teaching and social presence, the (negative) impacts from the distracting, disengaging, and exhausting pandemic environment should not be ignored.

Teaching presence is essential to select content and regulate learning. In an emergency transition, lecturers’ challenge/objective was twofold: managing the crisis and maintaining the quality of learning. Some tradeoffs between these two objectives may be inevitable. The differences among groups in this case study can be explained by the varied level of teaching presence. For example, group differences regarding online material quality and lecturer online teaching skills can be explained by the differences in lecturers’ performance concerning design & organization, facilitating discourse, and direct instruction. As aforementioned, teaching presence during the emergency transition was decreased due to constraints.

On the other hand, students who were learning in a new environment tended to expect more teaching presence, such as instructor guidance, building understanding, and motivating. It is not surprising that some lecturers performed better than others since teaching presence during the emergency transition is based on lecturers’ technology, pedagogy and content knowledge (TPACK). According to (Koehler and Mishra, 2009), TPACK knowledge refers to “a synthesis of what one needs to teach (content), how one should best teach it (pedagogy), and what technology can be brought to bear given the former two (technology knowledge)”. Nevertheless, it should be noted that it may be unfair to expect lecturers to manage all aspects of teaching presence. Collaboration at the department and university level is often essential. For example, the university IT support team should assist students with securing remote access to the software required in courses.

In addition, note that ERT is temporary and entails uncertainties. Preparing and delivering an online course from the very beginning is different to transforming a face-to-face course that was partially completed. Lecturers had to deal with the policy uncertainties regarding returning time and examination mode. Due to these unique challenges, it needs more effort to create and maintain cognitive, social, and teaching presence.

## 6.3 Limitations and future studies

The findings of this study should be interpreted in light of the following limitations. First, the survey sample size is modest. However, it does not appear to be biased in any direction. Participants appear to be representative of all civil engineering students in this case study. Due to this limitation, future research should seek a large sample size and consolidate the results. The second limitation is that instructors' views were not collected in this study. Future studies are needed to investigate instructors' views to complement the findings and validate the institutional resilience model of ERT. A third limitation is that this study examines student beliefs about their learning and does not consider or analyze measures of student performance or learning. Last but not least, the survey questions are focused on collecting students’ perceptions of teaching and learning in general and are not related to any specific course. Future studies should be conducted to evaluate the effectiveness of remote learning on the civil engineering curriculum (e.g., laboratory and design courses). As the Pandemic also significantly impacted the job market, future studies can investigate graduating students’ experience of job hunting.

This paper made an effort to interpret the results from a CoI perspective and discuss the uniqueness of ERT. In a post-COVID-19 era, ERT may become a "new normal". Arguably, the classic CoI framework focuses on three core elements and their intersections without explicitly considering the external environment where online learning occurs. Thus, future research is needed to reconceptualize the CoI framework for ERT circumstances. Categories and indicators of three core elements (i.e., social, cognitive, and teaching presence) were provided by Garrison et al. (2007) to define each presence and guide the coding of transcripts. Whether or not there are additional elements, categories, and indicators when online learning occurs in a crisis remains an open question. In addition, it would be significant to examine the dynamic relationships among core elements of the CoI in an ERT environment and compare the results reported by other researchers (Kozan et al., 2014; Pham et al., 2021). These future studies have the potentials to help tertiary education institutions develop resilience and enhance their adaptive capacity to deal with a future crisis like the COVID-19 Pandemic.

# 7. Conclusions

This paper analyses a survey study investigating students’ experience of online learning during the COVID-19 lockdown. Survey results indicated that the majority of students agreed on the flexibility enabled by online learning. However, there was a mixed view on the importance of flexibility. In addition to typical online learning challenges (e.g., administrative/instructor issues, social interactions, motivation, and technical problems), students also experienced unique challenges, such as social and emotional isolation, anxiety, depression, and uncertainty.

The results implied that the levels of cognitive, social, and teaching presence decreased during the emergency shift toward online learning. Attention should be paid to the impacts of the external environment on learning when traditional practices are applied that enhance cognitive, social, and teaching presence. Future research is needed to reconceptualize the CoI framework for ERT circumstances and examine the dynamic relationships among core elements of the CoI in an ERT environment.

Based on the results of this study, it is suggested that teaching presence be brought to the forefront of ERT. Lecturers must make efforts to maintain or even increase the level of teaching presence during and after the transition towards ERT. During the emergence, it is significant to heighten the awareness of how teaching presence impacts social and cognitive presence. It is not realistic and practical to expect that students will maintain the social and cognitive presence in ERT. A lecturer is advised to pay extra efforts to address the unique challenges of ERT concerning the three components of teaching presence: design & organization, direct instruction, and discourse facilitation. First, it is essential for lecturers to provide a clear and detailed online learning schedule and guidelines during the emergent transition. This may sound obvious, but an updated course calendar and instructor reminders and announcements are useful to reduce students’ stress and anxiety. Note that ERT schedule and guidelines by lecturers are subject to the central crisis management team and the government policies (e.g., Alert Level change). Thus, quick and effective communication between the institution and lecturers is essential. It would be helpful for both the institution and lecturers to create detailed contingency/scenario plans since there is uncertainty about the policy by the central government. Second, the results of this study suggested that students value both student-lecturer and student-student interactions in ERT. These interactions play a critical role in engaging and motivating students and promoting cognitive presence. Lecturers must establish teaching presence to facilitate both social and cognitive presence by creating well-crafted individual and group discussion questions, actively presenting themselves in course discussion, and providing timely and specific guidance and feedback. Students value the efforts, as the support from lecturers help them manage the external crisis environment and (re)focus on learning. Third, re-stating or updating clear expectations/learning outcomes for ERT is also critical to minimize students’ stress.

In a post-COVID-19 era, ERT may become a "new normal". The results of this study have demonstrated a strong need for both the university and lecturers to improve their preparedness for predictable future crises. They must improve the capability long before the next crisis arises by emphasizing pre-crisis mitigation efforts that recover and maintain the level of cognitive, social, and teaching presence during and after the transition towards online. Based on the results of this study, it is suggested that the university should invest in upskilling lecturers in online teaching regarding pedagogical design, online delivery, and technology. The effort is key to establishing a strong teaching presence for ERT. In addition, an awareness of how teaching presence interacts with cognitive and social presence is also significant. This would encourage lecturers to review instructional design, interact with students, and facilitate student-to-student interactions. At the technology level, more resilient technological infrastructure is needed to adequately prepare for future ERT. During the shift towards ERT, technical support should be in place to ensure that students have quick access to the software required.

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# 9. Disclosure statement

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# Appendix A: Survey

If you agree to participate in the survey, please click “I consent” below.

* I consent
* I do not consent

Q1. Are you a(n)\_\_\_

* Domestic student
* International student

Q2. Are you a

* Year 2 student
* Year 3 student
* Year 4 student
* Master student

Q3. Benefits of online learning

Please answer all questions based on your learning experience during the COVID-19 lockdown period. Circling one out of numbers 1 - 5 against each statement. 1= strongly disagree; 2 = disagree, 3 = neutral, 4 = agree, 5 =strongly agree

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| NO. | Statement | 5 | 4 | 3 | 2 | 1 |
| 1 | Online learning was flexible. |  |  |  |  |  |
| 2 | The flexibility provided by the online environment was important to me. |  |  |  |  |  |
| **3** | **I could learn at my own pace.** |  |  |  |  |  |
| 4 | The cost of online learning was relatively low. |  |  |  |  |  |
| **5** | **I could customize my learning environment to suit my needs.**  |  |  |  |  |  |
| **6** | **I could review course materials repeatedly.** |  |  |  |  |  |
| **7** | **I had the self-discipline needed for online learning.** |  |  |  |  |  |

Q4: Based on your experience, are there any other benefits of online learning?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Q5 Challenges of online learning

Please answer all questions based on your learning experience during the COVID-19 lockdown period. Circling one out of numbers 1 - 5 against each statement. 1= strongly disagree; 2 = disagree, 3 = neutral, 4 = agree, 5 =strongly agree

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| NO. | Statement | 5 | 4 | 3 | 2 | 1 |
| 1 | The Pandemic had negative effects on my academic performance. |  |  |  |  |  |
| 2 | It was difficult to concentrate on learning. |  |  |  |  |  |
| 3 | I lacked personal motivation for online learning. |  |  |  |  |  |
| 4 | Online learning could not achieve the learning objectives for my courses. |  |  |  |  |  |
| 5 | The online learning environment was not motivating. |  |  |  |  |  |
| 6 | There was a lack of communication among students. |  |  |  |  |  |
| 7 | Online learning meant I felt isolated. |  |  |  |  |  |
| 8 | Materials online were of a low quality. |  |  |  |  |  |
| 9 | There was a lack of interaction with lecturers online. |  |  |  |  |  |
| 10 | There was a lack of clear learning expectations from lecturers. |  |  |  |  |  |
| 11 | Provision of course materials were often delayed online. |  |  |  |  |  |
| 12 | Lecturers or instructors are not trained to teach online. |  |  |  |  |  |
| 13 | The required technology was unavailable to me. |  |  |  |  |  |
| 14 | I lacked adequate internet access. |  |  |  |  |  |
| 15 | The cost of an internet bundle was too high for me. |  |  |  |  |  |

Q6: Other challenges you faced during the COVID-19 lockdown?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Q7. In your opinion, what are the main factors that contribute to effective online learning?

* A supportive online environment
* Student-lecturer interaction
* Student-student interaction
* Active learning
* Prompt feedback
* Other \_\_\_\_\_\_\_\_\_\_\_

Q8: Why are these factors are important to you?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_