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Teaching Resilience: Enabling Factors for Effective Responses to COVID-19

Alex Baumber, Lucy Allen, Tyler Key, Giedre Kligyte, Jacqueline Melvold and Susanne Pratt
University of Technology Sydney, Australia

Abstract

The COVID-19 pandemic has disrupted higher education globally. Teaching staff have pivoted to online learning and employed a range of strategies to facilitate student success. Aside from offering a testing ground for innovative teaching strategies, the pandemic has also provided an opportunity to better understand the pre-existing conditions that enable higher education systems to be resilient - that is, to respond and adapt to disturbances in ways that retain the functions and structures essential for student success.

This article presents a case study covering two transdisciplinary undergraduate courses at the University of Technology Sydney, Australia. The results highlight the importance of information flows, feedbacks, self-organisation, leadership, openness, trust, equity, diversity, reserves, social learning and nestedness. These results show that resilience frameworks developed by previous scholars are relevant to university teaching systems and offer guidance on which system features require protection and strengthening to enable effective responses to future disturbances.

Keywords: Transdisciplinary; resilience; pandemic; blended learning.

Introduction

The COVID-19 pandemic has caused major disruptions to higher education teaching and learning, particularly through the limitations it has placed on students and staff interacting in physical proximity to each other. While responses to the pandemic have been diverse, one of the most prominent responses in universities globally has been a rapid pivot to online teaching (Crawford et al., 2020). In 2020, Chinese universities were the first to suspend classes in late January (XinhuaNet, 2020), with most Western nations following their lead in March. Italy led the wave of European university disruptions, with the Italian government ordering all universities to close on 4 March, 2020 (Crawford et al., 2020). Most leading US universities announced a move to online delivery in the week of March 6-13, 2020. In Australia, the shift to online learning largely followed the announcement of limits on public gatherings by the National Cabinet of federal, state and territory leaders on March 15, 2020, even though universities were exempt from the limits imposed at that time (Prime Minister of Australia, 2020).

While online learning approaches have the potential to enhance student accessibility, participation and success in higher education (Stone, 2017), much of the development of online learning at the start of the pandemic took the form of "emergency e-learning" (Murphy, 2020). Such responses lacked the luxury of time to rigorously gather input from diverse sources and undertake multiple rounds of testing and refinement. Within a few months of the events of March 2020, higher education scholars were beginning to catch their collective breath and evaluate the various responses deployed by universities around the world, with Butler-Henderson et al. (2020) identifying 138 manuscripts on higher education responses published online by 30

June 2020. This academic analysis of COVID-19 responses provides a valuable source of data on effective online learning and responses to major unexpected disruptions to higher education.

When disturbances arise with little warning or preparation time, responses are heavily influenced by the pre-existing characteristics of the affected system (Carpenter et al., 2012). In addition to documenting and analysing the strategies deployed by universities around the world in response to COVID-19, it is important to also analyse the pre-existing characteristics of teaching systems that may have enabled successful responses to emerge. In this way, we may learn not only what strategies to deploy when the next pandemic hits, but also how to enhance the broader resilience of university teaching systems to deal with a wide range of other potential disturbances. In this article, we evaluate the diverse responses to COVID-19 across two transdisciplinary undergraduate courses at the University of Technology Sydney (UTS), Australia, and seek to identify the enabling factors that influenced their capacity to facilitate student success in this difficult period. This analysis draws on the concepts of transdisciplinary learning and resilience-building in complex adaptive systems.

Conceptual Frameworks

Transdisciplinary Learning and Teaching

The focus of this article is on two undergraduate courses offered by the Faculty of Transdisciplinary Innovation (since renamed TD School) at UTS: the Bachelor of Creative Intelligence and Innovation (BCII) and the Bachelor of Technology and Innovation (BTi). Both courses are transdisciplinary degrees that bring together diverse knowledges from different disciplines and contexts to address real-world challenges in partnership with key stakeholders. The introduction of the BCII in 2014 and the BTi in 2017 reflect a broader trend towards transdisciplinary approaches to higher education across a diverse range of contexts, including education relating to health (Hudson, 2016), entrepreneurship (Penaluna & Penaluna, 2009) and sustainability (Evans, 2015).

Transdisciplinary higher education poses specific challenges in relation to online learning due to its focus on real-world challenges, diverse knowledge types, mutual learning and reflexivity (Polk & Knutsson, 2008; Scholz & Steiner, 2015). Situating learning around real-world challenges requires partnerships that expose students to non-university contexts, something that is routinely cited as a strength of the BCII and BTi in student surveys and was a key factor in the BCII winning recent national awards from the Australian Awards for University Teaching (AAUT) and Business Higher Education Round Table (BHERT). However, during the COVID-19 pandemic, this reliance on external partnerships meant that student learning was exposed not only to the disruption taking place within the university system and in the student's own lives, but also to the disrupted work and communication systems of multiple businesses, government agencies and community organisations.

Transdisciplinary approaches seek to transcend knowledge "silos" to achieve new collective learning (Häberli et al., 2001), drawing on diverse disciplinary perspectives and other knowledge types, including local, practical and Indigenous knowledges. This exposure to a diverse range of viewpoints requires dedicated processes of reflexivity that facilitate "on-going scrutiny of the choices that are made when identifying and integrating diverse values, priorities, worldviews, expertise and knowledge" (Polk, 2015, p. 114). This, in turn, enables transdisciplinary partnerships to move beyond traditional dichotomies, such as "teacher-student", "supervisor-intern" or "client-consultant" to form reciprocal partnerships of mutual learning (Baumber et al., 2020). However, while mutual learning is the "kernel" of the transdisciplinary process (Scholz & Steiner, 2015), it can also pose particular challenges in a pandemic due to the need to create "third spaces" in online settings that transcend traditional "lecture" or "tutorial" arrangements and allow for roles to be creatively reimagined (Kligyte et al., 2019).

Resilience in Complex Adaptive Systems

Resilience is a concept that has been widely explored in higher education, primarily in relation to the personal resilience of students. Recent examples include identifying predictors of student resilience (Robbins et al., 2018), designing strategies to enhance student resilience through learned optimism (Chadwick, 2019), and developing pilot programs that draw on academic scholarship on student resilience (Brewer et al., 2019). However, while individual student resilience is undoubtedly an important factor for coping with a disturbance like the COVID-19 pandemic, it is not the focus of this article. Rather, we are interested in the resilience of the broader teaching system in which students learn. Our objective is to identify factors that may enable and enhance the resilience of such systems, drawing on decades of research into resilience in complex adaptive systems

by researchers such as Buzz Holling, Dana Meadows, Nancy Doubleday, Brian Walker and Steve Carpenter (e.g., Carpenter et al., 2012; Doubleday, 2007; Holling, 1973; Meadows, 2008;; Walker, 2019;).

When viewed at the level of an individual student, resilience may be defined as "the heightened likelihood of success in school and other life accomplishments despite environmental adversities" (Wang et al., 1994, p. 46). However, viewing resilience at the system level requires some additional considerations. Carpenter et al. (2012) define resilience in complex systems as "the capacity of a social-ecological system to absorb disturbance, reorganise, and thereby retain essential functions, structures and feedbacks" (p.3249). Notably, this notion of resilience is about more than simply "bouncing back" and instead emphasises reorganisation and adaptation to maintain what is most important about the system. In the words of Brian Walker, resilience is about "learning *how* to change in order not to *be* changed" (Walker, 2019, p. 17, emphasis in original).

While resilience is almost always described as a positive attribute when viewed at the level of an individual student or staff member (e.g. Wang et al., 1994), resilience is not automatically desirable when viewed at the system level, nor are disturbances inherently undesirable. Undesirable system states, such as military dictatorships, have shown themselves to be highly resilient in the face of the various disturbances over time (Walker & Salt, 2012). Similarly, for teaching systems that were operating in a sub-optimal state prior to the COVID-19 pandemic, the aim may not be to retain the essential characteristics of that state, but rather to transform such systems into something else.

In order to determine whether resilience is a desirable attribute of a system, it is important to first consider what Walker and Salt (2012 p. 41) refer to as the "The Resilience of What?" (i.e. what do people value and what are the big issues?). If resilience is all about maintaining key functions, structures and relationships in the face of disturbances, then what are the functions, structures and relationships that actors in the system most value and wish to maintain? For the BCII and BTi degrees, some of these elements stem from the transdisciplinary principles that underpin them, such as the connections to real-world challenges, inputs of diverse knowledges and partnerships of mutual learning. Other factors relate to student success, which can be defined in many different ways. Some of the ways that student success has been defined within the faculty (e.g. in the recent AAUT and BHERT award nominations) include student satisfaction (as measured by student feedback surveys), employment prospects upon graduating, reputation amongst industry partners and sense of community (including an active alumni community).

Various resilience theorists have sought to identify factors that can enhance or reduce resilience in complex systems. Table 1 features nine enablers of general resilience that can be found in a diverse range of social and ecological contexts, as identified by Carpenter et al. (2012). Trade-offs may be required between some of these factors, particularly between the need for openness, which enables support from outside, and modularity, which helps to keep out threats and enables self-organisation to develop with sub-units of a system.

Table 1

Enabling Factors for General Resilience. Adapted from Carpenter et al. (2012)

Factor	Description
Diversity	Includes diversity of people, resources and potential response pathways
Reserves	Extra capacity or buffers held in reserve that can be mobilised after a disturbance
Modularity	Independent or autonomous units within the whole that allow for self-organisation at a local level and prevent threats from spreading
Openness	Strong connections to neighbouring systems that exchange or act as buffers against external shocks
Nestedness	Strong connections to higher system levels (e.g. a local entity that is linked to national and global scale support systems)
Feedbacks	Includes balancing feedbacks that push back against a disturbance and reinforcing feedbacks move the system in a desired direction
Monitoring	Capacity to gather information in a shared, transparent and regular fashion
Leadership	Leaders who recognise barriers and enablers to resilience and seek to manage these proactively
Trust	Trust enables people to collaborate effectively in the presence of uncertainty

Resilience frameworks developed by other authors feature many of the same factors shown in Table 1, along with some notable differences. For example, the enterprise resilience framework of Erol et al. (2010) includes several factors from Table 1, such as diversity, reserves (or redundant capacity) and monitoring (including awareness and risk intelligence), but also highlights the importance of collaboration, cohesion and efficiency. Meadows (2008) and Armitage (2007) have singled out self-organisation as a critical stand-alone factor rather than viewing it as a subset of modularity. Concern expressed by Cote and Nightingale (2012) that resilience theory overlooked important aspects of social theory led to a greater focus on the role of "social capital" in enhancing resilience in subsequent years, including the role of social networks (Walker & Salt, 2012) and equity (Cafer et al., 2019). Suárez et al. (2020) present a set of indicators for urban resilience that include some of the factors from Table 1 (diversity, modularity and feedback lengths) plus additional social factors covering social cohesion, equity and learning and innovation.

Through the case study introduced in the following section, we seek to identify some of the enabling factors that may have played important roles in the responses of the BCII and BTi teaching systems to the COVID-19 pandemic. In particular, our aim is to understand the value of enabling factors in establishing the pre-conditions for a resilient response that is able to maintain student success in the face of adversity. In other words, our focus is not just on what we did to respond to COVID-19, but on the underlying pre-conditions of the teaching system that enabled us to do what we did.

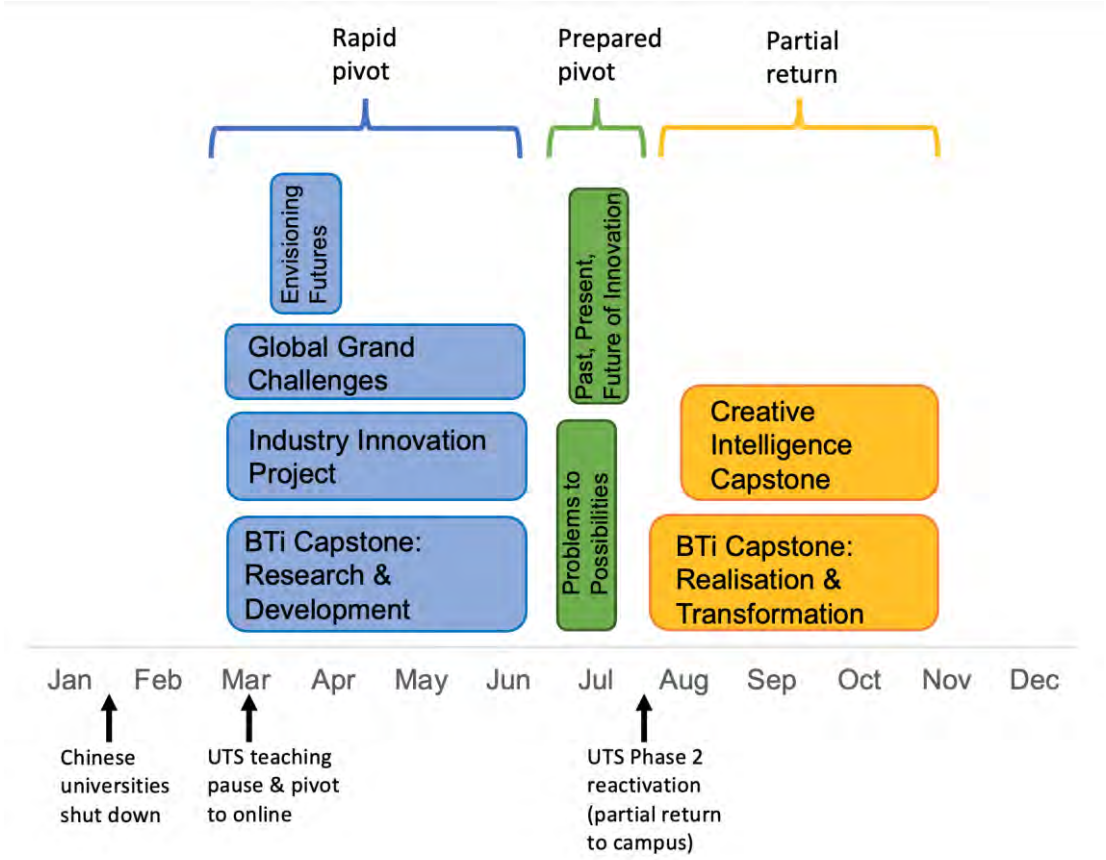
Case Study Methodology

The methodology employed for this study involved six subject coordinators (i.e. the authors of this article) preparing, sharing and discussing short reflections (~500 words) on their responses to the COVID-19 pandemic across eight different BCII and BTi subjects (Figure 1). While the BCII and BTi are both transdisciplinary courses, the BTi is a single degree over 3 years and the BCII follows a double-degree model whereby students choose from 25 different "core degree" options (e.g. business, design, arts, science). While BTi students mostly do transdisciplinary subjects (plus a few electives), BCII students do transdisciplinary subjects interspersed amongst their core degree subjects for the first 3 years before spend their entire 4th year exclusively studying transdisciplinary subjects. BCII students typically work in multi-disciplinary teams (i.e. students from different core degrees working together), while BTi students do not have a core degree and so must seek out and draw on multiple disciplinary perspectives to address their challenges. Staff teach across both courses in a highly-collaborative team-based approach.

The subjects under reflection included a combination of five full-semester (9-12 week) and three intensive (2-3 week) subjects. Four subjects have been classed as "rapid pivot" subjects in Figure 1, as they had already commenced (or were just about to commence) when UTS implemented its one-week teaching "pause" from 17 to 23 March. For the two "prepared pivot" subjects, coordinators had three months to plan for online learning. Lastly, our reflection includes two "partial return" subjects that commenced after UTS has moved to its "Phase 2" campus reactivation, in which online learning was combined with limited on-campus teaching undertaken in an environment of continually-evolving COVID-safe rules and processes. Enrolment numbers across the eight subjects varied from 13 to over 400.

Figure 1

Timing of Case Study Subjects Across 2020



The research methodology was influenced by the concepts of mutual learning and reflexivity that are inherent to transdisciplinary practice (Polk, 2015; Scholz & Steiner, 2015). An initial group reflection on our COVID-19 teaching experiences was held in September 2020, followed by the writing and sharing of individual reflections in October 2020 and a final collaborative process of identifying common themes and writing up a shared summary of our experiences.

The initial staff reflection in September 2020 took the form on an online workshop that was open in structure and allowed each coordinator to raise any issues and experiences related to their own online pivots, as well as discussing enabling factors for resilience identified by previous researchers in other contexts. For the writing of individual reflections in October 2020, each coordinator was asked to write approximately 500 words on the strategies they employed to adapt to online learning and the factors they felt had the greatest influence on the resilience of the teaching system in which they were operating. Each coordinator was asked to draw on a list of enabling factors for system resilience identified from previous research that included the nine factors shown in Table 1 (Carpenter et al. 2012) and the additional factors of collaboration, cohesion, efficiency, equity and self-organisation from Meadows (2008), Erol et al. (2010) and Suárez et al. (2020). In addition to highlighting which of these factors they felt were most significant, coordinators were also able to identify additional factors that had not been discussed by these previous researchers.

Following the sharing of individual reflections, thematic analysis was undertaken by the lead author of this article and refined collaboratively by all authors to identify the enabling factors that were most prominent in the individual reflections and the contexts in which they were discussed. The initial themes for the thematic analysis were based on the list of enabling factors from prior research, with scope to add new emergent themes if they did not align completely with those on the initial list of themes. The following two sections of the article provide a summary of teaching responses and a discussion of the most prominent enabling factors for teaching resilience from the thematic analysis.

Teaching Responses

Rapid Pivots

Two of the rapid pivots involved capstone subjects where students were working on major projects in an open, collaborative studio space. The BCII Autumn capstone, *Industry Innovation Project,* involved students working in multi-disciplinary teams of 4-5 on thirty different challenges set by industry and community partners, including large corporations such as PwC, Aurecon, IKEA and IAG, as well as smaller not-for-profits and start-ups. Many of these partners moved to home-working arrangements as the pandemic unfolded and some were dealing with operational closures and stand-downs. The BTi Autumn capstone, *Innovation Capstone: Research and Development*, is the first of two capstone subjects where students work individually or in small groups on an original response to a self-identified complex challenge. Both the BCII and BTi capstones feature weekly check-ins with tutors or coaches and workshops delivered by academics or industry guests, as well as self-directed and collaborative work.

Key strategies for managing the transition to online learning included switching our Online Learning Management System (LMS) from Blackboard to Canvas, developing online learning modules to support or replace in-class workshops, and shifting weekly classes and check-ins online using Zoom. The BCII capstone also involved weekly peer feedback sessions between teams and weekly meetings with partners over Zoom (or in person where circumstances allowed). The smaller cohort size for the BTi capstone allowed for some different approaches, including weekly individual reflections and a co-creation session with students to plan how online tools would be used. While students reported some communication challenges and disappointment at missing out on the usual student experience of working in a collaborative studio space, overall student satisfaction as measured through the student feedback survey was higher than in 2019 (Table 2). Tutors also reported that project quality was as high if not higher than past years, particularly with regards to the depth of research undertaken.

Rapid pivots were also required for the 2nd-year BTi subject *Grand Global Challenges* and the 4th-year BCII subject *Envisioning Futures*. This latter subject posed particular challenges due to its intensive delivery mode (Eight teaching days spread over three weeks), short preparation time (with the first class held only eight days after the teaching pause was announced) and its highly experiential curriculum, including sensory workshops, material prototyping, the use of a props and live action role-play. With tutors, industry mentors, and invited guests, students are encouraged to articulate original, well-informed future visions in response to real-world industry-driven challenges. Key "rapid pivot" responses included the use of "a futures playground" of online futuring methods resources on Canvas and shifting the traditional public showcase event at the end of the subject to Zoom, where audiences from across UTS, industry and community networks were invited to interact with student-envisioned futures to explore futures worth wanting. Despite the compressed planning and preparation time, overall student satisfaction for *Envisioning Futures* increased in 2020 compared to 2019 (see Table 2).

Prepared Pivots

The BCII features intensive "winter schools" each July, including *Problems to Possibilities* (P2P) for first year students and *Past, Present, Future of Innovation* (PPFI) for second year students. While these subjects started three months after the move to online learning and the coordinators for each had prior experience with a "rapid pivot" subject, the size of these winter schools and their highly interactive nature posed challenges for online learning. P2P involved 470 students working alongside a partner from industry, government or a community organisation to analyse a complex problem from multiple perspectives and find novel, creative solutions. Traditionally, this takes place in a large collaborative theatre in transdisciplinary teams of 4-7 students, where they are introduced to a plethora of tools, techniques and methods from diverse disciplines in an experiential way in order to understand different perspectives for problem-finding, -framing and -solving before tackling their complex problem.

The shift to online delivery required a transition in LMS (from Blackboard to Canvas), as well as a complete redesign of the subject to allow for asynchronous modules, which students could complete with their team at their own pace, and synchronous

modules, which were completed via Zoom with the tutor. Student feedback was overwhelmingly positive, with an increase in overall student satisfaction scores (see Table 2). In addition, students indicated that they felt well supported to work in a team in comparison to their core degree.

Table 2

Student Feedback Survey Scores for the Subjects Evaluated

Subject	Overall feedback score 2020	Overall feedback score 2019	Change from 2019 to 2020
Industry Innovation Project	4.47	4.17	+0.30
Innovation Capstone: Research and Development	4.30	3.60	+0.70
Innovation Capstone: Realisation and Transformation	3.67	2.00	+1.67
Creative Intelligence Capstone	4.52	4.00	+0.52
Envisioning Futures	4.79	3.94	+0.85
Problems to Possibilities	4.20	4.10	+0.10
Grand Global Challenges	4.83	4.67	-0.16
Past, Present, Future of Innovation	4.41	3.88	+0.53
Average change in overall score from 2019 to 2020			**+0.56**

Partial Return

Due to a substantial fall in local COVID-19 cases, a partial return to the collaborative studio space was possible for the BCII and BTi Spring capstone subjects, *Creative Intelligence Capstone* (CIC) and *Innovation Capstone: Realisation and Transformation* (R&T). While R&T involves a continuation of the BTi capstone projects that commenced in Autumn, CIC involves BCII students working on a new passion project in self-organised transdisciplinary teams, for which they must engage with community and industry stakeholders to identify and develop a proof-of-concept for an innovative product, service, initiative, campaign or creative output. Both subjects are traditionally run in an immersive studio mode, with students allocated their own work spaces which they can access 24/7, with scheduled interactive workshops and weekly check-ins with tutors or coaches.

Recognising the practical hands-on nature of these subjects, they were identified by the university as priority subjects for returning to campus in Spring semester 2020. The opportunity for face-to-face teaching was highly anticipated by the students who missed out on in-person interaction for most of the year. Extensive COVIDSafe return-to-campus plans were drawn, engaging in multiple levels of risk assessment and approval, including staggered class times to limit class sizes and physical reorganisation of the studio space to accommodate socially distanced learning activities. Student preferences were sought prior to the start of session through a co-design session and survey, with the decision taken to deliver these subjects in blended learning mode. This featured a combination of asynchronous online modules and live sessions, for which students were able to participate on campus or remotely on their own devices. Tutor check-ins and coaching sessions were also delivered flexibly, in the studio space or remotely, depending on the availability of the tutors and students' preferences. The studio space was available at any time for students to work in their teams at their own pace to progress their projects.

Despite a perception amongst staff that students were craving face-to-face teaching by Spring, utilisation of the studio space was typically around 40% of the available capacity at any given time. This result was an endorsement of the decision to offer students a choice of learning modes. Student teams chose to meet on campus on some days, yet continued working online at other times, making their decisions on a week-by-week basis. Student achievement was equivalent if not greater in comparison to previous years, with the majority of the teams producing high-quality outcomes that were relevant to external stakeholders. CIC achieved its highest-ever student feedback score for overall student satisfaction (Table 2).

Student Satisfaction

Table 2 shows the UTS Student Feedback Survey (SFS) scores for 2020 and 2019 for the eight subjects included in this evaluation. Students were asked to rate their level of agreement with the statement "Overall, I am satisfied with the quality of this subject" on a scale of 1-5. The average score across the eight subjects was 4.4, which corresponds to an average response somewhere between "agree" (4) and "strongly agree" (5). SFS scores across the subjects in 2020 were also 0.6 points higher than 2019. This provides evidence that students were broadly satisfied with the pandemic responses undertaken by staff and that teaching approaches demonstrated resilience in the face of a major disturbance. However, these results do not necessarily support the conclusion that students in 2020 had a better learning experience than students in 2019, as student satisfaction scores are influenced by student expectations and the 2019 and 2020 cohorts are likely to have had very different expectations. Other factors unrelated to the pandemic may also have changed between 2019 and 2020, such as coordinators, subject content and teaching strategies. In their SFS comments for 2020, students commonly cited effective communication, connections to industry and the application of diverse teaching strategies in an online environment as factors that facilitated their learning.

Enabling factors for teaching system resilience identified in staff reflections

Monitoring and Feedbacks

Monitoring and feedbacks were the two factors from Carpenter et al.'s (2012) general resilience framework that appeared most frequently in our reflections. They are highly interrelated in the context of teaching due to their focus on effective communication, which for us included student goal-setting and revision across semester, weekly reflections, peer mentoring and feedback provided by tutors, coaches and industry partners. While the communications mechanisms utilised during the pandemic were often new, the importance placed on these factors pre-dated COVID-19. Improvements had already been made to some subjects prior to the pandemic in order to tighten feedback loops between partners, students and staff based on experiences in previous years, with these communication mechanisms proving invaluable when COVID-19 struck.

The BCII and BTi have always had a strong focus on engaging students in curriculum co-creation (Baumber et al., 2020). Adaptations were made to enable this to continue following the pivot to online learning, including through co-design sessions and post-mortems for the BTi capstone subjects and CIC. Knowledge-sharing between staff is also a critical element of our collaborative teaching culture, with the sharing of online resources between staff becoming particularly significant during the pandemic.

Self-Organisation and Leadership

Under Carpenter et al.'s (2012) framework, self-organisation relates to modularity, which emphasises the structural conditions that enable self-organisation to occur (e.g. decentralised decision-making within sub-units of the broader system). While these structural conditions were indeed important for enabling our pandemic responses, our reflections also suggest that it is important for staff to have a mindset that is oriented towards self-organisation and to be willing to take leadership of the activities that are within their sphere of influence. This self-organising mindset extends to students within the BCII and BTi, including in relation to team formation, project selection and self-directed learning sessions that enable students to identify their learning needs and the contributions they are able to make. Critical to the creation on online spaces for self-organisation and new patterns of collaboration to emerge was the past experience of teaching staff with the creation of "third spaces" that belong neither to teachers nor students exclusively (Kligyte et al., 2019).

Openness, Trust and Equity

Trust and openness are explicitly mentioned in Carpenter et al's framework, and equity has been cited by other resilience scholars, such as Cafer et al. (2019) and Suárez et al. (2020). Examples of openness amongst subject coordinators included inviting one other onto our subject sites within our online LMSs to learn from each other and share online modules and resources for adaptation in other subjects.

Effective sharing of resources between staff can only happen with trust and a sense that such relationships are equitable and reciprocal. Trust between staff and students is also critical, especially when students are provided with opportunities to self-organise. Our reflections identified co-creation opportunities, both during and prior to the pandemic, as playing a critical role in trust-building between staff and students. The trust of a student in their own abilities was also seen to influence trust at a system level, impacting the ability of all students to collaborate effectively.

Diversity, Reserves and Past Experiences

Diversity and reserves are interconnected factors, as both relate to redundancies in the system that may not be utilised in normal times but become critical when disturbances strike. Diversity relates to the breadth of options available and reserves relates to the depth of resources that can be drawn on in times of need. Despite the challenges that transdisciplinary teaching can pose in an online environment, one key advantage it offers is the diversity of different expertise held by teaching staff, as well as the connections to industry partners, local stakeholders and practitioners who themselves possess a diversity of knowledge and experience.

In our reflections we noted that access to reserves was not equally or equitably distributed, either for staff or for students. For example, students without suitable devices and workspaces were more likely to face challenges engaging with their subjects online and those dependent on paid work lost in the pandemic may have faced financial stress that impacted on their learning. Similarly, a key resource for staff was time, the availability of which was dependent on their employment status (i.e. full-time, part-time or casual), other responsibilities at work (e.g. research and service roles) and responsibilities outside of work (e.g. caring for children who were also learning from home). Reserves of time and coping capacity were further diminished for those who coordinated multiple subjects across 2020.

The fact that the BCII and BTi are relatively new courses meant that we all had recent experience with the collaborative development of new subjects and this was cited as an asset in our pivots to online teaching. Past experience was an emergent factor that did not align entirely with any single factor from the list of factors we used as our starting point. To some extent it may be considered a type of reserve, which Carpenter et al. (2012) refer to as "social memory". However, we also noted in our reflections that these past experiences cannot be classified simply as "reserves", but also relate to the "learning and innovation" category that Suárez et al. (2020) cite as an enabling factor for resilience in their framework. Given the highly collaborative nature of transdisciplinary teaching, a more appropriate term may be "social learning and innovation", drawing on previous discussions of social learning in relation to both resilience (Folke, 2006) and transdisciplinary practice (Polk & Knutsson, 2008).

Nestedness

While we definitely valued our autonomy and capacity to self-organise, we also noted in our reflections that support from higher system levels was critical to an effective response. These support mechanisms included the UTS Institute for Interactive Media & Learning (IML), learning designers assigned to assist with transitioning subjects and faculty processes around communication and guidance. Nestedness was also an important principle in enabling student success. Anticipating that students may face difficulties making connections due to a lack of in-person interaction, coordinators for subjects such as CIC placed a much greater emphasis on developing student capacity to engage with external stakeholders and to build networks outside of the UTS context. For 1st year students undertaking P2P, a particular emphasis was placed on mentoring by more experienced BCII students to help students feel that they were part of a broader BCII student community. This in turn was supported by the strong sense of community that has been deliberately fostered amongst BCII students and staff since the program began.

Implications for Teaching System Resilience in Higher Education

Our results broadly validate the resilience framework of Carpenter et al. (2012), with all nine of their factors proving relevant. Moreover, we also found that some factors cited by authors other than Carpenter et al. (2012) were also prominent in our reflections, including equity, social learning and a self-organising mindset (Armitage 2007, Cafer et al. 2019, Suárez et al. 2020). These three elements of social capital complement the more structural factors cited by Carpenter et al. (2012) and demonstrate how the resilience of teaching systems is determined by a combination of structural enablers and staff agency. Our past experiences with collaboration in teaching and a culture of learning together, which Boone et al. (2020) argue are critical characteristics of transdisciplinary organisations, enabled us to make the most of the structural advantages we had.

By analysing the enabling factors for resilience within our teaching system, we hope to remind other teachers and university administrators that effective responses to disturbances are not simply the result of individuals coming up with great ideas under pressure or having the mental fortitude to withstand moments of crisis. Rather, it is important to remember that there are powerful structural and socio-cultural factors operating within teaching systems that can enable or hinder effective responses to disturbances. Furthermore, the enabling factors for resilience identified through this study have the potential to be either enhanced or diminished by decisions taken before, during or after such disturbances.

Some of the enabling factors identified through our reflections are currently under threat from the financial challenges facing higher education in Australia (Tjia et al., 2020). The inability of international students to enter Australia (i.e. a lack of openness) has placed the university sector under severe financial pressure, which has been exacerbated by the Australian Government's decision to exclude universities from its JobKeeper[1] wage subsidy program (i.e. a lack of nestedness). These financial pressures have led to a focus on "efficiency" measures across Australian universities, which, depending on how they are selected and implemented, have the potential to reduce resilience. Walker and Salt (2012) discuss the tensions that can exist between enhancing efficiency and maintaining resilience, arguing that "taking a holistic, systems view before deciding on efficiency actions allows you to distinguish between those likely to be resilience-negative and those likely to be resilience-positive" (p. 99).

Efficiency measures have the potential to reduce the availability of reserves, especially staff time and social memory (e.g. through job cuts), as well as the diversity of ideas and approaches that can be drawn on when future disturbances arise. Centralisation of support services and administrative structures can reduce operating costs, but may also impact on the ability of work units to self-organise. Conversely, efficiency measures that remove barriers to collaboration and facilitate agile responses may reduce costs while enhancing resilience (Erol et al., 2010). The perceived fairness of any cost-cutting measures may also affect future levels of trust, collaboration, communication and social learning.

Aside from the external factors threatening the resilience of our teaching system, there is also the question of whether our own responses to the pandemic have made us more or less resilient to future disturbances. On the one hand, several of our reflections noted that past experience with rapid adaptation was one of the factors that enabled us to respond effectively to COVID-19. Conversely, our own reserves of energy, time and stress-tolerance have been eroded by this experience, and, in some cases, our social and emotional support systems have been interrupted. Furthermore, there is a risk that demonstrating resilience at a time of crisis can lead others to conclude that teaching staff may be able to operate in such a manner on an ongoing basis. Ironically, demonstrating resilience could end up increasing the pressures to which a teaching system is exposed, thereby reducing its resilience over time.

While this study was able to identify a range of important factors that can enhance the resilience of teaching systems, it was limited by our focus on teacher perspectives and on the first eight months of the pandemic. Students, professional staff and university administrators could be included in future research and may be able to identify different enabling factors for teaching system resilience. Similarly, any conclusions we have drawn should only be considered preliminary at best. It is possible that the next stages of the pandemic will bring other enabling factors into play or expose the limits of our resilience. Indeed, as the final revisions to this article were being made in July 2021, Sydney was plunged into a further lockdown of unknown duration and some of the same subjects affected by the 2020 lockdown were forced to go online again after being planned for face-to-face teaching. However, despite their limitations, the lessons learnt through our initial period of rapid adaptation have served to identify key factors that may enable effective responses to a diverse range of disturbances in the future. To the extent it may be possible to "teach resilience" by demonstrating ways in which it can be enabled, we hope that our experiences can be drawn on to enhance the resilience of other teaching systems in a post-COVID world.

Author Contributions

Alex Baumber has been listed first to reflect his role in coordinating the reflection process, summarising responses and relating these to the literature. All other authors have been listed in alphabetical order due to their equal contributions to evaluating their teaching responses, identifying key insights collaboratively and contributing to the overall planning and design of the research.

[1] In Australia, the JobKeeper Payment was a temporary payment which supported businesses significantly affected by the coronavirus (COVID-19) https://www.ato.gov.au/general/jobkeeper-payment/

References

Armitage, D. (2007). Building resilient livelihoods through adaptive co-management: The role of adaptive capacity. In D. Armitage, F. Berkes, & N. Doubleday (Eds.), *Adaptive Co-Management* (pp. 62-82). UBC Press.

Baumber, A., Kligyte, G., van der Bijl-Brouwer, M., & Pratt, S. (2020). Learning together: A transdisciplinary approach to student–staff partnerships in higher education. *Higher Education Research & Development*, *39*(3), 395-410. https://doi.org/10.1080/07294360.2019.1684454

Boone, C. G., Pickett, S. T. A., Bammer, G., Bawa, K., Dunne, J. A., Gordon, I., Hart, D., Hellmann, J., Miller, A., New, M., Ometto, J. P., Taylor, K., Wendorf, G., Agrawal, A., Bertsch, P., Campbell, C., Dodd, P., Janetos, A., & Mallee, H. (2020). Preparing interdisciplinary leadership for a sustainable future. *Sustainability Science, 15*(6), 1723-1733. https://doi.org/10.1007/s11625-020-00823-9

Brewer, M. L., van Kessel, G., Sanderson, B., Naumann, F., Lane, M., Reubenson, A., & Carter, A. (2019). Resilience in higher education students: A scoping review. *Higher Education Research & Development*, *38*(6), 1105-1120. https://doi.org/10.1080/07294360.2019.1626810

Butler-Henderson, K., Crawford, J., Rudolph, J. r., Lalani, K., & Sabu, K. M. (2020). COVID-19 in higher education literature database (CHELD V1): An open access systematic literature review database with coding rules. *Journal of Applied Learning & Teaching*, 3(2), 1-6. https://doi.org/10.37074/jalt.2020.3.2.11

Cafer, A., Green, J., & Goreham, G. (2019). A community resilience framework for community development practitioners building equity and adaptive capacity. *Community Development*, *50*(2), 201-216. https://doi.org/10.1080/15575330.2019.1575442

Carpenter, S. R., Arrow, K., Barrett, S., Biggs, R., Brock, W., Crépin, A.-S., Engstron, G., Folke, C., Hughes, T. P., Kautsky, N. Li, C-Z., McCarney, G., Meng, K., Maler, K-G., Polasky, S., Scheffer, M., Shogren, J., Sterner, T., Vincent, J.R., Walker, B., … Zeeuw, A. (2012). General resilience to cope with extreme events. *Sustainability*, *4*(12), 1-12. https://doi.org/10.3390/su4123248

Chadwick, M. (2019). A reflection on harnessing learned optimism, resilience and team growth behaviour in order to support student groups. *Student Success*, *10*(3), 104-111. https://doi.org/10.5204/ssj.v10i3.1410

Cote, M., & Nightingale, A. J. (2012). Resilience thinking meets social theory: Situating social change in socio-ecological systems (SES) research. *Progress in Human Geography*, 36(4), 475-489. https://doi.org/10.1177/0309132511425708

Crawford, J., Butler-Henderson, K., Rudolph, J. r., Malkawi, B., Glowatz, M., Burton, R., Magni, P. A., &Lam, S. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *Journal of Applied Learning & Teaching*, *3*(1), 9-28. https://doi.org/10.37074/jalt.2020.3.1.7

Doubleday, N. (2007). Culturing adaptive co-management: Finding "keys" to resilience in asymmetries of power. In D. Armitage, F. Berkes, & N. Doubleday (Eds.), *Adaptive Co-Management* (pp. 228-246). UBC Press.

Erol, O., Sauser, B. J., & Mansouri, M. (2010). A framework for investigation into extended enterprise resilience. *Enterprise Information Systems*, *4*(2), 111-136. https://doi.org/10.1080/17517570903474304

Evans, T. L. (2015). Transdisciplinary collaborations for sustainability education: Institutional and intragroup challenges and opportunities. *Policy Futures in Education*, *13*(1), 70-96. https://doi.org/10.1177/1478210314566731

Folke, C. (2006). Resilience: The emergence of a perspective for social–ecological systems analyses. *Global Environmental Change*, *16*(3), 253-267. https://doi.org/10.1016/j.gloenvcha.2006.04.002

Häberli, R., Bill, A., Grossenbacher-Mansuy, W., Thompson Klein, J., Scholz, R. W., & Welti, M. (2001). Synthesis. In J. Thompson Klein, W. Grossenbacher-Mansuy, R. Häberli, A. Bill, R. W. Scholz, & M. Welti (Eds.), *Transdisciplinarity: Joint problem solving among science, technology, and society*. Birkhauser Verlag.

Holling, C. S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics*, *4*, 1-23. https://doi.org/10.1146/annurev.es.04.110173.000245

Hudson, D. L. (2016). Popular culture and public health: A fresh approach to transdisciplinary public health education. *Pedagogy in Health Promotion*, *2*(4), 251-255. https://doi.org/10.1177/2373379916650691

Kligyte, G., Baumber, A., van der Bijl-Brouwer, M., Dowd, C., Hazell, N., Le Hunte, B., Newton, M., Roebuck, D., &. Pratt, S. (2019). "Stepping in and stepping out": Enabling creative third spaces through transdisciplinary partnerships. *International Journal for Students as Partners*, *3*(1), 5-21. https://doi.org/10.15173/ijsap.v3i1.3735

Meadows, D. H. (2008). *Thinking in systems: A primer*. Chelsea Green Publishing Company.

Murphy, M. P. A. (2020). COVID-19 and emergency eLearning: Consequences of the securitization of higher education for post-pandemic pedagogy. *Contemporary Security Policy*, *41*(3), 492-505. https://doi.org/10.1080/13523260.2020.1761749

Penaluna, A., & Penaluna, K. (2009). Creativity in Business/Business in Creativity: Transdisciplinary Curricula as an enabling strategy in enterprise education. *Industry and Higher Education*, *23*(3), 209-219. https://doi.org/10.5367/000000009788640314

Polk, M. (2015). Transdisciplinary co-production: Designing and testing a transdisciplinary research framework for societal problem solving. *Futures*, *65*, 110-122. https://doi.org/10.1016/j.futures.2014.11.001

Polk, M., & Knutsson, P. (2008). Participation, value rationality and mutual learning in transdisciplinary knowledge production for sustainable development. *Environmental Education Research*, *14*(6), 643-653. https://doi.org/10.1080/13504620802464841

Prime Minister of Australia. (2020, March 16). *Coronavirus measures endorsed by national cabinet*. https://www.pm.gov.au/media/coronavirus-measures-endorsed-national-cabinet

Robbins, A., Kaye, E., & Catling, J. C. (2018). Predictors of student resilience in higher education. *Psychology Teaching Review*, *24*(1), 44-52.

Scholz, R., & Steiner, G. (2015). The real type and ideal type of transdisciplinary processes: Part I—theoretical foundations, Editorial. *Sustainability Science*, 10, 527-544. https://doi.org/10.1007/s11625-015-0326-4

Stone, C. (2017). *Opportunity through online learning: Improving student access, participation and success in higher education*. The National Centre for Student Equity in Higher Education (NCSEHE) https://www.ncsehe.edu.au/publications/opportunity-online-learning-improving-student-access-participation-success-higher-education/

Suárez, M., Gómez-Baggethun, E., & Onaindia, M. (2020). Assessing socio-ecological resilience in cities. In M. A. Burayidi, A. Allen, J. Twigg, & C. Wamsler (Eds.), *The Routledge handbook of urban resilience* (pp. 197-216). Routledge.

Tjia, T., Marshman, I., Beard, J., & Baré, E. (2020). *Australian university workforce responses to COVID-19 pandemic: Reacting to a short-term crisis or planning for longer term challenges?* LH Martin Institute. https://melbourne-cshe.unimelb.edu.au/__data/assets/pdf_file/0006/3501987/HE-Response-to-COVID-19-2020-09-25-Final-rev.pdf

Walker, B. (2019). Finding resilience. CSIRO Publishing.

Walker, B., & Salt, D. (2012). *Resilience practice: Building capacity to absorb disturbance and maintain function*. Island Press.

Wang, M. C., Haertal, G. D., & Walberg, H. J. (1994). Educational resilience in inner-city America: Challenges and prospects. In M. C. Wang & E. W. Gordon (Eds.), *Educational resilience in inner cities* (pp. 45-72). Erlbaum.

XinhuaNet. (2020, January 28). China postpones school semester amid novel coronavirus outbreak. http://www.xinhuanet.com/english/2020-01/28/c_138738646.htm

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