Conceptions of the Nature of Technology during the COVID-19 Pandemic

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Abstract

With the COVID-19 pandemic, the nature of teaching and learning shifted emphasis from classroom-situated learning to learning in a digital environment. This was a significant challenge for teachers and learners across the globe. It might be assumed that technology education teachers would be well-positioned to manage this shift because of how the subject is described. Technology education is often characterized as a subject where contexts for learning are variable, and teachers and learners can have significant autonomy in guiding learning. This is frequently represented as a unique strength of the subject area. Furthermore, with an explicit focus on Digital Technologies, the Technology Education curriculum of Aotearoa New Zealand should better prepare teachers for enacting curriculum in various ways (for example, in a remote context).

This research investigated the effects of the COVID-19 pandemic and the subsequent shift to remote learning on practices in Technology Education. Through an analysis of technology educators' reflections on practice during the lockdowns, conceptions of practice in technology education and the nature of technology are analysed. Initial data analysis highlights a disparity of conceptions of the nature of technology, which leads to different manifestations of practice in a remote learning context. Technical and Technological perspectives on practice are used as lenses to describe the different conceptions of the nature of technology observed, and implications for learning post-lockdown are drawn.

Keywords: COVID-19 Pandemic, Digital Learning, Nature of Technology, Online Learning, and Technology Education.

Introduction

Aotearoa New Zealand's (ANZ) response to the COVID-19 pandemic was lauded internationally. With an emphasis to "Go hard, go early" (Cumming, 2021; Jamieson, 2020), the government acted to limit the spread of the virus from early 2020. Despite stringent restrictions on international travel and community efforts, on the 25th of March 2020, with just 48 hours' notice, the country went into lockdown ("Timeline: The year of Covid-19 in New Zealand", 2021). Although the duration of the various lockdowns differed between regions, with Auckland being hit particularly hard, it is important to note two elements. With just 48 hours' notice, the lead-in time for teacher preparation of online resources for remote teaching was significantly limited. In addition, it is important to remember that ANZ acted early. Although it may not be immediately apparent, countries with case levels similar to ANZ stayed open much longer. Again, the point here is that the preparation time for teachers in this first national lockdown was minimal. As has been shown, these measures slowed the spread and impact of COVID-19 on the population of ANZ (Cumming, 2021).

Internationally, the pandemic is noted to have perpetuated socioeconomic inequity, vulnerability, and food insecurity (Ndumbe-Eyoh et al., 2021), leading to significant challenges for education systems. The learning gap between high and low socioeconomic groups has been shown to have widened during lockdowns (Andrew et al., 2020), and in addition, anxiety and frustration about the future, nutritional deficiency, and loss of enthusiasm for learning have all emerged as implications of schooling during the pandemic. While the impacts of lockdowns on children's well-being are only now coming to light, this study sought to investigate the impacts on technology education in ANZ's secondary schools.

Technology in the New Zealand Curriculum

Technology education is a mandatory subject from Year 1 to Year 10 since its inception in the early 1990s. Described within the curriculum as "intervention by design" (Ministry of Education, 2017, p. 1), the subject aims to develop students' broad technological knowledge, practices, and dispositions. Importantly, the curriculum emphasizes technology as a platform for technology-related careers, but this is not presented as a singular goal. Instead, this is secondary to students' capacity to "participate in society as informed citizens" (2017), highlighting the impetus placed on technology education in the curriculum as being a subject for all learners. To assist in articulating how technology education has shifted beyond the vocationally oriented past, the reformed curriculum is organized across three strands; Technological Practice, Technological Knowledge, and, The Nature of Technology. The three strands are then transposed across five different technological areas that students may study:

- Computational thinking for digital technologies
- Designing and developing digital outcomes
- Designing and developing materials outcomes
- Designing and developing processed outcomes
- Design and visual communication

The future-focused principle of the ANZ curriculum serves to amplify the nature of teaching and learning within technology. Described as a subject with fluid content boundaries (McGarr & Lynch, 2017), technology education is presented as a subject where teacher autonomy is significantly enhanced due to the affordances of selecting topics of study (Williams et al., 2016). It is important to note that this is viewed as a unique strength of the subject area. When compared with more

conventional subjects, the technology educator is afforded the autonomy to select topics for investigation based on their own, or their student's interests (Spendlove, 2012). In addition to this, in ANZ the technology curriculum has seen a push for a more localised curriculum. The expectation is that teachers should use local knowledge, and engage with members of the local community to learn in technology education (Ministry of Education, 2017). For example, the revised technology curriculum explicitly states "Students learn that technology is the result of human activity by exploring stories and experiences from their heritage, from Aotearoa New Zealand's rich cultural environment, and from contemporary examples of technology" (Ministry of Education, 2017, p. 1). While this is viewed as a unique advantage for technology education, it does lead to the potential for tasks and activities to develop well beyond the remit of the technology curriculum. This is viewed as an advantage, however, the additional autonomy on the part of the technology educator here raises questions about the conception of the nature of technology held. If teachers hold very different conceptions of technology, what does this mean for the technology student? Given the previous findings of a disparity between an envisioned technological focus and the more traditional technical orientation of technology education in ANZ (Reinsfield & Williams, 2017), this study focuses on conceptions of technology in the COVID-19 pandemic.

Aim and research question

Developing on the notion that teacher autonomy is greater in technology education than in most other subjects, it could be argued that the technology educator is in a better position to adapt to a novel context for teaching, such as the local curriculum focus outlined previously. Adapting teaching and learning is a common process in technology education, with educators being encouraged to allow their own and their students' interests to guide the context for learning. This research set out to investigate how the Covid-19 pandemic and subsequent shift to remote learning influenced the nature of technology being taught during lockdowns in ANZ. Specifically, this paper addresses the following research question: How have secondary technology teachers' perceptions and practices been impacted by the COVID-19 pandemic?

Method

In the context of a larger project concerned with how technology teachers' practices were impacted by the COVID-19 pandemic, this paper specifically addresses the nature of technology presented by participants (n = 7). Developing upon the primary author's thesis work (Doyle, 2020, 2022), representations of technology education, including the role of subject matter knowledge, application cases, and goals for teaching technology were used as the starting point of analysis. As such, the research presented herein may be viewed not as an extension of the Grounded Theory, but as the development of the Theory. Ultimately this led to an articulation of the different conceptions of the purpose(s) for teaching technology held by the participants in the study.

Participants and Data Collection

As this research was conducted in 2022, the uncertainty with COVID-19 and local lockdowns resulted in the decision to undertake the interviews online. Throughout

Table 1. Participants' technological area and background/experience

Pseudonym	Technological area	Background/experience
Alice	An Australian who was Head of the materials department.	Taught in Brisbane for a few years and then was a Head of Department in Wellington, New Zealand.
Caroline	New Zealand trained digital technologies (DT) teacher.	Had previously set up a technology centre [innovative pedagogy] and was now an across-school coordinator of DT.
James	Employed for a year [fixed term] in 2020 as a hard materials teacher.	Grew up on the South Island of New Zealand, and from a farming background. A lot of his youth was spent designing objects and using his hands. (e.g., he made go-carts with anything that could be found in the shed).
Katrina	Senior technology teacher (food, multi-materials & digital).	Learning area lead of technology, 22 years of teaching with a background in nutrition, home economics, and food technology.
Keith	28 years as a hard materials (wood) and design and visual communications (DVC) teacher.	Previously a machinist. Had been a curriculum tutor for student teachers (n=30+).
Emma	17 years in technology education (food).	Primary school training. Cooking and nutrition was a personal passion.
Richard	Technology teacher (Food & DVC) With the curriculum revision, was told they were the digital technology teacher.	Bachelor of Commerce, then a Chef. Did a Diploma to become a teacher in Auckland. Always has an interest in the digital aspect of technology education.

the interviews, we were cognizant of participants' apparent emotions, tone, and non-verbal communication (Anderson, 2010). The order of each interview was guided by pre-determined and previously shared questions but there was some flexibility here, as in addition to scripted questions, probing questions were used to further encourage participants to articulate their perceptions and practices in teaching technology.

As part of the informed consent process required for ethical consent (University of Waikato: FEDU014/22) we asked that participants share any resources they had developed to support students' learning during 2020-2021, which were used as a means to support their assertions. The seven participants' technological expertise, background, and experience are outlined in Table 1.

Data Analysis

The data collected was analysed in accordance with Charmaz' (2014), three stages of coding: initial, focused, and theoretical. As this research was developing upon an existing grounded theory, the emphasis was predominately on focused and theoretical coding. In short, the initial codes from the earlier study were used as a starting point for our analysis, but importantly, these codes were not viewed as canon, and this analysis was viewed as an opportunity to refine and elaborate upon the initial codes from the previous study. During the focused coding, we used the most common initial codes to sift through the interview transcripts. For this, the themes from the previous study were reviewed and analysed. The final phase of analysis, which began in tandem with the focused coding was theoretical coding. Within this phase, the initial and focused codes were amalgamated to form lenses through which to understand the data. Throughout this process, we continuously revisited the data using refining and clarifying the codes and groups of codes developed. As always within the constructivist grounded theory, these phases were not undertaken in a strictly linear way. Codes were identified and refined across the three 'stages' of analysis, ensuring that the research remained sensitive to the data. In guiding this process, the principle of theoretical agnosticism (Charmaz & Thornberg, 2021) was adopted throughout the research.

Findings

Although the participants in this study reflected on their practices before the COVID-19 lockdowns, in this paper we focus on the nature of technology represented during the lockdowns and associated remote teaching and learning. It is important to situate the findings of this study within the broader context of the grounded theory presented previously (Doyle, 2020). To do this, findings will be presented through the analytical lenses of the role of application cases in Technology Education and Subject Matter Knowledge in Technology Education. Following this, implications for the three different conceptions of the purpose of teaching technology will be discussed.

Role of application case in technology education

As noted earlier, technology education in ANZ is organised across five different technological areas. The role that different areas appeared to have a significant impact on the practices that teachers could adopt. If the technological area was traditionally hands-on, for example designing and developing materials outcomes, then the shift to remote teaching had an impact in terms of the nature of the activity that could be facilitated in a home environment. For some participants in this study, the shift to remote learning represented a required focus on theory:

> … seniors didn't complete any practical work during the lockdown. But I did have available resources for them to complete during the lockdown… Each senior class might have four or five different Unit Standard assessment booklets, and workbooks that they need to complete [for] the latest of their practical work… so they had access to this during the lockdown, and I was able to check with them, and monitor them. So, they had the resources and they knew the task they needed to have done.
>
> [James]

The perspectives held by teachers on the role of theory at this time were sometimes noted to be held in a positive light. For example, in discussing the nature of activity undertaken in lockdowns, Amber highlighted the potential of focusing explicitly on theory, which may not have been possible in a practical (i.e. workshop) environment:

> From my perspective… They didn't suffer at all. It was just a matter of rejigging you know, when we did… 'Cause the paperwork is such a pain in the neck. And the kids hate it. But we do it you know, we do it because we have to. But the paperwork became the godsend in lockdown. And they were able to share it with me individually and talk to me about it. You know, I was able to guide them a lot more with it. And you know, give them some samples just… Just share samples and stuff with them. I did come up with some projects that they could do with a practical nature while we were on lockdown.

The lack of access to specialist equipment for teaching technology appeared to be the primary limiting factor here. If we consider elements of the designing and developing processed outcomes area of the curriculum, where cooking equipment and raw ingredients are fundamental to undertaking practice in the subject, one could speculate that this could be enacted in a home environment. The reality for teachers was that this is very difficult to manage. In this interaction, Emma highlighted the challenges associated with this assumption:

> **Emma:** So, it was whatever they could sort of manage to make at home, 'cause you expect they have the basic stuff 'cause you don't want them to be going off to the supermarket to buy food because…
> **Interviewer:** Lockdown.
> **Emma:** Yeah. … 'I've just got to go and clear Mum and Dad out you know ten times a day, to get all these fancy ingredients. So, it was basically just carrying on with that the best way they could and just uploading photographs of what they've done. And accepting that for what it was, you know?

Interestingly here, there was a disparity between some of the participants in the study. For example, James identified the potential for teachers and students to use a wide array of materials in his "Materials Technology" lessons:

> … in Technology, they [Lessons] went surprisingly very well for me. I'm saying they went very well because I was able to use my experiences from going to the shed, looking round for bits-and-pieces that I can build stuff with, to facilitate my students to do the same stuff of discovery learning from around their home and, and find available resources that they could use to construct technology … An example for this in Year Nine and Year 10 was… One of the projects I got them to do was to get them to do… So, they each had to construct … It was an insect ... So, they had to find materials…
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> … the student would need to, for example, find the resources such as wood from around their garden, paper from around their home, cardboard that they could source from anywhere and they had to… If it involved paint they would have to see if they could find paint around home. So, they had to go on an exploratory type mission themselves, around the house, look for the tools and resources to construct their … And that phase of the project was quite good because it got the students to think about what they did have around their home. And it got them involved, as well as communicating with their parents, 'Am I allowed to chop off part of the cherry,' 'Am I allowed to use the knife to cut stuff,' 'Am I allowed to use this to do this.'

Representing a more relaxed perspective on material use, but still holding technological practices may seem reductive. Some participants in this study held this view during the short period that they met with learners influenced their ability to engage at all. For example, Rory acknowledged "I don't think we did it particularly well [during lockdown]… And I don't think we did it particularly well because we only had them for such a short time period". In any case, although such approaches may appear rudimentary in nature, or even tokenistic gestures toward technology education, in the instances where this was carried out, it was reported as having a positive influence by interviewees. Such an example is shown here with Kevin discussing the transferability of understanding between ridges in cardboard and grain direction in wood.

> … whether they were Year Nine, Ten, Eleven, Twelve, Thirteen it was still really relevant. Good skills for preparing themselves for being in the workshop because… You know, like individual pieces are individual pieces. And so, gave them an idea and they were able to share that with me, and I could feedback to them which way the grain direction should go etc. And so those people who did take the time to follow the instructions and make the cardboard models when they did come back to school were well ahead of those people who hadn't.

At this stage, it should also be noted that there were examples of practice on the opposite end of the spectrum, whereby participants and fellow technology teachers undertook the task of packaging equipment and materials and taking them to the students directly.

> **Katherine:** In terms of some of our Materials Technology – our teachers dropped equipment or materials off to the students…
> **Interviewer:** Oh okay.
> **Katherine:** Or because we knew the lockdown was kind of coming, they were able to take stuff home. With the first lockdown, because we knew it was coming, you know we had that tiny bit of warning.
> **Interviewer:** A day or two!
> **Katherine:** We made up – because we had planned an assessment, a practical assessment for our like, say, our Hospitality students. We made up ingredient bags.

At this stage it is important to reiterate a point from the introduction, the shift to remote learning, particularly in the first national lockdown was not foreseen by teachers, and the short notice given meant that time for preparation for remote teaching was significantly impeded. This is exemplified by Amber in discussing the shift to remote learning:

> We had limited resources. The students have left all their stuff at school. It was just… And I think, in hindsight, it was a bit of a panic. People were quite worried about getting sick and so the, the incredible urge to get home safely was above all else. We just, we just didn't think of you know, 'Okay, we need to take this home, we need to set this up.' You know, 'You need to have this with you, blah, blah, blah.' All that just didn't come into it, it was basically, 'Get home.' And that threw everyone off, and it meant that everyone was unprepared

Subject matter knowledge in technology education

Similar to how the nature of application case, or context for technology, was used to analyse practice, the same was done with subject matter knowledge (SMK). Importantly here, SMK is not presented as a classification or outcome of practice, but as a lens through which to analyse representations of practice. As noted in the previous section, a primary theme which emerged from our analysis was an acknowledgement, and emphasis on a shift to 'theory' elements of technology during remote teaching. What was particularly interesting when viewing this shift through the lens of SMK, was how theoretical elements of technology were represented. We observed three different views on how to treat technology SMK in a remote teaching setting.

Firstly, for some teachers it was clear that technology education as a school subject cannot be taught in a remote setting:

> So yeah, in terms of Technology just… You can't teach Food Technology when you're not with the kids because it is hands-on, you are trying to show them and explain things to them while they're doing it with you. Yeah. So, lockdown really had a huge impact on how the courses ran and what you did. And I guess because it was such a… A shock really to how we lived. Like one day you're at school, and then the next minute we were scrambling trying to find all the Chromebooks we had in the school and packaging up hard copies for kids who didn't have access to a device. And it was, it was so sudden – the way it was handled and obviously with the announcement. And then what we had to do it was just kind of like, 'Well your wellbeing is more important than anything else right now.'

This perspective was only discussed in a couple of interviews, and as can be viewed in the extract from

Emma's interview, the stresses of the short lead-in time and student well-being emerged as having affected remote teaching. In such cases, engagement with teachers became the primary focus of teaching and learning:

> You know? And so, I didn't… For me personally, I didn't focus on curriculum content, ticking those boxes, 'You must do this, this and this.' It was, 'Okay, we are working on this and you can do whatever you can to try and maintain some form of engagement with the learning that you're doing.

The second perspective on SMK that we identified was that the limitations surrounding 'doing' technology in the conventional classroom are significant, but that there were core skills that can be taught in a remote setting. The primary example identified was the capacity to sketch. Richard identified materials, and their ready availability as a key motivator for this approach, stating "I don't care what you draw on. You can get a piece of charcoal and a cardboard box. You can still do exactly the same drawing, you know?". This perspective was held by many participants in the interviews. Kevin took this one step further, and aligned core skills across different year levels to optimise his teaching workload.

> Yes, I think what I did was I altered the timelines on my different courses that I was teaching so that they all did align. I'll explain: so that they all ended up by cardboard scale modelling being the flavour of the week. And so that cut down the workload on me, but it also made it very relevant to what the students were doing. So, if I was teaching students to sketch in 3D for the Freehand Achievement Standard in Graphics for Year Nine and Ten, for their Design Folders – even for, the design work in the senior Achievement Standard Technology classes in the workshop. I made it that that couple of weeks during the lockdown were all about sketching.

The third and final perspective on SMK that we identified held that the "theory" of technology education was a legitimate focus of teaching remotely. Importantly here, although this approach was identified across junior and senior secondary, the emphasis appeared greatest in senior secondary. Here, the stresses of the impending National Certificate of Educational Achievement (NCEA) assessment loomed large. The emphasis on more theoretical SMK here did not appear to be a significant shift from what was taught at these levels pre-COVID-19.

> **Amber:** … The day we went back, the week before I'd been prepping the kids, 'We're going back, and we're going to get straight back into our Sewing. They'd all been missing the sewing machines incredibly.
> **Interviewer:** Yeah.
> **Amber:** There was no option of them staying sewing at home because NCEA make it quite clear… It's just too difficult to monitor that. So, we just made a plan to give up [sic], the students and I, that we would just pick up the pace when we got back. That's all they wanted to do, was go back to that project and finish it. We'd done all the prep for it, and we'd done the prep for the following project. So we brought ourselves some time. So we went straight back into catch-up mode. And then we were able to finish that project and move straight onto the next. The Food teacher was able to reschedule her assessments and stagger them.

As Katherine highlights, this approach was not so different to what would have happened any other year.

> … or worked from home and a lot of our senior students worked at home, and the work completion was huge for our portfolios just because they wanted to make sure that while they could focus… And you know… 'Cause they don't know what's going to happen later in the year.

Discussion and conclusion

> With the technology obviously, you kind of need to be in the classroom so that kind of just… We just didn't do it, it was all just basically theory. … my juniors, you know, 'If you can just cook things at home, just do that. Because at least your practising the skills and you're still making stuff. And you're giving Mum and Dad a help at home cooking dinner, or lunch, or whatever.' You know?

While no comment from an interview can accurately represent the challenges faced over weeks of lockdowns during the COVID-19 pandemic, the above quote from Emma outlines some of the challenges that technology educators faced. As highlighted in the introduction, the COVID-19 pandemic, associated lockdowns, and forced migration to online learning have had a significant negative impact on teaching and learning. While the full extent of the impact is yet unknown, this research sheds light on one element, the nature of technology studied.

Firstly, from the perspective of SMK within technology, the were multifaceted perspectives on how technology can be taught in a remote setting. As outlined, this ranged from disengagement with teaching technology to preparing resources and sharing these with learners. While both of these examples may seem at odds with each other, they are underpinned by the idea that the practical component of technological activity is fundamental to technology education. This aligns with the technology curriculum in ANZ where technological practice is one of three strands underpinning the curriculum. In applying the analytical lens of application case in technology education, the same theme was identified. The notable exception to these findings was the preponderance of theoretical approaches in senior schools. However as discussed, such approaches were not significantly different from patterns before COVID-19 and appear to be influenced by NCEA assessments.

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