

**Teachers' self-efficacy, self-beliefs and self-perceptions of
students' use of educational technology and applications before
and after the Covid-19 lockdown in New Zealand.**

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Abstract

Teacher self-efficacy can be increased through a range of teaching strategies. These teaching strategies include using open ended questions with students and collaborating with other educators. These strategies have the ability to increase student achievement and engagement, as teachers with high self-efficacy engage more with their students and aim to increase their interest in their schooling. This is also the case for teachers' and students' use of educational technology and applications. If teachers have high self-efficacy with the use of technology in the classroom, which indicates that they know how to use technology successfully, then this can help engage their students with technology also. In turn, teacher self-efficacy can be increased by students who feel confident with the use of technology. Two other constructs which affect whether educators' use of educational technology is successful are self-beliefs and self-perceptions. Furthermore, teachers need positive beliefs and perceptions of technology use for educational purposes in order for the use of them to be successful. It is important to acknowledge these constructs as important determinants of technology usage in the classroom. Barriers to obtaining and maintaining positive beliefs and perceptions involve a lack of technology training in professional development programmes, lack of importance put on technology usage from schools, and teachers' individual experiences with technology in their personal lives.

The goal of this research is to examine whether students' intense use of educational applications and technology during the Covid-19 lockdown affected teachers' self-efficacy, self-beliefs and self-perceptions. Results identified that although there was slight differences in the pre and post means, students' use did not significantly affect their teacher's self-efficacy, self-beliefs or self-perceptions. Furthermore, they did not significantly increase or decrease. This identifies that the use of technology before the lockdown did not affect these constructs in comparison to how teachers felt about technology after the lockdown.

Chapter 1

Introduction

Educational applications and educational technology use has become a common practice in New Zealand's education system, as the use of technology has become a prominent part of our society. The use of technology for teaching and learning purposes expands across all stages of New Zealand's education system, which includes early childhood, primary, secondary, and tertiary. Teachers commonly use technology for collaborating with other educators and recording students' academic data. Technology use is predominantly used in early childhood centres for teachers to record students' progress and to communicate with whānau (Bolstad, 2016). Some of the most common technology uses for primary school students and above include practicing subject specific skills, researching through internet use, and creating written documents or slideshow presentations (Bolstad, 2016). When New Zealand went into nationwide lockdown due to Covid-19, educators had to either rely on educational applications and technology for teaching and learning purposes, or use educational packs that were supplied from the Ministry of Education. Leading up to the possibility of a lockdown in early March 2020, all educators who were teaching students at the time, practiced the use of educational technology with their students, so them and their students felt as comfortable as possible with the use of technology (Bolstad, 2016). Some tools used before and during the lockdown included the use of internet and computers. Primarily during lockdown, Zoom and Google Classroom were used. Educational television was also launched, which broadcasted lessons on television between the hours of 9am to 3pm every school day (Ministry of Education, 2020). Lastly, educational games and applications, such as Prodigy and school led learning iPad games, were used to help children learn (Ministry of Education, 2020). As this was a huge adjustment for educators and their students, many challenges arose. Some of these challenges included the lack of confidence in

using technology, social isolation of students, lack of access to technology and reliable internet, and the struggle of adapting teaching methods to a new digital environment (Flack et al., 2020). The Covid-19 lockdown ultimately accelerated digital technology usage for teaching and learning purposes.

Three constructs were measured in this research, them being self-efficacy, self-beliefs and self-perceptions. Self-efficacy refers to an individual's belief in how well they can carry out a task (Bandura, 1997). Self-beliefs are personal beliefs that one develops from sources such as past experiences, events, knowledge and the environment (Sathyanarayana et al., 2009). These belief sources are then filtered through an individual's personality which then creates a belief system. Self-perceptions are perceptions that an individual creates through the selection of stimuli, organisation of the stimuli, and then interpretation of the stimuli (Rookes & Wilson, 2000). This ultimately helps us form our own self-perceptions that help us understand the world around us.

Self-beliefs and self-perceptions play a huge part in developing teacher self-efficacy, especially with technology usage. Teachers tend to select activities for their students to do based on whether they align with their already existing beliefs of what they think is good education (Zhao & Frank, 2003). It is important that teachers develop positive self-beliefs and self-perceptions regarding their teaching practices as this can increase their self-efficacy (Domingo & Gargante, 2016). This includes the use of educational applications and educational technology as a teaching practice. For example, if a teacher believes that an educational device distracts a child from learning, instead of promoting a child's learning, then it is likely that the teacher will abandon the educational device, as they do not have the level of self-efficacy and enough confidence required to continue to use it (Er & Kim, 2017). It is important that educators develop positive beliefs and perceptions regarding their use and students' use of educational technology and applications, as it has the ability to customise

learning and enhance students' motivation and engagement in the classroom (Anderson & Putman, 2020). Teachers who have a positive perception of educational technology tend to think of technology as a way of providing enrichment to their students through making classroom tasks more enjoyable and rewarding. Anderson and Putman (2020) stated that the use of educational applications increases children's life skills, which they found through interviewing multiple teachers on their perspectives of integrating technology into their classrooms. They argued that it could increase their problem-solving skills, social skills, and their level of patience and perseverance through interacting with other pupils in the classroom.

Teachers' self-efficacy, self-beliefs and self-perceptions of students' use of educational applications and technology is an important area of research to examine, as the use of educational technology within our education system is rapidly increasing, and there appears to be multiple benefits for teachers and their students. Teacher self-efficacy appears to have many benefits in terms of teaching performance, work ethic and level of stress reduction (Lohman, 2006). Teachers with high self-efficacy present with better classroom management skills and are more likely to implement innovative teaching methods. In turn, teachers' self-efficacy has been seen to positively impact student achievement and motivation (Caprara et al., 2006). This highlights the importance of investigating how technology use impacted teachers during the Covid-19 lockdown, as this is shown to affect students' achievement also.

The current research examined teachers' self-efficacy, self-beliefs and self-perceptions of students' use of educational applications and digital technology for teaching and learning purposes, before and after the Covid-19 lockdown. Additionally, the aim of this study was to see whether teachers gained higher or lower self-efficacy, and more positive or negative beliefs and perceptions from students' intense use of educational technology

throughout the Covid-19 lockdown. In order to carry out this research, a survey was created which analysed three main aspects; self-efficacy, self-beliefs and self-perceptions of teachers, all of which included questions asked before and after the Covid-19 lockdown, which were all investigated at a single time point. This survey was completely anonymous and was posted on social media for any teachers to complete who taught years 0-8 before, during and after the Covid-19 lockdown.

As there are multiple terms used within this research, it is important to distinguish between them, firstly, technology is an area which deals with computers and gadgets, whilst digital technology relates to anything that can be viewed or accessed through gadgets, such as an app. Educational applications refer to apps that are used for teaching and learning purposes, and include Reading Eggs, Mathletics, and Reading Rockets. These apps can be used through devices such as iPads and tablets. Educational technology includes any type of technology that is used within a classroom for teaching and learning purposes (Bolstad, 2016).

This thesis is structured as follows; Chapter 2 is a review of relevant literature, which encompasses the discussion of main themes for this research, which includes teachers' self-efficacy and its benefits, teachers' perceptions of educational technology and how this impacts teachers' incorporation of technology into their classrooms, teachers' self-beliefs and why the development of a positive belief system for teachers is important, and lastly, the benefits that can arise from students' use of educational technology and applications. Chapter 3 includes the methodology of the research and how the research was conducted. Chapter 4 includes the results, including the analyses of data, and the findings. Chapter 5 includes an examination of the results, strengths and weaknesses of the current study, possible implications, and recommendations for future research.

Chapter 2

Literature review

This chapter begins by describing what self-perceptions are and how they develop. More specifically, self-efficacy is defined and the sources that contribute to the development of self-efficacy. Teacher self-efficacy is then discussed in terms of the benefits that this has on teachers and students. Furthermore, the differences between teachers with high self-efficacy versus teachers with low self-efficacy is discussed. Factors that enhance teachers self-efficacy is delved into, such as the attendance of professional development programmes and support from schools. The next paragraph is concerned with teacher self-efficacy and the use of educational technology. In particular, benefits of teachers' use of digital technology is described, such as their increase in confidence. Professional development is also mentioned in relation to how such programmes can increase teacher self-efficacy with the use of technology. Predictors of technology usage are then introduced, such as teachers' perceptions of technology and how this can determine whether teachers use technology or not in their classroom. As negative perceptions are perceived to prevent teachers from using technology, the creation of positive beliefs is analysed, and the factors that create a positive belief system. Lastly, New Zealand's education system is described and how the Covid-19 lockdown affected the system. It is discussed how the use of technology during this time may have affected teachers' self-efficacy.

Self-related perceptions are associated with how an individual construes themselves, such as their beliefs around what attributes they hold, what role they play in society, what they believe they are capable of, and what they believe others think about them. Understanding how a self-perception develops is important, as this determines the choices individuals make and the actions they take in life (Bong & Skaalvik, 2003). Perception development is typically an unconscious one which has multiple stages (Rookes & Willson,

2000). The first stage is selection, which refers to the selection of a stimuli which someone chooses to focus on. This may be a feeling, sound or smell. The second step is organisation, where an individual constructs a mental representation of the stimuli. Lastly, interpretation takes place. This is where an individual uses existing information they have already gained from past stimuli in order to give the current stimuli a categorisation. This process is an intricate one that ultimately helps us form our own perceptions and understanding of the world around us (Rookes & Wilson, 2000).

Self-efficacy is a self-perception that explains and predicts individuals' thoughts, emotions and actions. Self-efficacy consists of efficacy judgements that are highly associated with the cognitive and behavioural skills needed to carry out a task (Bong & Skaalvik 2003). Efficacy judgements refer to the multiple sources that an individual uses to judge their own level of efficacy (Bong & Skaalvik, 2003). One of the main sources that shape self-efficacy is enactive mastery experiences, which refers to similar previous experiences that the individual has succeeded at (Bong & Skaalvik, 2003). Secondly, Bong and Skaalvik explain how a vicarious experience is considered to be a source. A vicarious experience is when an individual establishes their level of self-efficacy based on how well someone else performs on a task. This influence is even stronger when an individual perceives similarities between themselves and the person that has carried out the task. Thirdly, verbal persuasion can increase self-efficacy, which involves receiving evaluative feedback from significant others. This is more influential when the person delivering the information is seen as credible, and the information seems realistic. A key component of self-efficacy is the high cognitive level of evaluation that is needed. For example, when assessing whether you are good at an activity, you have to analyse the behavioural actions and cognitive skills that are needed to succeed at the task. Self-efficacy is also oriented to a specific goal, unlike other self-perceptions. Self-efficacy has the ability to increase confidence, engagement and interest,

whilst also improving academic functioning, especially areas such as academic engagement, goal setting, persistence and effort, intrinsic motivation and strategy use (Bong & Skaalvik, 2003).

Teacher self-efficacy

Teacher self-efficacy relates to teachers' personal beliefs regarding their skills and abilities as an educator, and their confidence in their ability to promote their students' learning (Hoy, 2000). Teacher self-efficacy is extremely important to establish as there are many benefits for the educator and their students. Henson (2001), for example, mentioned that high self-efficacy among teachers can increase their students' academic achievement. The reason for this relationship may be due to different teaching strategies. Teachers with high self-efficacy tend to ask their students more open-ended questions, use inquiry methods, and prefer small group learning activities, in comparison to teachers with lower self-efficacy (Henson, 2001). Furthermore, teachers with high self-efficacy are more willing to try creative teaching methods, be more open to new teaching methods, have a greater commitment to teaching, and have better classroom management skills (Henson, 2001; Lohman, 2006). These factors all help increase teachers' self-efficacy, whilst also increasing student academic achievement through increasing student engagement (Henson, 2001).

Mojavezi and Tamiz (2012) conducted a study which found that teacher self-efficacy had a positive influence on students' motivation, as well as academic achievement. Mojavezi and colleagues distributed a teacher self-efficacy questionnaire to 80 high school teachers, and a motivation questionnaire to 150 of their students. A significant positive correlation was found between teacher self-efficacy and students' motivation. One of the research questions was associated with investigating whether a teacher's level of self-efficacy affected their students' academic achievement. They found that the relationship between teachers' level of self-efficacy and students' academic achievement had a significant positive correlation.

Mojavezi and Tamiz (2012) identified that this correlation occurs when teachers with a high level of self-efficacy attempted to change their students' opinion on a certain subject. The attempt to change their opinion led to an increase in the students' interest in that subject, which then increased the students' achievement in that area. This was also found in Gibson and Dembo's (1984) study. They found that teachers who held high self-efficacy had the power to motivate and engage their students. Alternatively, teachers with lower self-efficacy had little belief that they could motivate their students. This is in line with Bandura's (1994) observation, which found that teachers who had high self-efficacy regarding their capabilities as an educator, had a higher chance of being able to motivate their students and increase their cognitive development. Evidently, self-efficacy has many benefits, such as an increase in using new teaching methods, an increase in commitment to teaching, and the use of more open ended questions towards students (Henson, 2001). This not only helps teachers' level of motivation and engagement, but also their students' academic achievement and motivation.

Enhancing teacher self-efficacy

In order for self-efficacy to develop, all teachers need to be given information regarding how students learn and develop, with the presence of physical interaction between them and their students, as this allows teachers to observe how each student learns. Thomas and Mucherah (2016) examined the change in self-efficacy of 32 preservice teachers through the use of an immersive learning programme for one semester, which taught them about the complex interplay of multiple factors that influence a child's learning. This study also included a control group of 64 participants. The programme involved a placement where teachers had to plan and teach lessons, and attend regular meetings at a community centre where they learnt from members of the community regarding how students learn. The aim of this programme was to provide teachers with a unified experience that educates them about

students' learning abilities. The results identified that this program gave teachers a good insight into a variety of cultures and socioeconomic status'. This is important as this educates teachers on how to work responsively with a variety of cultures. Taking part in family and community events allowed teachers to gain a better understanding of the students and their families. As teachers were given the opportunity to learn more about their students outside of the classroom, it gave them the chance to see what activities they enjoyed and how they acted when in their comfort zones. Giving teachers this opportunity highlighted the importance of teaching from a holistic view. In comparison to the control group, the immersive programme group had significantly higher scores in instruction, management and engagement on the Teachers' Sense of Efficacy Scale. A possible explanation for this result is that the teachers in the programme were challenged to see and understand concepts regarding students' development, which improved their level of self-efficacy in terms of instruction, management and engagement. This holistic approach enhanced teacher efficacy throughout the programme. The high level of interaction between teacher and student described in Thomas and Mucherah's (2016) study relates to Hoy and Woolfolk's (1993) findings, who found that physical interaction between teacher and student was extremely important for developing self-efficacy, especially in the area of multicultural educational settings. Wolters and Daughtery (2007) also perceived experience to be extremely important for developing self-efficacy in teachers. Hoy and Woolfolk (1993) conducted a study which aimed to analyse the relationship between general and personal efficacy, and various aspects of a healthy school climate, which included academic emphasis, resource support and principal influence. The Teacher Efficacy Scale and the Organisational Health Inventory were administered to 179 randomly selected teachers. It was found that a school that put a strong emphasis on academia and a principal who was willing to fight for change was likely to increase personal efficacy and student achievement. Furthermore, institutional integrity, which is when the school is

willing to protect their faculty from unreasonable outside demands, and teacher morale, were the only factors to increase general efficacy. Both of these studies highlight the many factors that contribute to the development of teacher self-efficacy. It is important to acknowledge that experience alone does not result in efficacy, as efficacy has the potential to decrease with experience, as factors such as confidence in engaging students, managing student behaviour and using effective instructional strategies has been seen to decrease with years of experience (Klassen & Chiu, 2010). Furthermore, as experience increases, so does the possibility of disengagement (Huberman, 1989), due to a decrease in confidence. Leonard et al. (2010) argues that supporting teachers is also needed. This support can include the availability of resources and the creation of a support network between teachers and principals. Teachers need to be given time to adapt to various environments and to learn from any challenges that may arise, which is otherwise known as resilient self-efficacy (Leonard et al., 2010). This information identifies that learning programmes which focus on teacher and student interaction are important for developing efficacy, as long as support is available. This is necessary for creating efficacious teachers who are prepared to learn about how students learn and develop.

A way in which teacher self-efficacy can be enhanced is through professional development courses. Darling-Hammond and Ball (2004) found that intensive, sustained, job-embedded professional development courses have the ability to improve teacher knowledge, classroom instruction and student achievement. This increases the likelihood of teachers' content knowledge and understanding of how students learn. Ultimately, professional development programmes promote teachers' level of self-efficacy through increasing their professional growth and knowledge of how students learn and develop (Cohen & Hill, 2000). A study that examines the relationship between teacher self-efficacy and professional development was conducted by Althaus (2015). Althaus analysed the impact of a

mathematics professional development programme on teachers' general and personal efficacy. General efficacy is defined as teachers' beliefs regarding the general factors that are associated with how students learn mathematics, whilst personal efficacy is defined as teachers' perception of how effectively they can teach mathematics. The 10 elementary school teachers who participated in this study attended a professional development programme four times a year over a two-year period. The aim of the programme was to improve conceptual understanding of mathematics content, increase the use of effective instructional strategies, increase the use of formative assessment strategies, and to align the district curriculum with state and national standards. Teacher self-efficacy was measured through the Math Teaching Efficacy Beliefs instrument and student achievement was investigated through state-wide yearly mathematics assessments. Althausser (2015) found that general efficacy was more likely to predict student achievement over personal efficacy. Furthermore, general efficacy was found to have a direct impact on students' mathematics achievement. It was also determined that even though personal efficacy was not found to have a direct impact on students' achievement, an indirect impact could be concluded as personal efficacy was found to be correlated with general efficacy. In terms of the results regarding the Math Teaching Efficacy Beliefs instrument, the higher the score on this instrument the more likely it was to significantly predict student achievement. Also, the scores on the Math Teaching Efficacy Beliefs scale was found to be the second most powerful predictor of student achievement, behind socioeconomic status. Althausser (2015) concluded that this professional development programme increased general and personal efficacy over the two-year period, which supports the use of professional development programmes. This is also important as this goes on to increase students' academic achievement.

Teachers' self-efficacy and educational technology

It has been described above how self-efficacy has the ability to increase confidence, engagement, and interest (Anderson & Putman, 2020; Bong & Skaalvik, 2003). Therefore, it is necessary for teachers to establish self-efficacy with the use of digital technology so that they can confidently use devices in their classroom to increase their students' academic engagement and achievement (Ross et al., 2001). Rutherford et al. (2017) investigated the self-efficacy of elementary school teachers involved in implementing an online mathematics programme. Specifically, the association between teacher value for professional development and teacher self-efficacy in implementing spatial temporal (ST) mathematics in the classroom was investigated, along with teacher self-efficacy and students' math achievement. Students' progress was recorded through MIND, which is where students participated in online games associated with spatial temporal mathematics. Schools in the regional school district were sent a 45-item survey for teachers to complete, which gathered information regarding participants' teaching experience, self-efficacy, help seeking behaviours and implementation strategies. Teachers who valued the ST math development programme reported higher self-efficacy for teaching ST math. Teacher self-efficacy had a small positive association with math achievement. This highlights once again that teacher self-efficacy is related to student outcomes. There are a number of reasons as to why students' achievement and teachers' self-efficacy increased when students were taught by teachers with high self-efficacy regarding the use of computers. For example, high efficacy teachers are more likely to take responsibility for teaching their students how to use technology correctly, instead of passing on that responsibility to an expert. Secondly, high efficacy teachers are more likely to interrupt their own teaching in order to help out students who do not understand the use of technology, compared to teachers with low self-efficacy, as high efficacy teachers are less concerned about students raising concerns that they would not be able to handle (Rutherford

et al., 2017). This identifies the importance of creating efficacious teachers who are able to understand various technologies, and who have the ability to confidently teach their students how to use them.

Professional development courses give educators the chance to develop their skills and learn new concepts that can positively impact both the teacher and their students (Cohen & Hill, 2000). One of the aspects learnt in a number of professional development courses is the use of educational technology for teaching and learning purposes. A study conducted by Menon and colleagues (2017) examined changes in teachers' technology self-efficacy using a specialised physics content course. This study included 34 preservice elementary teachers, who were given an iPad to use during class and at home. Many opportunities were given for the teachers to learn about physics through web-based software, collaborative teamwork, and group discussions. Data was collected through multiple forms, which included gathering self-efficacy data through the Technology Science Teaching Efficacy scale. Other methods included interviews, classroom observations and artifacts, which included lesson plans and handouts. Results showed that there was a noticeable positive shift in views regarding mobile technology from the beginning of the semester in comparison to the end of the semester. Level of confidence using technology increased during this time, which enhanced teachers' understanding of science content. Furthermore, instructor demonstrations of how to use technology and the positive approach they had were found to enhance teachers' confidence to integrate technology into their classes. The physics app used in Menon and colleagues' study was reported by participants to be very interactive and engaging. Furthermore, it was reported that the app supported the organisation of learning, which builds the collaboration between educators. This study indicates not only the importance of professional development courses, but also the integration of technology within them. Unfortunately, professional development

courses often lack the incorporation of technology, which reduces the likelihood of educators developing self-efficacy in terms of technology usage (Menon & colleagues, 2017).

Teachers' technology usage

Professional development is not the only factor that supports teacher usage of technology. Other factors include support from schools and any past relevant training. Perrotta (2013) examined the relationship between teachers' perceptions of technology-related benefits and a number of factors associated with the individual, school, and education system. This study involved the analysis of survey data from 683 secondary school teachers derived from the International Innovative Teaching and Learning project. The data gathered information regarding teachers' educational background, digital technology access and use in class, types of teaching and learning activities conducted in the classroom, professional development experiences, and the general nature of the school's organisation where the teacher taught at. A questionnaire was developed which gathered information such as teachers' age, gender, subject area, educational background, and previous professional development experience. Results indicated that educational technology was most beneficial in giving teachers access to a wide range of learning content and resources. Other benefits included the increase in students' motivation and students' independence. The second research question examined whether the reporting of the benefits described above differed according to individual-level factors. Results indicated that teachers who had experienced a level of training with the use of educational technology in the previous two years were more likely to report benefits of using digital technology, in comparison to those who had received no training. Teachers who perceived their school to be supportive of educational technology were more likely to report benefits, with one of these benefits being an increase in student motivation. This study ultimately identified a link between a teachers perception of whether a

school is supportive or not of educational technology, and their perceived benefits of the use of educational technology. It is evident that there are many factors that determine whether teachers perceive a number of benefits associated with technology usage.

There are two types of perceptions that can affect whether an educator is willing to use technology with their classroom or not. This includes the perceived ease of use and perceived usefulness. Perceived ease of use relates to the degree in which a teacher believes that they will be able to use the technology without a great deal of difficulty, whilst perceived usefulness relates to whether an educator believes that the technology will contribute to either their level of performance or their students' level of performance (Joo et al., 2014). It has been suggested that perceived ease of use and perceived usefulness affect an educator's willingness to use technology (Jeung, 2014). The intention to use technology is ultimately a form of technology acceptance behaviour which is determined by perceived ease of use and perceived usefulness. One model which describes the factors that go into whether teachers are willing to use technology or not is the technology acceptance model.

The technology acceptance model identifies that an individual's intent to use technology and their usage behaviour of technology is dependent on their perceived ease of use and perceived usefulness (Davis et al., 1989). In the technology acceptance model (Davis et al., 1989), perceived ease of use affects perceived usefulness, and both of these can be impacted by external variables, such as availability of technology and social influences. Perceived usefulness and perceived ease of use therefore impact the educator's attitude towards using technology, but can also directly affect the intention to use technology. These variables ultimately influence the actual usage of technology. The technology acceptance model ultimately identifies the factors that influence a teacher's willingness to use technology within their classroom, and additionally shows which factors affect each other.

There are many benefits of technology usage, but hesitation for some educators is still present. Some of the main reasons for this hesitation include internal barriers, attitudes, beliefs, and lack of self-efficacy (Kim et al., 2013). Therefore, it is useful to analyse these attitudes and beliefs and investigate how these can be changed. Minshew and Anderson (2015) examined students' use of iPads and teachers' practice of integrating a 1:1 initiative with their students, and how these teachers overcame any barriers. Teachers in this study were two middle grade mathematics and science teachers. Multiple sources of data were used to collect information; this included semi-structured interviews, field notes, observations, lesson plans and video data. Circle of influence diagrams were also used to collect data, which were based on the pedagogical content knowledge framework (Shulman, 1986). This framework describes three types of knowledge that educators are required to have in order to successfully integrate technology into their classroom, which are technological knowledge, content knowledge and pedagogical knowledge. The results indicated that connectivity was an external barrier to technology use (Minshew & Anderson, 2015). This refers to how accessible and easy the technology is to use. For example, a school needs to provide enough devices for their children and staff whilst also providing quality internet access so that they can be used uninterrupted. Professional development was also found to be important, which is what was found in previous studies. Both teachers in this study mentioned that they would have benefited largely from professional development that focused on the use of technology. Another external barrier is application acquisition, which refers to the lack of catering an app to suit each student's needs. As each student's academic needs are different, it is necessary to tailor the apps to suit each grade level and their learning needs. Internal barriers include the lack of knowledge about technology, teachers' negative perceptions of technology use and how valuable teachers believe technology to be. Lastly, perceptions of practice versus actual practice were identified as an internal barrier. For example, an individual's use of an app not

meeting expectations that they may have obtained from the observation of watching someone else use the app may reduce app usage. Alternatively, observing someone else use an app in an enjoyable way can help others feel more positively about an app. Interestingly in this study (Minshew & Anderson, 2015), the perceptions of how teachers thought they used an app was often different to how they actually used it. This study ultimately shows the potential barriers that can interrupt a successful relationship between educators and educational technology. Additionally, other barriers include access (Kopcha, 2012), as teachers may think that they lack access to technology even if it is available for them to use, as they may feel as though it is not useful or that it is too difficult to use. Teachers are also less likely to abandon their efforts to integrate technology in the classroom if they have a strong administrative vision for technology use. Lastly, time is considered as a barrier. If a teacher believes that they do not have enough time to appropriately integrate technology into their curriculum then they are less likely to do so. It is important to acknowledge these barriers and analyse ways in which these can be prevented so that technology use can be successfully used by educators.

Creating positive beliefs around technology usage

Teachers' educational beliefs are usually described as a set of often unconsciously held assumptions about the issues and processes that relate to teaching, the curriculum, knowledge, and schooling (Ertmer, 2005). Educational beliefs are associated with the use of technology for educational purposes. Creating a positive belief system for teachers regarding educational technology is sometimes difficult as each teacher has their own individual experience with technology. According to Nespor (1987), experiences and beliefs are closely related. If teachers are to develop positive beliefs around the use of educational technology, then they need to have positive experiences with them, which will make them feel confident and comfortable with technology use. Some of the ways in which this can be achieved is

through consistent exposure, technology support, and ongoing professional development training which integrates educational technology (Brinkerhoff, 2006). This can also affect teachers' mental state of readiness to use educational technology. However, changing the personal beliefs of teachers is not easy, as teachers' mental state of readiness to adapt to the use of educational technology is a large predictor of whether they will integrate technology use in their classroom (Domingo & Gargante, 2016; Koszalka, 2001). Teachers with more of a constructivist belief system are more likely to use technology in the classroom. This is because educators who hold more constructivist beliefs are more likely to implement student-centred and high level technology uses, while educators with traditional beliefs are more likely to demonstrate low level technology uses (Judson, 2006). This suggests that there is a need for schools and professional programmes to develop constructivist beliefs in their teachers. It is evident that beliefs are influential to whether teachers use technology in their classroom or not, therefore an emphasis needs to be put on how beliefs, such as traditional beliefs, can be changed. This can be done through support, exposure, and professional development (Brinkerhoff, 2006).

The use of technology for teaching and learning purposes is increasing, but integrating technology into the classroom still seems to be a struggle for some educators (Berrett et al., 2012). A main reason for this is that many teachers hold specific pedagogical beliefs which influence whether they are willing to incorporate technology into their teaching and learning, and how they carry this out (Deng et al., 2014). Pedagogical beliefs refer to the understandings and propositions around various methods of teaching (Deng et al., 2014). Chen (2011) examined the relationship between teachers' pedagogical beliefs and technology use in the classroom. Chen found that teachers who had experience with the use of technology were more likely to support pedagogical belief change. Interestingly, the use of computer technologies allowed teachers to practice being an innovative teacher, as well as a

constructivist teacher. This suggests that the use of technology can help change teachers beliefs around the methods in which they use to teach. Ertmer et al. (2015) found that educators who were technologically motivated were more likely to experiment, implement, and refine the ways that they teach. The participants in this study described that technology gradually helped them reshape the way that they teach. The findings on both of these studies show how technology can change their pedagogical beliefs. Furthermore, a shift in pedagogical beliefs can help teachers see the use of technology as a way to engage students with their learning content, access authentic digital information, and communicate and collaborate with students, teachers and parents (Ertmer et al., 2015).

In contrast to the findings in the studies mentioned above, teachers' pedagogical beliefs may hinder technology integration. Donnelly et al. (2011) found that the nature of an ICT based resource did not match the pedagogical beliefs of a group of science teachers. Furthermore, teachers who held contented traditionalist beliefs seemed to see no real purpose for the use of technology in their classroom, and these beliefs increased when teachers viewed their existing practices to be adequate. Traditionalist beliefs include teachers who lack in collaboration and group learning, and who put more of an emphasis on results rather than the understanding of concepts (Donnelly et al., 2011). Similar findings were evident in Lim and Chan's study (2007). They found that educators who had received personal learning experiences predominately through direct instruction, believed that technology was not essential for teaching and learning purposes. Although this could be due to a lack of exposure. The results suggest that the use of technology in the classroom heavily relies on teachers' beliefs, and their pedagogical beliefs especially. Therefore, there needs to be an emphasis put on how schools and teaching programs can increase positive beliefs surrounding the use of technology (Tondeur et al., 2016).

Aotearoa New Zealand's education system and Covid-19

Aotearoa New Zealand's education system involves four stages; early childhood, primary, secondary and tertiary. The New Zealand Curriculum (Ministry of Education, 2020) focuses on areas such as reading, writing and maths during the primary school years, as these core areas are needed for students to progress through to secondary school and successfully complete all NCEA levels. These core areas are focused on as they can underpin success in all other areas of a child's schooling. Digital technology is also incorporated throughout all stages of New Zealand's education system. Digital technology is commonly used by students for practising skills, researching, and producing work through documents and slideshows (Ministry of Education, 2020). These are the main ways in which technology is used but some of the other ways include the creation of multimedia, playing games or simulations, collecting or analysing data, and coding/programming. Ultimately, digital technology is becoming increasingly incorporated in our education system as secondary students are now expected to bring their own digital device to school, whilst primary school students often have tablets or iPads in which they can play educational games on (Bolstad, 2016). Furthermore, digital technology is a learning area within schools as the requirement for students to bring digital technology to schools is increasing. A national survey was undertaken which assessed teachers' and principals' thoughts on formally integrating technology into the curriculum, which was announced by the Ministry of Education in 2016. It was reported that participants generally had positive views about including technology into the education system, with some participants even describing the inclusion as necessary and essential. Additionally, there was some concerns brought up, such as funding issues, overcrowding of the curriculum, and lack of support for educators (Bolstad, 2016). An interesting finding was that teachers would like their students to use technology to collaborate and communicate with people outside of school on shared projects. Some reasons as to why

this is not happening may be due to time pressures and lack of opportunity to connect with other students and schools (Bolstad, 2016). Evidently, technology is a big part of Aotearoa New Zealand's education system and it is used in many ways by students for a variety of reasons.

The Covid-19 lockdown in New Zealand began at the end of March in 2020. On the 21st March 2021 New Zealand went into alert level 2, with the country moving to alert level 3 on the 23rd March. New Zealand went into alert level 4 on the 25th March with lockdown easing slightly on the 27th April. Lockdown ended on the 13th May as we went into alert level 2. Throughout the alert levels, schools in New Zealand were closed during alert level 4, partially open during alert level 3, as students who needed to attend school had to join a bubble of no more than 20 students. This is determinant on the number of staff available and teaching space. Furthermore, schools were open and operating as usual during alert level 2 and 1. Alert level 3 and 4 forced educators across New Zealand to adapt to online learning in order to teach a majority of their students. This was an adjustment for educators, their students and their whānau as many struggles arose during this time, such as financial issues, the balance of working from home, whilst also helping students with their schoolwork, and inevitably, the mental health impact of being in lockdown (Flack et al., 2020). The Ministry of Education provided multiple distance learning-resources online for educators and families, which included the use of computers. The government supported families by providing computers and internet connection to those who did not have access to these items or could not afford them (Ministry of Education, 2020). Other resources include packs of printed materials and the creation of educational television, which is where lessons were broadcasted on television between 9am-3pm every school day, during alert levels 2, 3 and 4.

Online learning was relied on heavily during lockdown, which resulted in numerous challenges (Flack et al., 2020). Flack and colleagues (2020) distributed a survey across New

Zealand and Australia which examined educators' perspectives on the new realities and challenges associated with online distance teaching. A total of 2,737 educators responded to the survey questions that were associated with online learning due to the Covid-19 lockdown. These questions measured the challenges of meeting students' needs from a distance, the use of educational technologies, teacher wellbeing, and teacher needs. They found that there were around equal numbers that felt confident using educational technology and that felt unconfident. Some of the main challenges teachers reported included the difficulty of engaging students who typically need one-on-one attention, the feeling of a loss of social connection between students and teachers, and the struggle of adapting their teaching methods to online learning. Some recommendations for the future included focusing on students' emotional wellbeing, the prioritisation of extra instructional support for when students returned to school, providing extra support for students who were academically struggling, increasing support for teacher and student relationship building, and creating a multi-platform approach that integrates a variety of curricular resources.

In terms of teachers' level of self-efficacy regarding students' use of educational technology during the Covid-19 lockdown, a study conducted by Cardullo et al., (2020) explored the relationship between factors in the technology acceptance model (Davis, 1989) and teachers' self-efficacy. This was assessed through a 49 item questionnaire. The questionnaire identified that teachers had a low sense of self-efficacy in using technology to teach. Cardullo and colleagues (2020) suggested that this is due to a lack of support and resources available to teach online, and having to motivate students to be engaged with their schoolwork. A lack of equipment and resources was also a finding in Santi, Gorghiu and Pribeanu's (2020) study, who researched issues that educators faced with the use of educational technology during Covid-19. Cardullo and colleagues (2020) also found that teachers needed time to explore technology use in the classroom, and to experience the

benefits before going into lockdown. This would have been important as this increases the likelihood of teachers developing positive beliefs regarding educational technology (Lei & Zhao, 2008), and educators who held negative beliefs may have struggled with the idea of only using technology to teach their students during the lockdown. Furthermore, if teachers are forced to use technology that they are not comfortable with, then this may hinder their confidence whilst using it (Mishra & Koehler, 2006), which impacts their self-efficacy.

Overall the Covid-19 lockdown was an unprecedented time for teachers, as they had to adjust to teaching online whilst trying to engage and motivate their students. This came with many challenges, such as a loss of social connection between themselves and their students, and the struggle of trying to maintain their students' academic achievement (Flack et al., 2020).

Seemingly, teacher's self-efficacy, self-beliefs and self-perceptions surrounding the use of technology may have been affected during the Covid-19 lockdown as educator's dealt with distance learning. Understandably, there is a lack of research associated with the use of technology and its impact on teachers during a pandemic. The research questions as follows are aimed at examining this.

- Did the Covid-19 lockdown affect teachers' self-efficacy regarding students' use of technology and educational applications?
- Was teachers' self-perceptions of students' use of technology and educational applications affected by the Covid-19 lockdown?
- Was teachers' self-beliefs of students' use of technology and educational applications affected by the Covid-19 lockdown?

Chapter 3:

Methodology

Introduction

The primary goal of this study was to investigate whether the Covid-19 pandemic changed the way that educators viewed educational applications. The research examined if there was any change in teachers' self-efficacy, beliefs and perceptions of their students' use of educational apps, over the lockdown period. The first research question was concerned with whether teachers' self-efficacy regarding students' use of educational applications and technology differed between pre- and post-Covid-19 lockdown. The second research question was whether teachers' perceptions regarding students' use of educational applications and technology differed between pre-and post-Covid-19 lockdown. The third research question was whether students' use of educational applications and technology affected teachers' self-beliefs prior to the Covid-19 lockdown in comparison to after the Covid-19 lockdown. In order to conduct this research, a survey was created and distributed on social media for teachers across New Zealand to participate in. Information provided in this methodology section includes details regarding the participants, instrumentation, data collection and data analysis.

Participants

There were 29 participants who voluntarily decided to take part in this study. Eligibility criteria for participating in this survey included teaching within Years 0 to 8, and the use of educational applications and technology for teaching and learning purposes with students before and after the Covid-19 lockdown. Participants were completely anonymous, meaning that the identification of participants did not occur. Table 1 describes the

demographics of the participants. It is identifiable that the majority of participants identified as female with the majority of participants teaching for more than 10 years. Although there were 29 participants in the current research, participants selected more than one answer for year levels taught and school type, making the overall number of answers for these questions higher than 29. Furthermore, some of the teachers that took part in this study were teaching more than one year level during the Covid-19 lockdown, and some qualified for more than one option for school type, for example, a teacher could have been teaching at a private school that is also a full primary school. The total for location is 26 as three of the participants did not complete this question. The research was approved by the Educational Research Human Ethics Committee (2020/04/ERHEC-LR) and was carried out according to the policies of the University of Canterbury.

Table 1*Demographics*

	Number of people	Percentage
Gender		
Male	2	6.90%
Female	26	89.66%
Non-binary	1	3.44%
Location		
North Island	20	68.97%
South Island	6	20.69%
I'd rather not say	3	10.34%
Years teaching		
Less than 10 years	11	37.93%
More than 10 years	18	62.07%
Year levels taught during lockdown		
Primary (Year 0-6)	34	58.62%
Intermediate (Year 7-8)	24	41.38%
School type		
Primary school (state)	25	75.76%
Intermediate and secondary	7	21.21%
Private primary school	1	3.03%

Measures

The current study included a measure adapted from the Mobile Teacher's Sense of Efficacy Scale (mTSES) (Power, 2015), which was initially developed from the General Teacher's Sense of Efficacy Scale (TSES) (Tschannen-Moran & Woolfolk, 2001). The mTSES measures teacher's perspectives of their self-efficacy in regard to mobile devices being used for teaching and learning purposes. The mTSES contains three subscales, including efficacy in student engagement, efficacy in instructional strategies and efficacy in classroom management. Each of these subscales included eight questions each. In order to find the overall efficacy of each of the subscales, the unweighted means that loaded onto each

factor were computed (Power, 2015). The reliability of the mTSES has also been established. Power (2015) reported Cronbach alpha for each of the subscales, which identified high internal reliability. For the subscales, engagement ($n=8$) had a Cronbach's alpha score of ($\alpha=.88$), instruction ($n=8$) had a Cronbach's alpha of ($\alpha=.84$) and classroom management ($n=8$) had a Cronbach's alpha of ($\alpha=.77$).

I selected 21 items from the mTSES and adapted them so that they targeted either teacher's self-efficacy, self-beliefs or self-perceptions regarding students' use of educational technology. Twenty-one items were selected based on how well they suited questions associated with self-efficacy, self-beliefs and self-perceptions. Some questions were not selected as they were related to behaviour, which is not what the current research was investigating. As shown in table 2, each subscale has an example of each question derived from the mTSES and how it was altered for the current research. Each question was asked in relation to before and after the Covid-19 lockdown, along with ensuring that the questions were being asked in past tense and that they were being asked in regard to students' use of educational applications and technology. Each item included a five-point likert scale and the number of questions asked in the subscales ranged from between five to thirteen. The number of questions per scale differed due to the elimination of questions that were not suitable, as multiple questions were too similar.

Table 2*Questions from the mTSES and adjustments made for the current research*

	Examples from the mTSES	Adjustment for current research
Self-efficacy	How much can you gauge student comprehension of content delivered using technology resources?	How well could you gauge student comprehension of content delivered using technology-based resources?
Self-beliefs	How much can you do to adjust your lessons to the proper level for individual students?	Did you believe that educational apps catered the learning needs of all students?
Self-perceptions	How well can you implement alternative (technology-based) strategies in your classroom?	I felt that I could implement technology-based strategies in my classroom well.

Procedure

Once the survey was created, it was posted on social media with information explaining the purpose of the study. The survey was posted on multiple Facebook pages; NZ Teachers PD – Primary, Primary Teachers Resource Sharing (NZ) and Teaching Resources (NZ). The survey was then emailed to schools across Aotearoa New Zealand asking teachers to complete. Access to schools’ emails in Aotearoa was done through an online database named Education Counts (Education Counts, 2021), which is where contact information is made available for the public to view, if the school chooses to make such information accessible. Once participants had completed their survey via UC Qualtrics, data could be viewed and analysed by myself and my supervisors. Data collection took place from July 2020 to October 2020.

Chapter 4

Results

The current study was concerned with investigating the influence of the Covid-19 lockdown in Aotearoa New Zealand on teachers' beliefs, perceptions, and self-efficacy regarding students' use of educational applications and digital technology. Each scale item was presented on a 5-point Likert scale with 1 being the highest and 5 being the lowest. Reverse coding was carried out on the fourth item in the self-perception subscale as this was negatively phrased. All data was analysed using SPSS software (Version 27). Factor analysis was used to determine the number of factors the subscales were measuring. Paired sample t-tests were then used to identify if the means were significantly different between all of the sub-scales pre- and post-Covid-19. Independent sample t-tests were used to examine the effect of teachers' length of teaching experience on teachers' self-efficacy, self-belief and self-perception score.

Reliability

Reliability for each scale was determined by running an inter-item reliability analyses which produced a Cronbach alpha score. Analysis was carried out for all scales at pre-test. For self-efficacy ($n = 5$), a Cronbach's score of ($\alpha=.75$) was calculated. The self-belief ($n=11$) scale had a Cronbach's score of ($\alpha=.89$). For self-perception ($n=5$) a Cronbach's alpha score of ($\alpha=.67$) was identified. According to Tavakol and Dennick (2011) a strong correlation is considered to be between .70 and .90. With the current study, the self-efficacy scale and self-belief scale are within this range. These Cronbach alpha scores are relatively high, apart from self-perceptions, which is below .70. One of the first analyses conducted was a factor analysis, which was carried out to check that the relevant items were being loaded

onto the three subscales. Results suggested that 5 of the items were being loaded onto another factor. This was included in data analyses as an additional scale, which was named ‘student factors’ as the items were not solely related to teacher beliefs, as feelings was also covered, but all of the items related to students. This fourth scale ($n=5$) had a Cronbach alpha of ($\alpha=.79$), which is identified as a strong correlation (Tavakol & Dennick, 2011).

Descriptive statistics

Demographic data was collected from 29 participants. As described in table 1, the majority of participants were female ($n=26$), with the majority of the participants from various regions around the North Island ($n=20$). There were 3 participants who did not select their location, therefore only 26 participants answered this question. The majority of participants had been teaching for more than 10 years ($n=18$) and the participants in this study mostly taught in year levels 0-6 during the Covid-19 lockdown, which were categorised as primary year levels, whilst years 7-8 were categorised as intermediate year levels. Year levels taught had a large number of responses ($n=58$) as participants selected multiple options due to them teaching a number of year levels at once. Lastly, types of schools taught at included state schools, private schools, state-integrated schools, contributing primary schools, full primary schools, intermediate schools and intermediate and secondary combined. The majority of teachers taught at full primary schools ($n=25$).

Factor analysis

In order to determine whether each scale contained items that contributed to measuring the correct construct, a principal component factor analysis was conducted. This was conducted in order to reduce the number of variables in the data set, so that the data was a lot easier to explore and analyse. A scree plot was developed which helped identify that

there are four significant factors. The first three components were identified as self-efficacy, self-beliefs and self-perceptions, which were the three subscales in the current study.

However, a fourth component was identified. This subscale was named as 'student factors'. A component matrix identified that there were two items from the self-belief scale and one item from the self-perception scale that came under this new scale. The rotated component matrix further clarified which items came under the fourth subscale. This identified that the first four items of the self-belief scale, and the fifth self-perception item contributed to the fourth subscale. Following this finding, subsequent data analyses were carried out using these four subscales.

Table 3*Rotated component matrix*

Items	Factor loadings			
	1	2	3	4
Factor 1: Self-efficacy				
How well could you gauge student comprehension of content delivered using technology-based resources?	.84	.27	.18	.14
How well could you develop quality collaborative learning activities for your students through the use of educational apps?	.60	.31	-.12	.32
How well could you motivate your students to engage with educational apps?	.65	.11	-.16	.20
How well could you collaborate with whānau/parents/caregivers to help support students reach their full potential through the use of educational apps?	.58	.31	.13	-.30
How well did you teach your students how to use technology-based resources for at-home learning?	.82	.16	.27	-.30
Factor 2: Self-beliefs				
Did you believe that the use of educational apps at home improved a student's knowledge of the content learned in the classroom?	.21	.65	-.21	-.18
Did you believe that your students enjoyed learning through educational apps?	.15	.91	-.38	-.21
Did you believe that student engagement occurred when using educational apps?	.13	.89	.33	-.30
Did you believe that the features included in educational apps helped promote a student's engagement?	.14	.82	-.20	-.13
Did you believe that you had received the appropriate skills and resources from your professional development to successfully teach the use of educational apps to your students?	.40	.84	.26	-.12

Did you believe that educational apps promoted students' critical thinking?	.16	.50	-.40	-.23
Did you believe that educational apps helped students grasp concepts better?	-.13	.70	.23	.17
Factor 3: Self-perceptions				
I felt that educational apps provided appropriate challenges for students in my classroom.	.13	.48	.59	-.10
I felt that I could implement technology-based strategies in my classroom well.	.38	.12	.76	-.17
I felt that the content provided in educational apps complimented the content I taught in the classroom.	.45	-.14	.55	.24
I felt that the features included in educational apps distracted tamariki/children from learning the content.	.45	.13	.56	.23
Factor 4: Student factors				
Did you believe that technology-based resources motivated students who demonstrated less enthusiasm with their schoolwork?	-.12	.19	.23	.39
Did you believe that educational apps catered to the learning needs of all students?	-.14	.28	.37	.40
Did you believe that educational apps provided quality explanations or examples for students who required additional support in their learning?	.18	.12	.39	.81
Did you believe that educational apps could get students to believe that they could do well with their schoolwork?	.28	-.25	.25	.41
I felt that the use of educational apps amongst my students contributed to my job satisfaction as an educator.	.12	-.16	.33	.41

Comparing means for pre and post Covid-19 lockdown

In order to determine whether teachers' self-efficacy, self-beliefs, self-perceptions, and student factors changed pre- and post- Covid-19 lockdown, means and standard

deviations were calculated for each subscale. As it is reported in Table 4, there is a small decrease between the pre- and post-means, for all subscales, although none were significantly different. The mean for self-efficacy had a slight decrease between the pre-test ($M=2.96$, $SD=1.05$) and the post-test ($M=2.89$, $SD=.98$), which was the case with the pre-test for self-beliefs ($M=2.62$, $SD=.93$) and the post-test ($M=2.56$, $SD=.90$). The mean for self-perceptions also decreased from pre-test ($M=2.53$, $SD=.85$) to post-test ($M=2.48$, $SD=.86$). Lastly, the mean for student factors decreased from pre ($M=2.71$, $SD=.96$ to post ($M=2.68$, $SD=1.01$) Covid-19 lockdown. This indicates that there were slight changes in teachers' self-efficacy, self-beliefs, self-perceptions, and student factors, from educational app usage.

Table 4

Means for each pre- and post-scale

Scales	<i>M</i>	<i>SD</i>	<i>p</i>
Self-efficacy pre COVID	2.96	1.05	.57
Self-efficacy post COVID	2.89	.98	.57
Self-beliefs pre COVID	2.62	.93	.17
Self-beliefs post COVID	2.56	.90	.17
Self-perceptions pre COVID	2.53	.85	.48
Self-perceptions post COVID	2.48	.86	.48
Student factors pre COVID	2.71	.96	.59
Student factors post COVID	2.68	1.01	.59

A t-test was then performed to determine if the differences in means between the pre- and post-scales were statistically significant. This small decrease was found to be not statistically significant, which suggests that teachers' use of educational applications and technology during the Covid-19 lockdown did not significantly increase or decrease the constructs measured.

Length of time teaching

To determine whether number of years teaching experience affected teachers' self-efficacy, self-beliefs, self-perceptions, and student factors from educational app usage, pre-Covid-19 lockdown, a t-test was carried out for all four subscales. Table 5 reports the means for each of the subscales. There is a slight decrease in means for all of the subscales, apart from self-perceptions. Furthermore, teachers who had been teaching for more than 10 years had slightly higher means than teachers who had been teaching for less than 10 years, although this result was not the same for self-perceptions, which identified that the mean was slightly higher for teachers who had been teaching for less than 10 years ($M=2.82, SD=.92$), compared to those who had been teaching for more than 10 years ($M=2.36, SD=.78$). Results identified that although there was a slight difference in means for all of the subscales, the difference was not statistically significant. This highlights that time spent teaching did not significantly increase or decrease teachers' self-efficacy, self-beliefs, self-perceptions and student factors, before the Covid-19 lockdown.

It was also assessed whether teaching experience affected teachers' self-efficacy, self-beliefs, self-perceptions and student factors, post Covid-19. As shown in table 5, there was a slightly higher mean for self-efficacy for teacher's who had been teaching for less than 10 years ($M=3.02, SD=.90$), compared to those who had been teaching for more than 10 years ($M=2.81, SD=1.04$). This was also found with self-perceptions, which had a slightly higher mean for teachers who had been teaching for less than 10 years ($M=2.66, SD=.86$), compared to teachers who had been teaching for more than 10 years ($M=2.38, SD=.85$). Interestingly, self-beliefs had the exact same mean for teachers who had been teaching for less than 10 years ($M=2.56, SD=.87$) and for those who has been teaching for more than 10 years ($M=2.56, SD=.93$). Although there was a slight difference among all of the means, on all of the subscales, they were not found to be statistically significant. Once again, this identifies

that self-efficacy, self-beliefs, self-perceptions student factors was not affected by length of teaching experience.

Table 5

Independent samples t-test: Teaching experience

Variables	Less than 10	More than			Less than	More than		
	years	10 years			10 years	10 years		
	Pre-test				Post-test			
	<i>M(SD)</i>	<i>M(SD)</i>	<i>t</i>	<i>p</i>	<i>M(SD)</i>	<i>M(SD)</i>	<i>t</i>	<i>p</i>
Self-efficacy	2.80 (1.04)	3.06 (1.05)	-.14	.16	3.02 (.90)	2.81 (1.04)	.31	.76
Self-beliefs	2.61 (.88)	2.63 (.97)	-.10	.92	2.56 (.87)	2.56 (.93)	-.25	.80
Self-perceptions	2.82 (.92)	2.36 (.78)	2.87	.01	2.66 (.86)	2.38 (.85)	.86	.40
Student factors	2.70 (.90)	2.72 (1.01)	-.19	.85	2.65 (1.09)	2.69 (.97)	.20	.84

Summary

Factor analysis determined an additional subscale, which was associated with analysing student factors. Subsequent data analyses included four subscales which were self-efficacy, self-beliefs, self-perceptions and student factors. Descriptive data identified small decreases between the two means, on all of the subscales, which were identified as not statistically significant by a t-test. Lastly, to investigate whether teaching experience affected teachers' self-efficacy, self-beliefs, self-perceptions and student factors, an independent samples t-test was conducted. Although results showed a slight difference among the means, it was not statistically significant. Ultimately, teachers' self-efficacy, self-beliefs, self-perceptions and student factors were not affected by the intense use of educational applications and technology during the Covid-19 lockdown.

Chapter 5

Discussion

Introduction

The main aim of this research was to investigate whether teachers' self-efficacy, self-beliefs and self-perceptions of students' use of educational applications and educational technology changed over the period of the Covid-19 lockdown. Constructs such as self-efficacy, self-beliefs and self-perceptions were necessary to investigate during a pandemic, as the Covid-19 lockdown was a time that no educator has had to navigate before, therefore there is an extreme lack of research regarding how distance learning during a pandemic can affect educators. Self-efficacy has been positively associated with teachers' confidence, performance, and classroom management skills (Lohman, 2006). Research has also found that self-efficacy is associated with the increased likelihood that teachers will use a variety of teaching strategies, including educational apps and technology. The use of technology has been found to support students' levels of motivation and engagement (Anderson & Putman, 2020), although the use of educational technology largely depends on whether educators hold a positive belief system about them (Domingo & Gargante, 2016).

Findings

Data analysis began by conducting a factor analysis in order to determine whether my items were measuring the constructs that they were designed to measure. This analysis acknowledged that five of the items measured a fourth construct. This construct was identified as student factors. Subsequent data analyses was conducted in respect to the four subscales.

Results found that there was a slight decrease in means between pre-and post-Covid-19 lockdown in terms of teachers' self-efficacy, self-beliefs and self-perceptions of students' use of educational applications and technology. There was also a small decrease for the new scale which assessed student factors. However, none of these findings were statistically significant. This indicates that students' use of educational applications and technology during lockdown did not change teachers' self-efficacy, self-beliefs and self-perceptions of students' use of educational applications and technology. It was also found that students' use of educational applications and technology before and after the Covid-19 lockdown did not affect student factors.

The current study also examined if the number of years teaching affected teachers' self-efficacy, self-beliefs, self-perceptions and student factors from students' educational app usage, before and after the Covid-19 lockdown. Although there was a slight difference between almost all of the means, these were not statistically significant. This indicates that all of the constructs measured were not affected by whether teachers had been teaching for less than 10 years, or whether they had been teaching for more than 10 years.

In relation to the research questions, the intense use of educational applications and technology during lockdown did not significantly affect teachers' self-efficacy, self-beliefs, self-perceptions or student factors, from students' educational app usage. Furthermore, students' use of educational technology during lockdown did not significantly increase or decrease teachers' self-efficacy, self-beliefs and self-perceptions of technology use for teaching and learning purposes. Student factors was also not affected.

Teachers' self-efficacy

In relation to past research, Santi, Gorghiu and Pribeanu (2020) conducted a study which examined self-efficacy among 125 science and technology teachers, who carried out

educational activities with their students with the use of technology during Covid-19. This research was carried out by the use of a questionnaire which aimed to capture a variety of issues that teachers experienced with the use of technology during the Covid-19 pandemic. It was found that teachers perceived self-efficacy was found to be generally quite high. Furthermore, around 85% of participants viewed themselves as having the digital competencies in order to carry out the use of technology through distance learning. This included the ability to identify applications that are suitable for certain purposes. It was also found that 79% of participants were able to explain and understand difficult concepts through the use of technology, whilst also stimulating students to learn better in a distance learning circumstance. Santi and colleagues stated that there were also many variables that effected their participants' self-efficacy, such as equipment, resources and funding. Furthermore, one of the most common factors affecting teachers' self-efficacy during the Covid-19 pandemic was the lack of equipment in schools. This was followed by the lack of internet, teachers' low digital competency and the lack of teachers' ICT abilities. These factors ultimately have the power to affect teachers' level of self-efficacy in a negative way. Therefore, as suggested by Santi and colleagues, there needs to be an emphasis put on incorporating technology use into professional development programmes so that teachers are trained accordingly with technology usage and feel confident when using them. Additionally, the technology acceptance model (Davis, 1989) highlights that a factor relating to intention to use and technology usage is perceived ease of use. This is a way in which professional development programmes can increase teacher self-efficacy, as teaching educators how to use technology successfully will increase their perceived ease of use and encourage teachers to feel more open to using technology.

The current study identified that there was very little change before and after the Covid-19 lockdown, on all of the four subscales. The change was so small that the results

were found to be not statistically significant. There is an array of possible explanations as to why there was virtually no change. Past research has found that educators who have received training in the use of technology for teaching and learning purposes, and who feel confident in their ability to motivate and engage their students through technology usage, tend to have high self-efficacy (Hoy & Woolfolk, 1993), in comparison to teachers who have limited training with the use of technology and who do not feel confident with the use of technology. The slight change in self-efficacy in the current study may suggest that self-efficacy was already well established. Furthermore, teachers may have felt confident with their use of technology before New Zealand went into lockdown, and they may have felt as though they could engage their students through the use of technology. Which ultimately led to them perceiving technology as useful during the lockdown.

Hoy and Woolfolk (1993) also mention that support from schools and other educators can contribute to high self-efficacy. As there was little change in self-efficacy with the current research, it can be suggested that self-efficacy was already well established through the support teachers have received from their school and other teachers. Support that educators received from their students' families may also be included in this. Support from others is crucial for self-efficacy as it helps reduce stress from an individual's workload (Hoy & Woolfolk, 1993). Understandably, support during lockdown was essential for educators as they navigated distance learning during an event that was uncertain. This suggests that teacher self-efficacy was already established before lockdown as there was little change, meaning that educators were receiving the support they needed from schools, and that a network was already created between teachers to help support one another.

The many reasons that could support the idea that self-efficacy had already been established before lockdown has been described above, but there is one explanation that may explain why self-efficacy was not significantly increased or decreased, and that is the lack of

availability of resources (Cardullo et al., 2020). Leonard et al. (2010) explained that the lack of resources can contribute to a decrease in self-efficacy, as this prevents students from learning, which reduces teachers' confidence and self-efficacy with the use of technology. This may suggest that teachers had a lack of resources before, during and after the lockdown, which explains why self-efficacy was not significantly increased or decreased. Ultimately, the insignificant change suggests that teachers' level of self-efficacy was already established before lockdown, and that factors such as confidence in using technology, support from others and the lack of resources was not affected by the lockdown. Essentially, dealing with distance learning during the lockdown may have prevented the affect that such factors have on increasing teacher self-efficacy.

Teaching experience

The current study found that although there were slight changes regarding teaching experience and teachers' self-efficacy before and after the Covid-19 lockdown, the differences were found to be not statistically significant. Although the findings were found to be insignificant, a difference was found for self-efficacy, before and after the Covid-19 lockdown, which found that self-efficacy was slightly higher for teachers with less than 10 years experience before lockdown. In terms of after lockdown, self-efficacy was higher for teachers with more than 10 years experience. Past research has identified that teachers who were in the beginning or middle part of their career had higher self-efficacy than those who were in the later stages of their career (Klassen & Chiu, 2010). Klassen and Chiu conducted a study which examined the relationships between teachers' years of experience, teacher characteristics, teachers' self-efficacy, job stress and job satisfaction. Participants were recruited at an annual teacher conference where they were approached by a team of researchers asking whether they would be willing to participate in a brief questionnaire.

Results showed that self-efficacy steadily increased with teaching experience from 0 years to approximately 23 years. Self-efficacy then started to steadily decrease as teaching experience continued to increase. Additionally, teachers' confidence in engaging students, managing student behaviour and using effective instructional strategies had the same pattern. In contrast to Klassen and Chiu's research, it is identified that self-efficacy increases with experience (Wolters & Daughtery, 2007). Bandura (1997) also supports this by describing that self-efficacy beliefs remain stable once established. Huberman (1989) stated that the later years of a teacher's career are accompanied by disengagement, which is what was found in Klassen and Chiu's research. Disengagement can be a result of low self-efficacy and low enjoyment (Huberman, 1989). The current study found that self-efficacy was higher for teachers who had been teaching for less than 10 years, before lockdown, which is similar to what Klassen and Chiu (2010) found. Although this was not found post lockdown. Research suggests that teachers with more than 10 years experience in the current study may have been more disengaged than teachers with less than 10 years experience before lockdown. Although this was not the case post lockdown. This change in disengagement may be due to workload stress and poor classroom management (Huberman, 1989), which would have been challenges faced by teachers once they returned to the classroom post lockdown. As teachers with more than 10 years experience had higher self-efficacy post lockdown, than those with less than 10 years experience, this could indicate that those with more experience felt more confident with dealing with a large workload and classroom management, due to previous mastery experiences (Bong & Skaalvik, 2003). In summary, teachers with greater experience had lower self-efficacy than those with less experience pre lockdown, which may have been due to the presence of disengagement, which is what teachers in the later part of their career generally experience (Klassen & Chiu, 2010). This result was found to be the opposite post lockdown, which may be explained by the existence of previous mastery experiences when

dealing with a large workload and classroom management skills, which is greater with teachers who have more experience.

Implications

Although the current research did not find any significant change in teachers' self-efficacy, self-beliefs, self-perceptions and student factors, pre- and post- Covid-19 lockdown, this finding still indicates the affect that educational applications and technology had on participants during this time. As there was little change, it can be suggested that self-efficacy was already well established before lockdown. Previous research has identified that factors such as support, and training with the use of technology through professional development programmes, has the ability to increase teachers' self-efficacy. Furthermore, teachers were receiving a good amount of support and training in order to feel confident enough to use technology with their students during lockdown. This shows how crucial it is for educators to attend professional development programmes. Universities and training institutions across New Zealand need to put an emphasis on incorporating technology use into their training programmes, and schools need to make sure that their educators attend regular professional development programmes. This helps educators feel more confident with the use of technology, which then increases their self-efficacy and their students' academic achievement and engagement.

As there was no significant increase across all of the scales it can be assumed that this may be due to the four sources of self-efficacy. It has been described that the four sources of self-efficacy; mastery experiences, vicarious experiences, verbal persuasion and physiological state all contribute to increasing an individual's self-efficacy (Bong & Skaalvik, 2003). Being in lockdown would have prevented these sources from developing. Furthermore, in reference to mastery experiences, educators have never had to teach their

students by distance before for such a long period of time, especially during a global pandemic. Educators have never had the opportunity to deal with this before and successfully achieve the task of educating their students by distance during a pandemic. Vicarious experiences is another source which has not had the chance to develop. As educators have not experienced teaching during a global pandemic before, other educators are unable to have observed others and experienced how they felt. Knowing that these two sources contribute to the presence of self-efficacy indicates that the opportunity for educators to develop their self-efficacy during lockdown was absent, as these two sources were unable to be accessed. Practically, schools across New Zealand need to share their experiences in lockdown and what strategies educators used to cope with learning through technology. This will then help other educators across New Zealand learn and understand ways in which they can manage future lockdowns.

Limitations

A methodological issue within the current study is that the pre- and post-scales were both administered after the Covid-19 lockdown, at the same time. This is an issue as teachers may not have been able to accurately recall how they felt about educational applications and technology before the Covid-19 lockdown. This is otherwise known as recall bias. Conducting the pretests before the Covid-19 lockdown would have prevented this problem, although this is not possible due to the timeframe between the lockdown announcement and the first day of lockdown being extremely short. The number of participants that completed the survey was also limited, which is considered to be a limitation as this study was expecting to gain a larger number of responses than what was received. Post lockdown came with multiple challenges for educators. These challenges included helping children catch up with any schoolwork, adjusting to teaching in person again, and dealing with children who had

developed anxiety from the Covid-19 lockdown (Flack et al., 2020). This may have affected teachers' willingness to complete the survey, as they appeared to be very busy post lockdown. These limitations reduce the ability to generalise the findings, but it is important to acknowledge that preventing these issues is difficult, as such past research concerning the use of educational technology during a pandemic is very little.

Recommendations

Future research should consider the factors that made technology usage during the lockdown difficult, as this was a situation where educators had to quickly adapt to a shift in their education system. It is important to recognise that some schools in New Zealand will have better access to devices than other schools. This is mostly determined by school decile and funding for each school. This is a factor that needs to be taken into consideration for future research. Future studies should also take into account how to conduct the pre-test early enough so that participants' reporting is not hindered by recall bias. This may be done by analysing how teachers' self-efficacy, self-beliefs and self-perceptions change during a lockdown, instead of after the lockdown. These recommendations should be considered for future research as these factors have the potential to interrupt the accuracy of the research findings.

Conclusion

Research concerning teachers' self-efficacy regarding students' technology usage during a pandemic is significantly lacking, as there has not been a global pandemic in recent years. Existing research that has focused on teachers' use of technology for teaching and learning purposes has identified a range of benefits which includes an increase in teachers' job satisfaction, confidence, and enjoyment (Gibson & Dembo, 1984), and increases in

students' academic achievement and engagement (Leonard et al., 2010). Such research can be related to the current research, but it has to be recognised that the presence of a pandemic in the current research has provided many challenges that past research has not had to encounter.

Results identified that students' use of educational applications and technology before the Covid-19 lockdown did not significantly change teachers' self-efficacy, self-beliefs, self-perceptions and student factors, in comparison to after the Covid-19 lockdown, although there were slight differences. Additionally, it was investigated whether these constructs being measured were affected by length of teaching experience. Once again, although slight differences were found, they were not statistically significant. Although data analysis suggested that there was no significant difference between pre- and post-lockdown, this is interesting in itself as it may suggest that self-efficacy had already been established with the use of educational technology before the lockdown, due to social support from their school and other educators. Another factor that may have established their level of self-efficacy pre-lockdown is the involvement of professional development programmes, that help educators learn about technology usage in the classroom. Self-efficacy may not have significantly increased from before to after the lockdown, due to factors such as a lack of resources. Findings in this study indicate that there are many factors that can affect teachers' self-efficacy regarding their students' use of technology. In future, there needs to be an emphasis put on how these factors can be maintained when children are unable to attend school for a long period of time.

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Appendix A

Survey questions

Demographics

- What is your gender?
- What region of Aotearoa do you teach in?
- How many years have you been teaching?
- What year levels do you teach?
- What type of school do you teach at?

Self-efficacy

- How well could you gauge student comprehension of content delivered using technology-based resources?
- How well could you develop quality collaborative learning activities for your students through the use of educational apps?
- How well could you motivate your students to engage with educational apps?
- How well could you collaborate with whānau/parents/caregivers to help support students reach their full potential through the use of educational apps?
- How well did you teach your students how to use technology-based resources for at-home learning?

Self-beliefs

- Did you believe that technology-based resources motivated students who demonstrated less enthusiasm with their schoolwork?
- Did you believe that educational apps catered to the learning needs of all students?
- Did you believe that educational apps catered to the learning needs of all students?
- Did you believe that educational apps provided quality explanations or examples for students who required additional support in their learning?
- Did you believe that educational apps could get students to believe that they could do well with their schoolwork?
- Did you believe that the use of educational apps at home improved a student's knowledge of the content learned in the classroom?
- Did you believe that your students enjoyed learning through educational apps?
- Did you believe that student engagement occurred when using educational apps?
- Did you believe that the features included in educational apps helped promote student engagement?
- Did you believe that you had received the appropriate skills and resources from your professional development to successfully teach the use of educational apps to your students?
- Did you believe that the content and available features in educational apps fostered student creativity?
- Did you believe that educational apps promoted students' critical thinking?
- Did you believe that educational apps helped students grasp concepts better?

Self-perceptions

- I felt that educational apps provided appropriate challenges for students in my classroom.
- I felt that I could implement technology-based strategies in my classroom well.
- I felt that the content provided in educational apps complemented the content I taught in the classroom.
- I felt that the features included in educational apps distracted tamariki/children from learning the content.
- I felt that the use of educational apps amongst my students contributed to my job satisfaction as an educator.