Collaborative Kete: Fostering Digital Technologies Agency

Abstract

As of 2020, all schools and kura in Aotearoa New Zealand are expected to teach digital technologies as part of their core curriculum. Our digital world is rapidly expanding and in order to be successful in this space, our rangatahi (youth) need to be capable of both using and creating digital tools. Inequality of access to resources in this area, however, has left our some of our nation's schools woefully underprepared to meet these new requirements. This project seeks to support secondary-school teachers of different subject-specialty areas to authentically integrate computational thinking concepts into their regular teaching practice. This was accomplished through a series of workshops and exploration phases, with a focus on critically reflective practice and ako (reciprocal learning). Questionnaires and observation were used to understand changes in teacher confidence in the areas of understanding, lesson design, and ability to give feedback in relation to computational thinking principles. Results of this research have shown that supporting teachers to learn and apply computational thinking in their classrooms positively impacts their agency in developing high-quality lessons that are aligned with digital technologies curriculum. The findings from this project are intended to support other schools in Aotearoa New Zealand to develop their own frameworks of professional development in this area.

Keywords: Computational Thinking, Professional Learning and Development, Digital Technologies, Education

Introduction

Collaborative Kete: Fostering Digital Technologies Efficacy was an initiative developed to understand how supporting secondary-school kaiako in a variety of subject areas affected their confidence to create, develop, and deliver computational thinking-focused learning experiences. This was done through the teacher (in collaboration with a digital technologies specialist) creating subject specific lessons, as well as a number of hui (meetings): an initial introduction to the concepts surrounding computational thinking and ideas of implementation in different subject areas; the creation of three lessons aligned with computational thinking concepts over the course of the project; and three wānanga(educational meeting) in which teachers gathered to discuss their experiences and further iterate on their lessons. Through this, I hoped to contribute to the reduction of inequitable accessibility to quality digital technologies aligned education in New Zealand, and answer the question of how supporting teachers in learning areas other than digital technologies helps them to build their agency in developing high-quality lessons that are aligned with digital technologies curriculum.

Social justice is the fair distribution of resources and opportunities in society. This does not necessarily mean *equal distribution* as marginalisation and biases have resulted in an inherently unequal society. An aspect of social justice in digital technologies education that this project seeks to address is inequity of access to quality digital technologies resources. These resources include teacher knowledge as well as how they can apply learning without the need for significant investment in hardware. In a socially just world, all students in New Zealand would have access to high quality learning experiences that incorporate digital technologies concepts, regardless of where they go to school.

The participating school is a state secondary school located in South Auckland, New Zealand. It is situated in a relatively low-income community, and has an ethnically diverse student population. This school has a well-established, comprehensive senior digital technologies programme, but its junior digital technologies programme is optional. As the participating high school does not offer Digital Technologies as a compulsory subject at a junior level, in order to meet new requirements set by the Ministry of Education, the school will need to integrate digital technologies concepts into other subject areas. This also has the added benefit of ensuring that computational thinking concepts are explored in authentic and familiar contexts to the students, further increasing its accessibility. This will allow the school to provide more equal accessibility to this content as other schools in the New Zealand.

While the teachers participating in the project were aimed grow in their own understanding of computational thinking concepts and confidence in applying this knowledge to lessons in their own classrooms, there were benefits to other stakeholders as well. Non-participating teachers in the school could expect to have some understanding of the research that the project undertook, and it's applications to their future responsibility of delivering this content. The leadership team (principal, associate principal, and deputy principals) as well as the wider New Zealand digital technologies teaching community could benefit from sharing the project journey and findings which is essential to supporting the participating school and other non-participating schools in the country in their implementation of the new digital technologies curriculum as it can provide a proven pathway to teaching the new skills. In this way, the project will contribute to social justice in digital technologies education in the participating school, as well as other schools in Aotearoa.

Digital technologies education currently rests in a unique position within the Aotearoa New Zealand Curriculum. It exists as a relatively unexplored area of study in primary and secondary schools: diversity of available tools and contexts; lack of standardisation in learning outcomes across schools leading to equitable access to quality education; international lack of available resources suitable for traditional secondary school use (Bell, 2014).

Revisions to the New Zealand curriculum have emphasised the importance of digital technologies in supporting our tamariki to become confident, connected, actively-involved and lifelong learners ("The New Zealand Curriculum", 2007). These revisions require students in all schools in Aotearoa from year one to year ten to meet digital technologies progress outcomes throughout their studies (Ministry of Education, 2018; "Digital Technologies and the national curriculum"). These progress outcomes are in the areas of

computational thinking, and designing and developing digital outcomes. It is essential that all schools within Aotearoa deliver this new curriculum in order to ensure that all students have the opportunity to learn about digital technologies concepts, regardless of the school that they attend.

Evidence

Resources and Teachers

Students in New Zealand should have equitable access to quality digital technologies education. Based on my observations, the shortage of digital technologies expertise across schools in New Zealand has negatively impacted the quality of delivery and content delivery throughout the county. In addition to this, the heavy workload of teachers in regards to planning, assessment, and suitable curriculum information means that the standard of content, delivery, and outcomes, especially in the area of information technology, differ between schools (Clear & Bidois, 2005). As a result of this, it is my understanding that schools will adjust to the changes to the New Zealand curriculum in the same way: differently. This means that students may have access to different content, and content of varying quality. As such, schools that have a wealth of knowledge around digital technologies concepts may have better access to high quality digital technologies education than those who do not. While learners across the country may have access to the necessary technological tools within their school, having access to the tool itself does not necessarily mean that access to education around using the tool effectively is equitably available (Cullen, 2001). In some cases, students do not have satisfactory access to learning from home via device at all. In 85% of New Zealand schools decile three or lower, fewer than three-quarters of all students have internet access at home (N4L, 2019). This means that this lack of equitable access disproportionately affects our country's poorest communities. Equity of access to computers has been a concern since the 1960s. As identified previously, this access does not only refer to physical access to devices, but to learning in this area as well, as technology is now seen as an increasingly vital component of both work and personal life (Jones & Bridges, 2016). All of our tamariki deserve equality in their journey of learning to navigate our rapidly changing digital landscape, and high quality digital technologies education that this project seeks to address is a key part of succeeding in that journey.

Best Practice in Professional Learning Development

Best practice in professional learning development suggests that iterative programmes that allow for theoretical applications into existing practice are more effective at impacting student outcomes than one-time, prescribed practice initiatives.

Expert Led vs Exploration Driven

Single-occurrence workshops and conferences are an extremely popular form of professional learning and development in Aotearoa New Zealand, just as in the United States. Almost all of the studies that I reviewed took this format, and all included some kind of expert either delivering presentations, presenting demonstrations, or both. The Ministry of Education states that there is little evidence that supports the idea that these activities actually affect teacher practice enough to impact student outcomes(Timperley, Wilson, Barrar & Fung, 2007). Garet, Porter, Desimone, Birman & Yoon (2001) say that active engagement in "meaningful discussion, planning and practice" is a core feature of effective professional learning and development. Yadav, Stephenson, & Hong agree with this, adding that the context of information is also incredibly important (2017). Participants need to be involved in more than just listening to speakers and the emphasis should be on developing skills instead of absorbing knowledge (active learning and cooperative learning). The activities of listening to speakers and watching demonstrations, as utilised by many single-occurrence workshops and conferences, leave participants in a passive and unfavorable state of learning. As a result of this, the professional learning development that I lead will heavily focus on skill development and collaboration, with limited “expert-led” presentations.

Collaboration and a Māori Lens

In Aotearoa (New Zealand), we have the benefit of Māori kaupapa that can help guide our learning in responsive ways that are specific to our unique context. Two core concepts of te ao Māori (the Māori world) that can directly support active learning are wānanga and ako. Wānanga describes a dynamic learning environment reliant on the sharing of knowledge, experiences, feedback, and debate. Ako is the idea that all people have valuable knowledge to share and that learning takes place as kōrero (conversation) between equals, rather than expert-led instruction (Bishop, Berryman, Cavanagh, & Teddy, 2007). This concept is usually seen in New Zealand classrooms as teachers learning from their students. This kaupapa Māori (Māori concept) contrasts directly with the approach of most existing research in the area of teacher professional learning and development in the area of computational thinking, and is supported by the recommendations of best practice in New Zealand (Allan, Barr, Brylow & Hambrusch, 2010; Blum & Cortina, 2007; Hickmott & Prieto-Rodriguez, 2018; Imberman, Sturm & Azhar, 2014; Morreale, Joiner, & Chang, 2010; Yadav, Mayfield, Zhou, Hambrusch & Korb, 2014; Garet, Porter, Desimone, Birman & Yoon, 2007). I firmly believe that professional learning and development I lead should follow these principles in order to provide an active learning environment that is most beneficial to the learning of our teachers.

Providing Resources vs Transformation of Teaching Practice

A large number of the existing studies that I researched led professional learning development with a focus on tools or provided resources rather than the teaching practice that supports them (Allan, Barr, Brylow & Hambrusch, 2010; Blum & Cortina, 2007; Hickmott

& Prieto-Rodriguez, 2018; Imberman, Sturm & Azhar, 2014; Morreale & Joiner, 2011; Morreale, Joiner, & Chang, 2010; Yadav, Mayfield, Zhou, Hambrusch & Korb, 2014). While this in itself is not problematic, research says that the most effective change in teaching practice occurs when teachers utilise tools and techniques provided by professional learning opportunities to influence their individual teaching practice (Timperley, Wilson, Barrar & Fung, 2007). For true change to occur, resources and tools provided during professional learning need to be adaptable to each teacher's context (Yadav, Stephenson, & Hong, 2017). Given that teachers' practice, style, values, and expectations vary greatly even between similar environments, this is an impossible feat. In addition to this, as Guskey and Yoon mention, the focus on tools and provided resources also has the inherent risk of creating an "echo chamber", where practice and tools that participants already believe to be effective are emphasised, rather than encouraging the use of methods that are proven to produce results (2009). The individualisation of learning programmes is just as important to student success as it is to professional learning development for teacher practice, and in this project, a focus will be put on this to further encourage change in student outcomes.

Single-Occurance Workshops vs a Learning Journey

According to the New Zealand Ministry of Education, powerful professional learning experiences should allow for teachers to revisit, reflect, and grow in their knowledge and understanding over a period of time (Timperley, Wilson, Barrar & Fung, 2007). This does not mean that time in itself is impactful, but rather that time spent engaging with new ideas and understanding their implications for teacher practice were important for growth (Timperley, Wilson, Barrar & Fung, 2007; Garet, Porter, Desimone, Birman & Yoon, 2001). Guskey and Yoon (2009) agree with this, but argue that one-time initiatives like workshops have been proven to result in positive improvements in student outcomes. However, the workshops they studied focused heavily on active learning activities and opportunities for practice adaptation which have been described as key to effective professional learning and development by the New Zealand Ministry of Education (Timperley, Wilson, Barrar & Fung, 2007). Additionally, in that research, only nine of the 1343 studies were deemed "credible" enough to be used to inform their opinions. Timperley, Wilson, Barrar & Fung agrees with the New Zealand Ministry of Education and stresses the importance of learning taking place in everyday contexts in order to accurately and authentically experience the new knowledge (2008). Despite this, many of the existing professional learning development studies in the area of computational thinking are one-off workshop efforts, and do not provide support over a period of time and follow a one-time model (Allan, Barr, Brylow & Hambrusch, 2010; Blum & Cortina, 2007; Hickmott & Prieto-Rodriguez, 2018; Imberman, Sturm & Azhar, 2014; Morreale & Joiner, 2011; Morreale, Joiner, & Chang, 2010; Yadav, Mayfield, Zhou, Hambrusch & Korb, 2014).

Of the eight projects I studied, only one aligned with an extended, iterative, and adaptive practice-based approach, as suggested by best practice research.

The combination of revisions to the New Zealand curriculum in the area of digital technologies and lack of adequate support to develop the expertise necessary to deliver it,

along with inequitable access to quality education in the area of digital technologies means that more support is necessary to better allow our communities to provide the best digital technologies education possible.

Methodology and Process

This project relied on gathering a range of qualitative and quantitative data from teachers participating in the project. The project was intended to be a series of workshops with time for exploration of content between them. Data was gathered to understand supporting teachers in learning areas other than digital technologies helps them to build their agency in developing high-quality lessons that are aligned with digital technologies curriculum. This data generally came in the form of questionnaire responses and kōrero from wānanga.

Recruitment of Teachers

Participating teachers were invited openly from core subject areas, and as a result of this I recruited a diverse range of teachers from different cultures, values, and preferred learning-styles. This means that participants were able to draw from the experiences and world-views of a wide range of practitioners and through this, improve the accessibility of their lessons to meet the needs of all of their learners. This was a vital part of this project as it was focused on reducing inequality of access to quality computational thinking education, both within and outside the classroom. For the participants, the major outcomes for the project were aimed to be growth in their own understanding of computational thinking concepts and confidence in applying this knowledge to lessons in their own classrooms.

Before and After Hui Tracking

Questionnaires were used to monitor the progress of participants in the areas of how they are feeling in regards to their skills of developing digital technologies-aligned lesson plans as the project progressed. These questionnaires allowed participants describe their confidence in lesson planning, confidence in giving feedback and feedforward, and understanding and awareness in relation to computational thinking. The questionnaire was given four times - once before the first hui, and three further times after each hui. This was to ensure that participants were given time to make connections with new learning, and to allow them to explore what new ideas mean in their own contexts. Each questionnaire contained the same questions, and asked participants to rate their confidence in each area of study on a scale of one to six.

Questionnaire was chosen as the appropriate method to gather this quantitative data because of its efficiency and consistency. Questions were able to be focused on the specific data that was needed, which meant that this data was always reliably collected when it may not have been identified through discussion. Reliability of data collection can sometimes be a concern with surveys, especially in regards to response rate. A high response rate was encouraged in this research through the use of allocated time to complete the survey during

hui. There was only one incidence of non-response and this was a result of the participant being absent from the hui. Efficiency in questioning came at the cost of the richness of data gathered, but this data was still important in affirming my research, and data from observation of kōrero was sufficient in providing additional information. Consistent data was essential in seeing the growth of participants in each area over time. Because of this, the same questionnaire was delivered throughout the project. This eliminated any discrepancies caused by differences in wording and understanding of questions. Likert scale questions were intentionally given with no mid-point (six possible options on the scale) in order to ensure that participants selected a positive or negative response. Unfortunately due to the long periods between questionnaires, it was common for participants to forget their previous responses, and therefore accurately identify changes in understanding. This is another situation where observed conversation was key to supporting any questionnaire responses given by participants.

During Wānanga

Kōrero during wānanga was recorded to better understand the process of each participant's learning. This was recorded as my own informal observations, and made available to participants on request for their own records. Observations included the descriptions and reflections on lessons delivered as part of the project, as well as any additional kōrero that was observed in relation to the project aims.

The recording of kōrero was a suitable method of data gathering because it allowed for rich qualitative data and genuine responses. The data gathered from conversations at the hui was rich in content and substantiated statements made by participants in the questionnaire. It gave better clarity on why they answered the questionnaire in each way, and the relatively unstructured flow of the hui meant that participants could freely offer perspectives and improve their own understanding through ako. A structured approach is often used for focus groups in order to ensure completeness and continuity between interviewees, but this was not a priority in this case as the data was supplementary to quantitative data gathered by the questionnaire. For this research, the main purpose of hui was both ako and reflecting on the journey that we were undertaking as a rōpū. The structure was left intentionally fluid to enable an organic flow of conversation and provide a safe space to encourage the discussion and debate of ideas. Additionally, this process was intended to enable a relaxed environment where all parties involved in the kōrero were treated as equals, as a more structured focus group setting may have established an impression of power imbalance between myself and the participants and affected the data that was gathered.

Refinements to Wānanga

Changes were made between wānanga to strengthen the data gathering process. The questionnaire was presented more clearly after the first wānanga, and participants were expected to complete it before they left the hui. This was as a result of late responses that could have impacted on results as participant's understanding of computational thinking concepts and their applications grew over time. Notes from the wānanga were shared with

participants after each session were shared with participants in order to ensure their validity. This change was made after participants expressed interest in the notes that had been taken.

Findings

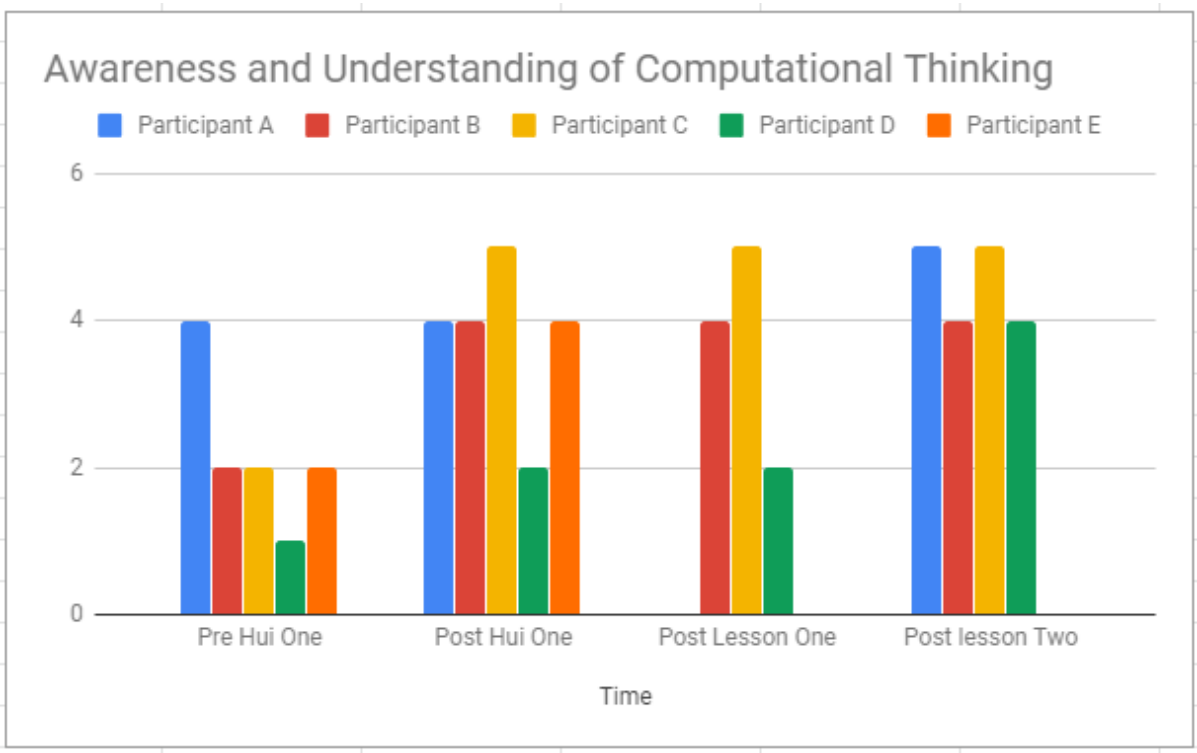

Figure One: Awareness and Understanding of Computational Thinking as Reported by Participants Over the Duration of the Project

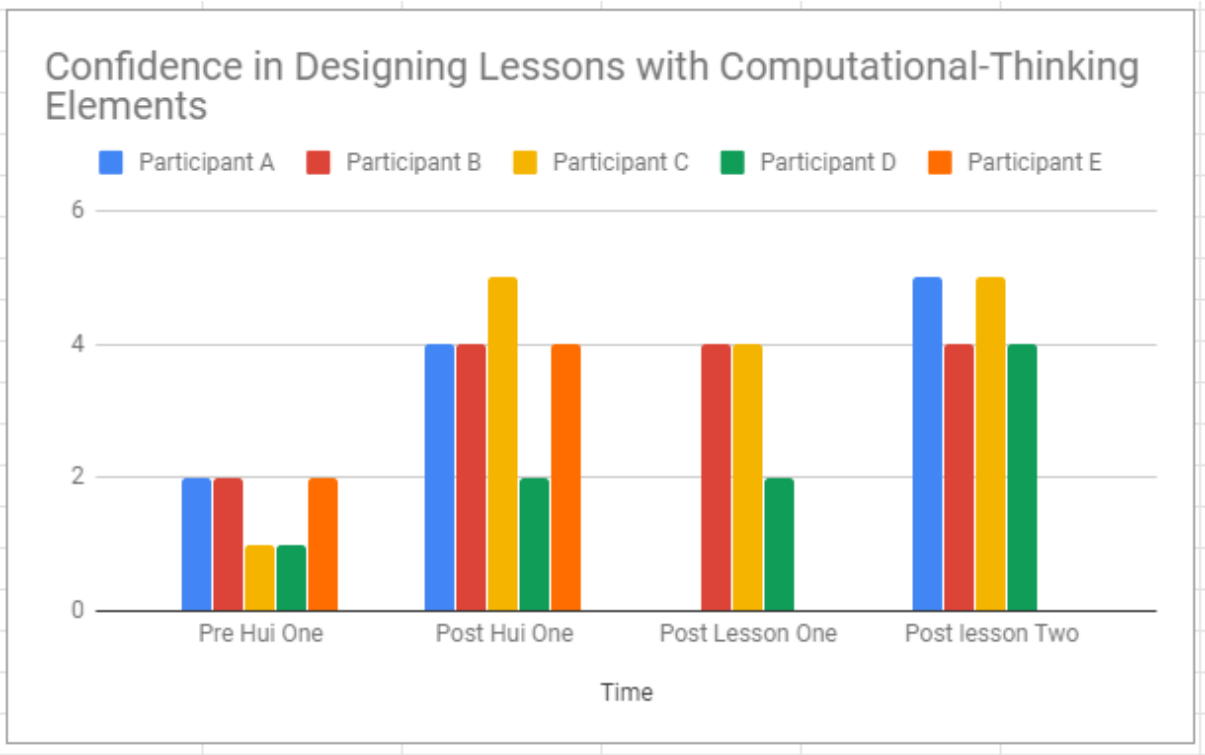

Figure Two: Confidence in Designing Lessons with Computational Thinking Elements as Reported by Participants Over the Duration of the Project

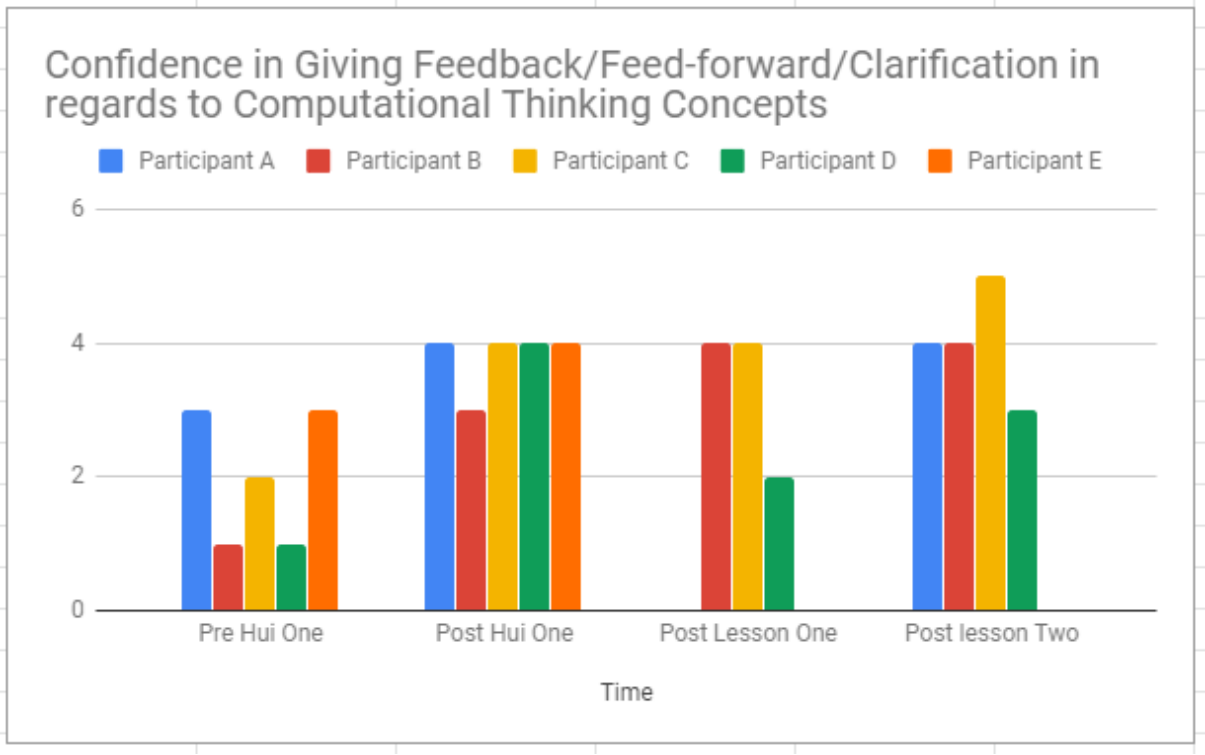

Figure Three: Confidence in Giving Feedback/Feed-forward/Clarification in regards to Computational Thinking Concepts as Reported by Participants Over the Duration of the Project

Overall, the biggest change in all areas (awareness and understanding of computational thinking; confidence in designing lessons with computational thinking elements; confidence in giving feedback/feed-forward/clarification in regards to computational thinking concepts) came after the first hui where participants were introduced to the decomposition and algorithm design areas of computational thinking. Beyond this, there was generally a gradual increase over time in confidence as further lessons were developed and delivered, as shown in figures one, two, and three. This aligns with Timperley, Wilson, Barrar & Fung's (2007) assertion that practice-transforming professional learning development is most effective as a journey or learning, experimenting and reflection, rather than a one-time experience.

The exception to this was Participant A, who only had an increase in confidence in lesson design and ability to give feedback after the first hui, while their awareness and understanding of computational thinking remained the same, as shown in figure one. This was due to the participant's prior knowledge of the topic as they identified that they had studied computational thinking in the past. The benefit for them came through utilising the knowledge in the context of their practice, rather than just being aware of it, as suggested by their increase in confidence in the other two areas over the course of the project, as shown in figures two and three. This consistent with Yadav, Stephenson, & Hong's (2017) findings that recognise contextualisation to be at the heart of knowledge application, rather than a knowledge of the subject matter itself.

The data suggests that in most cases, the initial hui prompted significantly more growth than the creation, delivery, and reflection of lessons over the course of the project, but I found that this was inconsistent with kōrero from participants. When asked about the usefulness of the introductory hui in comparison with the collaborative wānanga, participants stated that they "learned a lot from the practical activities of the first hui", but found the wānanga to be especially valuable, particularly in the areas of sharing ideas and hearing about what other participants were trying in their learning areas (excerpt from research journal). This is important because it meant that participants found benefit and growth in the process of sharing and reflecting on their experiences, which was a key part of the support provided by the project and aligns directly with the Māori concepts of ako and wānanga.

All four participants specifically mentioned that wānanga were a highlight of their experiences, and participants often found that learning activities were both applicable and effective across several learning areas. Participants regularly made suggestions to each other about ways that their activities could be improved and how they could apply similar ideas to their own learning areas. They mentioned sharing resources with other participants, as well as other teachers within the school who weren't participating in the project (excerpt from research journal). This demonstration of integrated ako was key to my own vision of success for the project. These findings demonstrate the value of exploration in transformation of practice over the use of expert-led instruction and provided resources, as found by Garet, Porter, Desimone, Birman & Yoon (2001). This also indicates that participants felt a degree of confidence and understanding of the activity and content that it explores, and by extension, an understanding of computational thinking.

Participants identified that simplification of concepts, as well as providing ample time to reflect, discuss, and explore the implementation of the concepts in their own classroom was key to growth in their confidence and understanding (excerpt from research journal).

The focus on ako and wānanga as a framework guided the model of leadership that this project utilised. As the leader of this project, I had significant experience working with computational thinking concepts and utilising them in my classroom. As a new teacher, however, my knowledge in creating rich and diverse learning experiences was limited, just as my knowledge of content in the subject areas of participating teachers was limited. Participating teachers generally were limited in their knowledge of computational thinking concepts, but had a wealth of knowledge in the creation of engaging learning experiences as well as in their subject-specific areas. This was an ideal scenario for situational leadership to be applied throughout the process.

During the first hui, it made sense for the relationship between myself and the participants to be directive, as the participants were generally high in commitment to the project, but with little understanding of computational thinking. This meant that I was leading the learning and participating teachers were engaging, without much ownership of the process. This, in itself, is not conducive to social justice, but was necessary in order to ensure that participants had a foundation of understanding in computational thinking. After the first hui, participants were able to utilise their existing expertise in lesson design and content-knowledge and start applying their new computational thinking skills to their own subject areas. This is when participating teachers moved away from being part of a directive relationship with me, and into a supportive one. These teachers were developing their own ideas and looking to me and other participants for guidance in implementation, rather than being given content. Finally, some participating teachers moved into a delegate relationship with myself and the other participants, where they were confident in developing and delivering their own lessons without the need for input from other participants. This meant that the support provided by the project helped to grow their agency in developing high-quality lessons that are aligned with digital technologies curriculum.

Overall, all four participants stated that they felt more confident in their ability to develop and deliver lessons that use computational thinking concepts than they did before the project. Two of the four participants also added that while they do feel somewhat more confident, additional time, experimentation, and exploration (especially in the area of student outcomes) are key to affirming their understanding and application of their learning (excerpt from research journal). This means that supporting these teachers helped them to build their agency in developing high-quality lessons that are aligned with digital technologies curriculum.

Impact and Next Steps

Regardless of how well resourced a school or individual is, students should have access to the same quality digital technologies education. Collaborative Kete has allowed teachers and students to apply and explore computational thinking principles when they otherwise may not

have had the opportunity to do so. This means that those students had increased opportunities to grow in their problem solving skills, resilience, and communication skills, that they may not have had if their teachers had not been involved in the project (Ministry of Education, n.d). The teachers who participated gained confidence in the areas of understanding, lesson design, and feedback and feedforward in relation to computational thinking. This means that more students have access to digital technologies education as a result of the increase in confidence from their teachers. While participants have identified that they are not entirely comfortable in this area, this confidence will benefit them as they continue to explore aspects of computational thinking in their own learning areas.

As a result of the project and its findings, the school involved is looking at ways that they can now implement the learning from the pilot programme across other areas of the school. Some of this will involve delivering similar content on a whole staff level, but also looking at ways of encouraging learning areas to identify where they are already using computational thinking in their units. The overall objective is to create a school wide unit plan that allows learning areas to identify where computational thinking is taught in their units and which progress outcomes they fulfil.

The participating school has begun exploring potential ways of educating non-participating teachers on the applications of computational thinking concepts to their lessons. The initial project required extensive resources to relieve participating teachers of their classes so that they would be able to attend hui, and unfortunately, this means that the direct continuation of the project with all teachers at the school is not possible. It is possible that the project take a similar approach to other initiatives in the school, where one teacher from each learning area is appointed the “champion” who engages directly with the content and then disseminates information to other learning area members afterwards. While this is a much more cost-effective route, it means that “non-champions” would not be exposed to the same direct learning, and wānanga aspect of the original project - something that participants identified as a significant benefit of the project. By extension, “non-champion” teachers may not see the same understanding and growth as teachers who participated in the initial project. In this way, this course of action would probably not significantly improve access to quality digital technologies education in New Zealand as is the aim of this project.

Another iteration of this project has been planned to be run during term four of 2019, after changes to content and structure have been made, based on the feedback of participants from this round. This feedback was received after the results of the research had been disseminated to participants, during the final hui. Some of these changes will include the simplification of hui one content, and the inclusion of more interactive activities to support a strong foundation of understanding. Other changes may include monitoring the effects of the lessons on student outcomes, lengthening the project duration, and weaving observation into the process to ensure quality of computational thinking education. These changes would strengthen the research component of the project, take further steps to ensure that learners within the participating school have equality of access to quality computational thinking education, and increase the project’s value to the education community.

Towards the end of this project I reached out to Kia Takatū ā-Matihiko, an initiative developed by the New Zealand Ministry of Education to support schools to implement the new digital technologies curriculum. Kia Takatū ā-Matihiko were impressed by the impact of the approach used and how the collaborative and reflective nature of the process improved the confidence of participating teachers in developing and delivering lessons that teach computational thinking concepts. They offered to support me in sharing the work we had done through Collaborative Kete with other schools in the country through the creation of a showcase video. This video would be made available to other schools on the Kia Takatū ā-Matihiko website. This was an excellent opportunity for our journey through this kaupapa to inform other schools in their own learning and support them to gain more equal access to quality digital technologies education than they otherwise might have had.

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