Primary Digital Technologies Jumpstart Report – 2019

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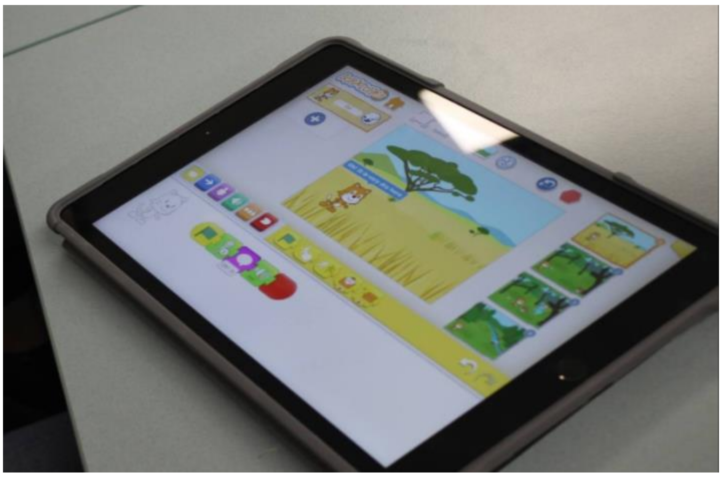

In Partnership with Google & NSW Government Schools

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1 Background

Google Pty Ltd offers the largest international grant scheme that support computer science education. The purpose of the Google Computer Science Educator Professional Development Grant scheme is to make a positive and lasting impact on computer science education around the world. In 2019 Macquarie University applied for and was awarded a $15,000 grant to help primary school in-service and pre-service teachers to address digital technologies outcomes in the classroom by offering stage-based jumpstarter professional learning for schools.

The professional program centred around 2-hour workshops (entitled the "*Jumpstarter workshops*"), which were carefully designed to provide teachers with the core knowledge, capabilities and confidence to teach with digital technologies, including tactile devices, through face-to-face hands-on activities. Teachers were exposed to a range of technologies, and were guided through tasks and teaching strategies that support students to achieve the targeted learning outcomes. The workshops were tailored to the specific stage levels of the teachers, to promote relevance and applicability, with different technologies being used at each level:

- Stage 1: Bluebot, Makey Makey, Scratch Jr.
- Stage 2: Scratch, WeDo 2.0, Makey Makey
- Stage 3: Microbit, WeDo 2.0/Mindstorm EV3, Scratch

Teachers learnt about different sorts of technologies and activities that can be used to develop the computational thinking capabilities of their students. They learnt the disciplinary terminology for the components (e.g. "*controller*") of digital systems and how to explain their functionality. They developed skills in how to use digital systems to solve problems using algorithms, and how to teach their students to do the same. This involved being able to deconstruct the problem, recognise patterns, specify algorithms, and test solutions. Comparing problems and solutions across technologies helped teachers to abstract their understanding of computational thinking problem solving. Threshold concepts for students (e.g. control flow for conditional statements) were discussed, as well as evidence-based pedagogical strategies that teachers could apply. A community-oriented design-based approach was adopted, so that teachers felt supported to trial their digital technology lessons (building their confidence).

After the workshops teachers designed, implemented and collaboratively reflected upon a digital technologies lesson or module. Completing the Digital Technologies Jumpstarter Professional Learning program contributed 7 hours of NSW Education Standards Authority (NESA) Registered PD addressing 2.6.2, 3.4.2, 6.2.2, 6.3.2 and 6.4.2 from the Australian Professional Standards for Teachers towards maintaining Proficient Teacher Accreditation in NSW.

2 Data collection

This study collected both quantitative and qualitative data in order to evaluate the professional learning and better understand the perceptions of in-service primary school teachers. Creswell and Plano Clark (2011) state that mixed method enables a greater degree of understanding to be formulated than if a single approach were adopted to specific studies.

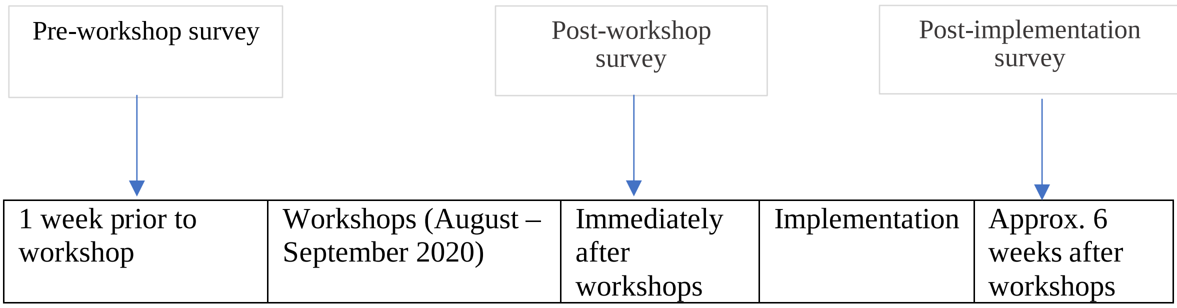

Figure 1. Timeline of data collection

Data collection was in three stages – pre-workshop survey conducted one week prior to the commencement of the workshop, post-workshop survey immediately after the workshop and post-implementation survey, six weeks after the implementation of the class activity (Figure 1). Teacher lesson plans and reflections were also collected via the online course sites that were setup for teachers.

3 Data analysis

In this study, quantitative data was analysed by descriptive statistics of each quantitative item of the questionnaires. All questionnaire data was collected by the Qualtrics online questionnaire platform. Differences between groups were examined using t-tests (Table 1). The quantitative analysis was conducted by using Statistical Package for the Social Sciences (SPSS), Version 25. A significant level of 5% was applied to all statistical tests.

Qualitative data analysis was conducted by using QSR Nvivo, Version 12. The data were explored inductively, by which the codes and category systems were generated by directly examining each answer. The inductive approach was undertaken by outlining the frequency of codes. The approaches to data analysis are summarized in Table 1.

Table 1. Data analysis approach

Strategy	Instrumentation	Purpose
Descriptive Statistics	Online questionnaires	To describe all quantitative data by means, standard deviations, skewness, histograms and pie charts
T-tests	Online questionnaires	To explore any significant differences between pre- and post-workshops.
Coding	All qualitative data	To identify and label common themes

3.1 Participant background

Information about the participant demographics and background were collected in the pre-survey questionnaire in September 2020. In total there were 164 respondents who either completed pre- or post-workshop surveys. Only respondents who finished both pre- and post-workshop questionnaires were included in the sequential data analysis, resulting a total sample of 124 participants. Additionally, there were 45 respondents who also completed the post-implementation survey, and a separate data analysis was performed involving these participants.

The participants were from four schools – Carlingford West Public School (CWPS), Kellyville Ridge Public School (KRPS), Eastwood Public School (EPS), and Sherwood Ridge Public School (SRPS). These schools were all part of the so called NSW Department of Education "*Big School Network*", whose principal saw value in participating in the professional learning program.

Of those completing pre- and post-workshop surveys, 33.1% of the respondents were from KRPS, followed by SRPS (29.8%), CWPS (21.0%) and EPS (16.1%). Regarding the post-implementation survey, 37.8% of respondents were from KRPS, followed by CWPS (28.9%), SRPS (22.2%) and EPS (5%) (Table 2).

Table 2. Number of respondents in different schools

Schools	No. of respondents completed pre- and post- surveys	No. of respondents completed post-implementation survey	Workshop implementation dates
Carlingford West Public Schools (CWPS)	26	13	7th August 2019
Kellyville Ridge Public School (KRPS)	41	17	4th September 2019
Eastwood Public School (EPS)	20	5	11th September 2019
Sherwood Ridge Public School (SRPS)	37	10	12th September 2019

Regarding the pre- and post-workshop surveys, 109 teachers (87.9%) identified as female and 15 teachers (12.1%) identified as male. The age ranges were collected in five-year increments (i.e. the questionnaire with ranges 20-24, 25-29, 30-34, etc.). Over half of the participants were aged between 20 and 34 years (n=65, 52.4%), while the others were aged between 40 and 65 or above years (n=56, 45.2%).

The teachers on average had 12 years of teaching experience. The majority of the teachers (n=86, 69.4%) indicated that they had not completed any course relating to digital technologies, computational thinking or computer programming before. However, most of them (n=97, 78.2%) were aware of the recent K-10 Australian Digital Technologies Curriculum. Of note, the large majority of the teachers (n=89, 71.8%) stated that they had taught less than 20 lessons relating to computational thinking and digital technologies.

3.2 Pre-workshop questionnaire results

The pre-workshop questionnaire was delivered one week before the workshop, with workshop delivery dates indicated in Table 2. The online questionnaire included a mixture of closed and open questions relating to background, experience, their knowledge of computational thinking, their perception on the importance of develop students' digital technologies and computational thinking capabilities, as well as their confidence with technology (Appendix A).

3.2.1 Pre-workshop questionnaire – Likert scale items

The item measuring the importance to develop students' digital technologies and computational thinking was using a seven-point Likert scale ranging from (0) "*Extremely unimportant*" to (6) "*Extremely important*", with (3) being "*Neutral*". Another question about teachers' confident with technology was measuring with also a seven-point scale ranging from (0) "*Extremely unconfident*" to (6) "*Extremely confident*", with (3) being "*Neutral*". Table 3 summarises the mean scores for 124 participants. Respondents indicated that it was important to develop students' computational thinking capabilities (M=5.05) however they were only mildly confident to develop students' digital technologies capabilities (M=3.23). Given that majority of the teachers had not completed any course relating to digital technologies, computational thinking or computer programming before, this low self-confidence rating was not surprising.

Table 3. Pre-workshop questionnaire rating items (All schools)

Pre-workshop	Mean	Standard deviation
How important do you think it is to develop your students' digital technologies and computational thinking capabilities?	5.05	1.23
How confident do you feel to develop your students' digital technologies and computational thinking capabilities?	3.23	1.44

3.2.2 Pre-workshop questionnaire – open-ended responses

In addition to the quantitative data, the pre-workshop questionnaire collected qualitative data using two open-ended questions. These two questions further inquired as to teacher's self-confidence in developing students' digital technologies capabilities:

- *Pre-workshop Q17. What prevents you from feeling confident about developing your students' digital technologies and computational thinking capabilities?*
- *Pre-workshop Q18. What could help you to feel more confident about developing your students' digital technologies and computational thinking capabilities?*

3.2.2.1 Causes of lack of confidence

Table 4 shows the coding frequency that emerged through the thematic analysis of the first qualitative question – what prevents the teachers from feeling confident about developing students' digital technologies and computational thinking capabilities. Teachers before the workshops indicated that "*lack of knowledge or experience*" (82 responses) was the main reason preventing them from feeling confident to help students' learning computational thinking (Table 3). For instance:

> *"Lack of knowledge regarding technologies being used in classrooms to develop computational development and digital intelligences with students."*

"Not knowing the background of how the digital technologies operate and function in order to successfully teach my students those skills and the knowledge and understanding about them"

In addition, teachers were concerned about the lack of resources (16) and lack of opportunities to implement technologies in classroom teaching (15). Diversified needs of students (10), lack of professional development opportunities (9), and lack of time (7) were also mentioned by the teachers. Surprisingly, only five teachers believed that technological issues affected their self-confident in teaching digital technologies.

Table 4. Pre-workshop questionnaire coding frequency – Lack of confidence (Q17)

Themes	**No of coding frequency**
Lack of knowledge or experience	82
Lack of resources	16
Lack of opportunities to implement technologies in classroom teaching	15
Diversified needs of students	10
Lack of professional development opportunities	9
Lack of time	7
Technological issues	5
Unsure	1

3.2.2.2 Ways to build confidence

Teachers stated that in order to build their confidence, they would like to have more availability of resources and information (48 responses) (Table 5). Specifically, they indicated that they would like to "*obtain ideas or strategies to teach computational thinking skills in class*"; or "*some practical ways to incorporate technologies into the Curriculum*". Closely related to resources and information, teachers indicated that they would like to have more training or professional development in terms of workshops or provision of more opportunity to explore and develop teaching skills (37). Teachers also felt that their confidence could be improved through continuous support from experience teachers and professionals (14) as well as some more hands-on experience or practice.

Table 5. Pre-workshop questionnaire coding frequency – Building confidence (Q18)

Themes	**No of coding frequency**
Availability of resources and information	48
Training/Professional Development	37
Support from experience teachers and professionals	14
Need more hands-on experience/practices	13

3.3 Post-workshop questionnaire results

The post-workshop questionnaire was conducted immediately after the workshops to explore participants' perceptions of the workshops as well as their learning and development in three seven-point Likert scale questions, and four open-ended questions (Appendix B).

3.3.1 Post-workshop questionnaire – Likert scale items

Respondents to the question, "*this workshop helped prepare me to teach digital technologies and computational thinking to my students*" confirmed that on average, teachers reviewed the workshop as helpful (M=4.72) (Table 6).

Table 6. Post-workshop questionnaire rating items (All schools)

Post-workshop	**Mean**	**Standard deviation**
This workshop helped prepare me to teach digital technologies and computational thinking to my students	4.72	1.03
After completing the workshop, how important do you think it is to develop your students' digital technologies and computational thinking capabilities?	5.16	0.83
After completing the workshop, how confident do you feel to develop your students' digital technologies and computational thinking capabilities?	4.21	0.95

Examining the item in relation to "*How important do you think it's to develop your student's digital technologies and computational thinking capabilities?*", teachers believed that it was important to develop the capabilities, both in pre- and post-workshop surveys, with 64 and 68 responses respectively (Figure 2). Only one teacher stated that it was extremely unimportant of developing the relevant skills after the workshop. A paired sample t-test was used to determine whether a statistically significant difference existed between the means of the pre- and post-workshops about the teachers' perceptions on the importance of children develop computational thinking capabilities. Results showed that the importance rose to M=5.16, from an initial level of M=5.05, but that this increase was not statistically significant, t(123) = 0.98, p=0.327.

Regarding the item about "*How confident do you feel to develop your students' digital technologies and computational thinking capabilities?*" question, responses indicated that teachers were more confident to develop students' digital capabilities. It was shown in Figure 3 that more teachers rated mildly confident, confident and extremely confident in the post-workshop survey. Teachers' confidence to develop students' capabilities rose from M=3.23 to M=4.21, which was a statistically significant increase, t(123) = 7.52, p=0.000.

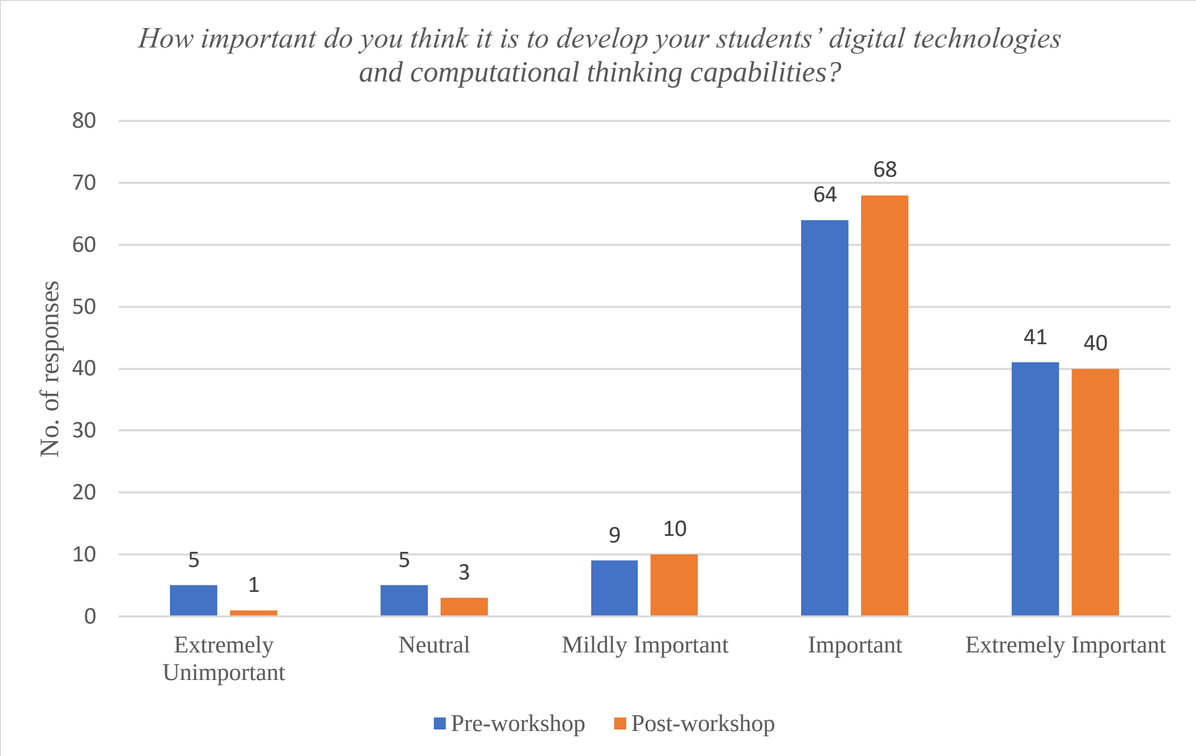

Figure 2. Teacher pre- and post- workshop perceptions of importance of developing their students' digital technologies and computational thinking capabilities

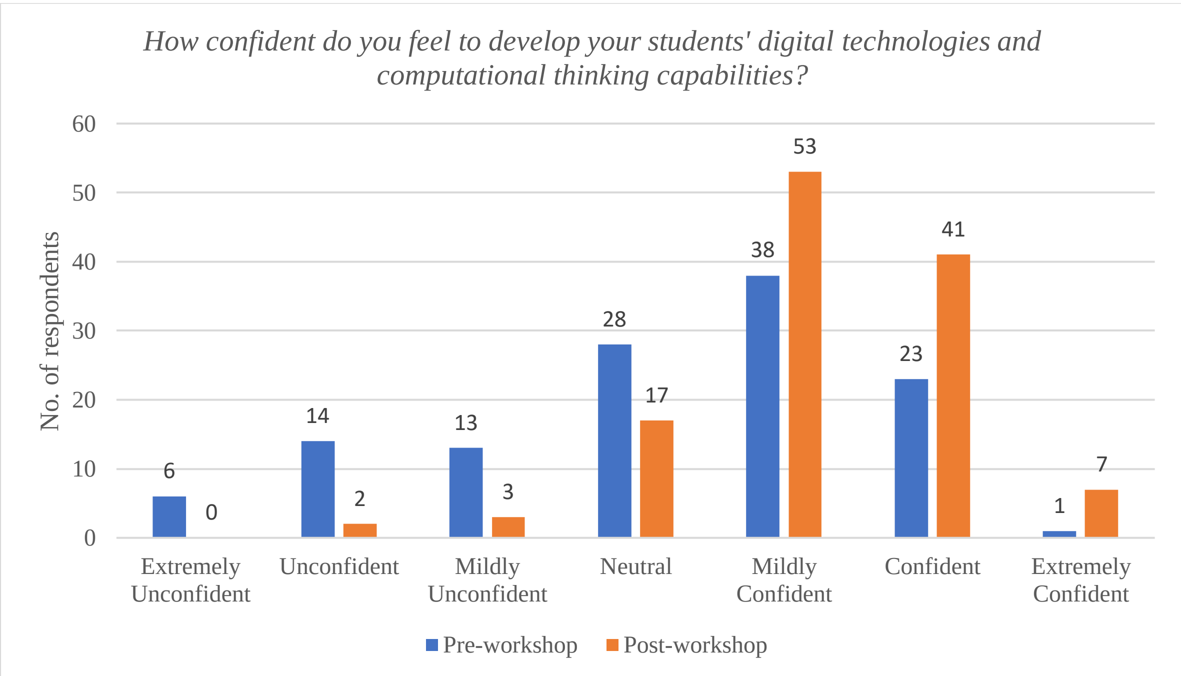

Figure 3. Teacher pre- and post- workshop perceptions of confidence of developing their students' digital technologies and computational thinking capabilities.

3.3.2 Post-workshop questionnaire – open-ended responses

The post-workshop questionnaire included four open-ended questions and qualitative thematic analysis was performed. Question 1 and 2 focused on the effectiveness and the suggestions relating to the workshops, while Question 3 and Question 4 related to the difficulties anticipated in teaching and the assistance needed in general.

- *Post-workshop Q6: What were the most helpful aspects of this workshop and why?*
- *Post-workshop Q7: What suggestions do you have for changing this workshop and why?*
- *Post-workshop Q10: What difficulties do you anticipate when designing and implementing your digital technologies and computational thinking lessons in your upcoming classes?*
- *Post-workshop Q11: What assistance would you like in order to design and implement effective digital technologies and computational thinking lessons in your upcoming classes?*

3.3.2.1 Helpful aspects of workshops

Regarding the helpful aspects of the workshops, teachers benefited from the hands-on experience by using different technologies (70 responses). Example teacher quotations included:

> "*Having hands-on activities where we were able to try and test and become familiar with the different activities before we teach the students the activities*".

> "*The hands-on aspect allows me to experiment and play around with technology that my students will be able to use"*.

In addition, teachers appreciated the applicability of the activities and software in the workshops (23) (Table 7). They valued that the activities could be implemented in their classroom setting. Teachers also obtained knowledge relating to computational thinking as well as unpacking the relevant ideas (23). Another advantage of the workshops was that the collaborative learning environment (18) helped knowledge sharing. For instance, one teacher commented that they particularly enjoyed the "*collaborative nature with stage partners to bounce ideas about the concepts being explored and applied*". The usefulness of the training materials and the assistance from the instructors were valued by the teachers (12). Furthermore, the teachers engaged in the workshop activities and had fun (2).

Table 7. Post-workshop questionnaire coding frequency – Helpful aspects of workshops (Q6)

Themes	Frequency
Hands-on experience by using technologies	70
Applicability of the activities and software - could be implemented in classroom	23
Knowledge/unpacking computational thinking	23
Collaborative learning	18
Instructors/Training materials – useful	12
Engagement/Fun	2

3.3.2.2 Suggested improvements for the workshops

The structure of the workshops was also critiqued by the teachers (65 responses) (Table 8). For instance, they would like to have more time to rotate and try more different activities in the workshop. One teacher mentioned that "*perhaps have a rotation where we get to try all the activities, so we have knowledge of more activities to play around with in the classroom. I would have loved to have a go using the other apps and technology*". Besides, teachers suggested that the practicality of the workshops could be improved (18). Teachers would prefer more time to spend around practical ways of incorporating workshop activities into teaching environment. Some of them felt that the instructions provided in the workshops could be clearer (5) and they wanted more different activities, in addition to Scratch, or LEGO robotics (3). A few teachers mentioned that it would have helped to have more collaborative discussion (2) and organize more workshops in the future (1). However, some teachers believed no change was needed (18).

Table 8. Post-workshop questionnaire coding frequency – Suggestions (Q7)

Themes	Frequency
Structure of the workshops, e.g. able to rotate and try more activities	65
No change	18
Improve the practicality of the workshops	18
More/clearer instructions	5
Varity of activities (e.g. not only Scratch)	3
More collaborative discussion	2
More workshops in the future	1

3.3.2.3 Difficulties anticipated in the upcoming classes and assistance needed

A number of anticipated difficulties for upcoming classes were raised at the workshop. Teachers were concerned about the lack of adequate resources when designing and implementing digital technologies and computational thinking lessons in their upcoming classes (54 responses) (Table 9). They worried that "*some of the digital technologies will be difficult to access*". Also "*the availability of resources such as Makey Makey and Bluebot to implement lessons"* was one of the major challenges. The participants were concerned about their ability to effectively use digital technologies in their lessons (32), and also the ability of students (25) . For instance, one teacher was concerned about "*my own lack of knowledge and understanding*" would make the classroom teaching difficult. Another teacher feared that "*it might be tricky explaining how these digital technologies work on a scientific level to younger students who don't have much scientific literacy at their stage level*". Lack of time in the curriculum (24) was described as foreseeable problem by the teachers. Also, how to prepare teaching materials with clear and explicit instructions (11), technological issues (8), how to incorporate the computational thinking into curriculum (7) as well as no opportunity to teach these ideas in class (6) were mentioned by the participants.

Table 9. Post-workshop questionnaire coding frequency – Difficulties (Q10)

Themes	Frequency
Lack of hardware resources (e.g. Wi-Fi, availability of technologies)	54
Teacher efficacy	32
Student efficacy/ability	25
Lack of enough time in the curriculum	24
Prepare teaching materials - how to provide clear and explicit instructions	11
Technological issues	8
How to incorporate into curriculum	7
No opportunity to teach	6
None	2

3.3.2.4 Types of assistance desired

There were eight different assistance the participants would like to have in order to design and implement effective digital technologies and computational thinking lessons (Table 10). Having lesson exemplars, lesson ideas or resources was an area of focus for the teachers (48 responses). For instance, teachers mentioned that:

> *"I would like to have stage-based NSW Syllabus linked lesson exemplars, in a variety of formats (e.g. Mini lessons, hour long, term units of work) which explicitly identify the computational thinking components".*
>
> *"Access to examples of previously designed programmes".*
>
> *"I would like lesson examples from the beginning to show the sequential development from the beginning".*
>
> *"Some sample lessons to work from, perhaps units of work that we can modify to suit our students".*

Access to variety of technologies and technological resources (19) especially at schools was described as one of the supports they needed. Teachers also indicated that they would like to have more collaboration with others, for team teaching or to have the opportunity to observe others' lessons (10). Teachers also desired more time to go through links and materials provided (10). Expert assistance (8) was also desired by the teachers.

Table 10. Post-workshop questionnaire coding frequency –Assistance (Q11)

Themes	Frequency
Lesson exemplars, lesson ideas/materials (e.g. videos; written guidelines; websites)	49
Access to variety of technologies/technological resources (e.g. at school)	19
None	11
Collaboration with others/team teaching/observations	10
More time	10
Expert assistance	8
More workshops/training/professional development	7

3.4 Post-implementation questionnaire results

3.4.1 Post-implementation questionnaire – Likert scale items

A post-implementation questionnaire was sent to teachers after they had completed their modules in August to September 2019, which was completed by 45 participants. Quantitative data was collected in terms of three seven-point Likert scale questions (Appendix C). Table 11 summarises the mean scores for the three Likert-scale items in the post-implementation questionnaire. In general participants believed the professional learning program was helpful (M=4.36). Teacher believed that it was important to develop students' digital technologies and computational thinking capabilities (M=5.07) and overall indicated a degree of confidence to develop students' capabilities (M=4.22).

Table 11. Post-implementation questionnaire rating items (All schools)

Post-implementation	Mean	Standard deviation
This professional learning program has helped prepare me to teach digital technologies and computational thinking to my students	4.36	1.21
After completing the professional learning program, how important do you think it is to develop your students' digital technologies and computational thinking capabilities?	5.07	0.70
After completing the professional learning program, how confident do you feel to develop your students' digital technologies and computational thinking capabilities?	4.22	1.15

To indicate the trend of change in the perception of importance to develop students' digital capabilities, Figure 4 showed that the level of importance increased from pre-workshop (M=5.05) to post-workshop (M=5.16) but was slightly decreased in the post-implementation survey (M=5.07). A paired sample t-test was conducted with those 45 teachers who completed both the post-workshop as well as post-implementation workshop surveys and no statistically significant difference was found, $t(44) = 0.21$, $p = 0.84$. Therefore we can see that the workshops, and implement computational thinking lessons did not increase teachers' perceptions of the importance of developing their students' digital technologies and computational thinking abilities, with ratings already quite high (slightly above Agree towards Strongly Agree).

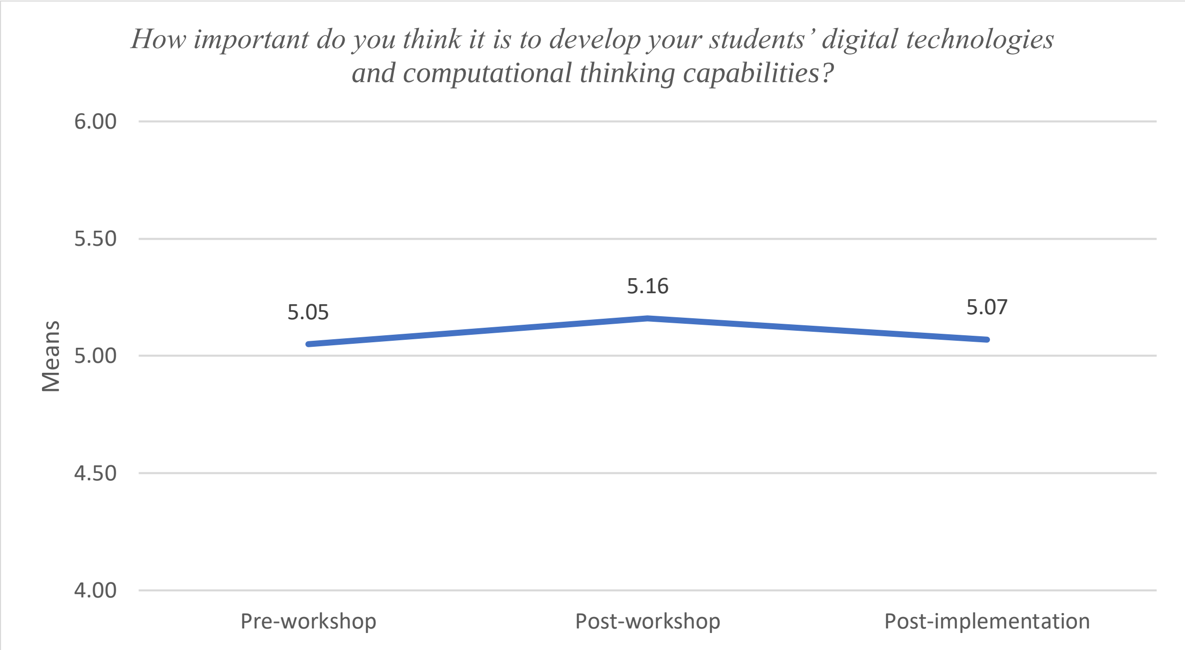

Figure 4. Responses to question "How important do you think it is to develop your students' digital technologies and computational thinking capabilities?" – pre-workshop, post-workshop and post-implementation

However, in regard to levels of confidence to develop digital capabilities in students, there was an obvious trend that the workshops helped improving the teachers' confidence and that this increase in confidence was maintained after teachers had implemented their lessons (Figure 5). This indicates that the workshops had a significant and sustain impact on teacher confidence, which constituted a positive outcome for the project.

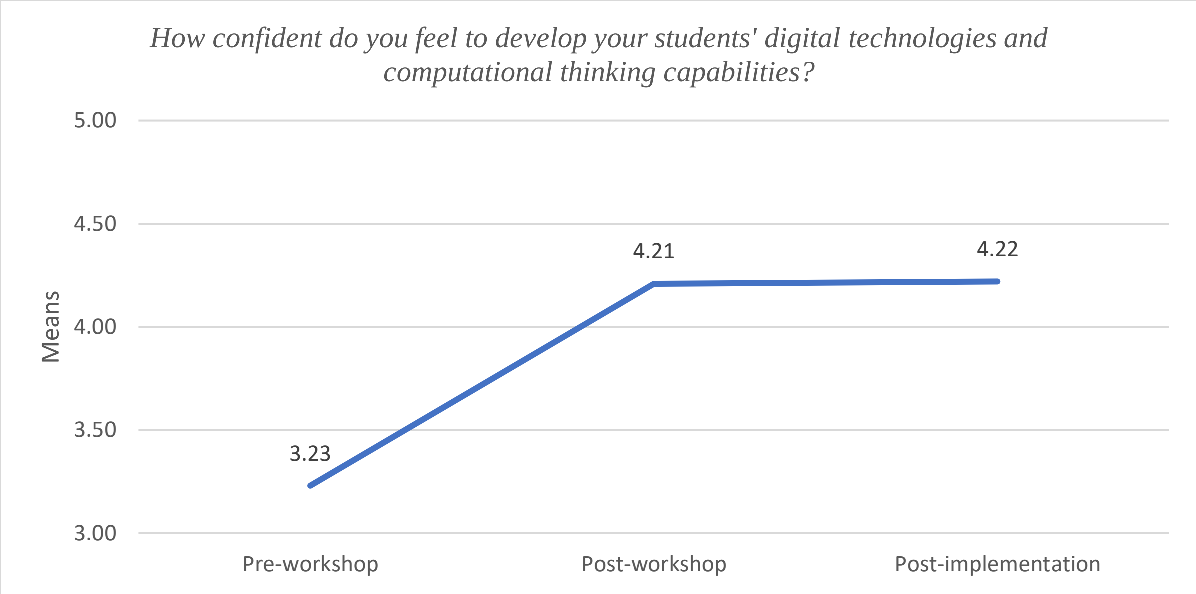

Figure 5. Responses to question "How confident do you feel to develop your students' digital technologies and computational thinking capabilities?" – pre-workshop, post-workshop and post-implementation

3.4.2 Post-implementation questionnaire – open-ended responses

The post-implementation questionnaire included five open-ended questions that in a large extent same as those asked in the post-workshop questionnaire, with one additional question about pedagogical strategies used by the teachers. Question 7 invited teachers to share the most helpful aspects of the professional learning program, while Question 8 asked teachers some suggestions they had for changing the program. Question 12 explored difficulties teachers experienced in teaching whereas Question 13 investigated pedagogical strategies used by the teachers. Question 14 asked teachers what assistant they most needed.

- *Post-implementation Q7:* What were the most helpful aspects of this professional learning program and why?
- *Post-implementation Q8: What suggestions do you have for changing this professional learning program and why?*
- *Post-implementation Q12: What difficulties did you experience when designing and implementing your digital technologies and computational thinking lessons in your classes?*
- *Post-implementation Q13: What pedagogical strategies (if any) did you use when designing and implementing your digital technologies and computational thinking lessons, and how successful were they?*

- *Post-implementation Q14: What assistance would you like in order to design and implement effective digital technologies and computational thinking lessons in your future classes?*

Due to the similarity of questioning used in both the post-workshop questionnaire and post-implementation questionnaire, the research team decided to build on the themes that were used for the earlier questionnaire.

3.4.2.1 Helpful aspects of professional learning program

Similar to the post-workshop questionnaire, the most commonly referenced theme was the hands-on experience by using different technologies (25 responses) (Table 12). Some quotations include:

> "*I feel the most helpful aspect was the hands-on approach being able to manipulate the different items in order to see how it worked.*".

> "*I appreciate the hands-on workstation activities where we got to use the technologies. We were able to test and try different models to complete the design.*".

In addition, teachers said that the training materials were very useful (16). Teachers emphasised the applicability of the activities and software in the program (9). They believed the collaborative learning, e.g. team teaching was helpful. They also valued the expert support (3) and the knowledge about computational thinking (2).

Table 12. Post-implementation program coding frequency – Helpful aspects (Q7)

Themes	Frequency
Hands-on experience by using technologies	25
Training materials - useful	16
Applicability of the activities and software - could be implemented in classroom	9
Collaborative learning, e.g. Team teaching	8
Expert support	3
Knowledge/unpacking computational thinking	2

3.4.2.2 Suggested improvements for professional learning program

Teachers still preferred some changes to the structure of the workshops/program, especially the allocation of time within workshops (22 responses) (Table 13). One teacher stressed that:

> *"Provide enough time to experiment with all the available technology in the workshop. I only got to work with the Blue-Bots. There was no time given for Makey Makey or Scratch. I had already worked with Bee-bots prior to this workshop so I*

would have liked to have tried the other technology available."

A number of teachers would like to see improvement in the practicality of the workshops (11). For instance, they would like to have information on "*activities or examples linked specifically to the Curriculums*" or "*I would like to play with something I could actually use at school"* in order to increase the practicality of the workshops. Some teachers would like to have more or clearer instructions on how to use technologies (4). They also encountered issues with Moodle (2) where the resources for the workshop were held and where they needed to upload their reflections. They also wanted more workshops in the future (2).

Table 13. Post-implementation program coding frequency – Improvements (Q8)

Themes	Frequency
Structure of the workshops/program, e.g. able to rotate and try more activities	22
Improve the practicality of the workshops	11
No change	8
More/clearer instructions on how to use technologies	4
Issues with Moodle	2
More workshops in the future	2

3.4.2.3 Difficulties experienced in classes

The post-implementation responses showed that teachers were concerned about the lack of sufficient resources in schools, especially for the students (10 responses) (Table 14). Teachers particularly worried about the following issues:

> "*We are not having enough resources for all the students. We wanted to use Makey Makey, however, to deliver that lesson properly you need laptops for all students. As such, we had to change our plans*".
>
> "*Lack of resources. Had to share minimal resources around the school"*.
>
> "*Not enough technology for 1:1*."

Like the post-workshop responses, teacher efficacy was also mentioned by teachers (7). They worried that "*I do not have enough knowledge/experience using these technologies - spent a lot of time in the holidays using the apps and understanding how to use them*", and "*I have very limited knowledge or confidence in this field of teaching. To be honest, I didn't know where to begin".*

Also, other difficulties were raised like the structure of the class activities (5), time management in class (5), student efficacy/ability (3) and linkage between computational thinking and the class activities (3).

Table 14. Post-implementation program coding frequency – Difficulties (Q12)

Themes	Frequency
Lack of hardware resources (e.g. Wi-Fi, availability of technologies)	10
Teacher efficacy	7
None	7
Lack of time in the curriculum	7
Structure of the class activities	5
Student efficacy/ability	3
Linkage between computational thinking and the class activities	3

3.4.2.4 Pedagogical strategies used

Teachers in post-implementation questionnaire mentioned different pedagogical strategies used when designing and implementing digital technologies and computational thinking lessons. Nearly all of the strategies were collaborative, learner-led, inquiry-based and constructivist (Table 15). Many teachers used collaborative learning (10 responses), followed by student-centred learning (9), explicit teaching (7), problem-based learning (7) and they also modelled and scaffolded the lesson (6) (Table 15). Some other teachers used experiential learning (4), differentiated teaching (4), inquiry-based learning (2). A few teachers indicated that they did not use any particular pedagogies (3).

Table 15. Post-implementation program coding frequency – Pedagogies (Q13)

Themes	Frequency
Collaborative learning	10
Student-centred learning	9
Explicit teaching	7
Problem-based learning	7
Modelling and scaffolding the lesson	6
Experiential learning	4
Differentiated teaching	4
No particular pedagogy	3
Inquiry-based learning	2
Others	2

3.4.2.5 Types of assistance needed

Teachers in the post-implementation survey revealed that they would like to obtain six different types of assistance (Table 16). Similar to the post-workshop survey, teachers still wanted to have lesson ideas, lesson plans exemplars and instructions relating to design and implement effective digital technologies and computational thinking lessons (24 responses). Less frequently raised forms of assistance included more workshops, training, or professional development were needed (6) better access to technologies and technological resources at schools (5), more time to teach digital technologies and computational thinking (4), more hands-on experience or practices (4) as well as one-on-one expert assistance (2).

Table 16. Post-implementation program coding frequency – Assistance (Q14)

Themes	Frequency
Lesson exemplars, lesson ideas/materials	24
More workshops/training/professional development	6
Access to variety of technologies/technological resources (e.g. at school)	5
More time	4
More hands-on experience/practice	4
Expert assistance	2
None	2

4 Summary

In this study, the answers of a total of 164 respondents who either completed pre- or post-workshop surveys were recorded. Only respondents who finished both pre- and post-workshop questionnaires were included in the sequential data analysis, with a total sample of 124. Additional 45 respondents completed the post-implementation survey, and separate data analysis was performed. The respondents were recruited from four schools - Carlingford West Public Schools (CWPS), Kellyville Ridge Public School (KRPS), Eastwood Public School (EPS), and Sherwood Ridge Public School (SRPS).

Paired sample T-tests of pre- and post-workshop questionnaire revealed increase teachers' confidence to develop their students' digital technologies and computational thinking capabilities from a mean of $M=3.23$ to $M=4.21$, which was a statistically significant increase ($t(123) = -7.52$, $p=0.000$). After the workshops teachers also stated that it was important to develop their students' digital technologies and computational thinking capabilities. The mean scores rose from $M=5.05$ (pre-workshop) to $M=5.16$ (post-workshop), though this increase was not shown to be statistically significant.

Teachers felt that the most useful aspect in both the pre- and post-workshops was the hands-on experience by using technologies. The main suggestion for improvement was to change the structure of the workshops, hence enable the participants to try more activities. However, the ability of teachers to try all of the different workstations was constrained by the 2-hour time allocation available for the workshops after school. The main difficulty that teachers experienced when designing and implementing digital technologies and computational thinking lessons classes was the lack of hardware resources (e.g. Wi-Fi, availability of technologies). The teachers would like to have lesson exemplars, lesson ideas/resources (e.g. videos; written guidelines; websites) in order to design and implement effective digital technologies and computational thinking lessons in future classes.

APPENDICES

Appendix A: Pre-workshop questionnaire

Digital Technologies and Computational Thinking Jumpstarter Workshop

ONLINE REGISTRATION AND CONSENT FORM

Thank you for your interest in participating in this Digital Technologies and Computational Thinking Jumpstarter Workshop. Please let us know a little bit about yourself so that we can customise the workshop to meet your needs. Note that at the end of this registration form you will be asked whether you are willing to have your contributions to this workshop used anonymously for research purposes. Declining to have your contributions anonymously used for research purposes will in no way jeopardise your opportunity to complete this workshop. Further details are provided at the end of this registration form.

1. First name:____
2. Surname: ____
3. School name: ____
4. Work e-mail address:____
5. How many years of teaching experience do you have to the nearest year? (whole numbers only, e.g. 4): ____
6. Which years/classes do you usually teach?____________________________________
7. Have you ever completed a course relating to digital technologies, computational thinking or computer programming before?
    - Yes
    - No
8. If 'yes' is selected please briefly outline the content and scope of the course/s (e.g. 3 day course on programming, university semester on information systems, etc.)
9. What is your gender?
    - Male
    - Female
    - Prefer not to say
10. What is your age? (Don't worry, we won't tell anyone!)
    - 20-24
    - 25-29
    - 30-34
    - 40-44
    - 45-49
    - 50-54
    - 55-59
    - 60-64
    - 65+
11. Are you aware of the recent K-10 Australian Digital Technologies Curriculum?
    - Yes
    - No
12. Have you heard of the term "computational thinking" before completing this form?
    - Yes
    - No
13. In your teaching career how many lessons do you estimate you have taught relating to computational thinking and digital technologies? (e.g. 12)________________________________

14. What digital technologies lessons/modules have you taught before (please indicate the year level and technologies used)?____
15. How important do you think it is to develop your students’ digital technologies and computational thinking capabilities?
    - Extremely unimportant
    - Unimportant
    - Mildly unimportant
    - Neutral
    - Mildly Important
    - Important
    - Extremely Important
16. How confident do you feel to develop your students' digital technologies and computational thinking capabilities?
    - Extremely Unconfident
    - Unconfident
    - Mildly unconfident
    - Neutral
    - Mildly Confident
    - Confident
    - Extremely Confident
17. What prevents you from feeling confident about developing your students' digital technologies and computational thinking capabilities? ____
18. What could help you to feel more confident about developing your students' digital technologies and computational thinking capabilities?____

Appendix B: Post-workshop questionnaire

Digital Technologies and Computational Thinking Jumpstarter Workshops

POST-WORKSHOP FEEDBACK SURVEY

Thank you for participating in this Computational Thinking and Digital Technologies Jumpstarter workshop. Please complete this brief feedback survey to let us know your impressions of the workshop and how we might best cater to the needs of teachers in future.

1. First name: ____
2. Surname:____
3. School name:____
4. Work e-mail address:____
5. This workshop helped prepare me to teach digital technologies and computational thinking to my students.
    - Strongly Disagree
    - Disagree
    - Mildly Disagree
    - Neutral
    - Mildly Agree
    - Agree
    - Strongly Agree
6. What were the most helpful aspects of this workshop and why?______________________
7. What suggestions do you have for changing this workshop and why?__________________
8. After completing the workshop, how important do you think it is to develop your students' digital technologies and computational thinking capabilities?
    - Extremely Unimportant
    - Unimportant
    - Mildly unimportant
    - Neutral
    - Mildly Important
    - Important
    - Extremely Important
9. After completing the workshop, how confident do you feel to develop your students' digital technologies and computational thinking capabilities?
    - Extremely Unconfident
    - Unconfident
    - Mildly unconfident
    - Neutral
    - Mildly Confident
    - Confident
    - Extremely Confident
10. What difficulties do you anticipate when designing and implementing your digital technologies and computational thinking lessons in your upcoming classes?______________________
11. What assistance would you like in order to design and implement effective digital technologies and computational thinking lessons in your upcoming classes?______________________

Appendix C: Post-implementation questionnaire

Computational Thinking and Digital Technologies Jumpstarter Workshops

POST-IMPLEMENTATION FEEDBACK SURVEY

Thank you for participating in this Computational Thinking and Digital Technologies Jumpstarter professional learning program. Please complete this brief feedback survey to let us know your impressions of the overall program and how we might best cater to the needs of teachers in future.

1. First name:____
2. Surname:____
3. School name:____
4. Work e-mail address:____
5. Stage you teach:
    1. Early Stage 1 (Kindergarten)
    2. Stage 1
    3. Stage 2
    4. Stage 3
6. This professional learning program has helped prepare me to teach digital technologies and computational thinking to my students.
    - Strongly Disagree
    - Disagree
    - Mildly Disagree
    - Neutral
    - Mildly Agree
    - Agree
    - Strongly Agree
7. What were the most helpful aspects of this professional learning program and why?
8. What suggestions do you have for changing this professional learning program and why?
9. After completing the professional learning program, how important do you think it is to develop your students' digital technologies and computational thinking capabilities?
    - Extremely Unimportant
    - Unimportant
    - Mildly unimportant
    - Neutral
    - Mildly Important
    - Important
    - Extremely Important
10. After completing the professional learning program, how confident do you feel to develop your students' digital technologies and computational thinking capabilities?
    - Extremely Unconfident
    - Unconfident
    - Mildly unconfident
    - Neutral
    - Mildly Confident
    - Confident
    - Extremely Confident
11. Did you end up designing and implementing a module of work relating to Digital Technologies and or Computational Thinking?
    - Yes

- No

If answer NO, Skip to Q16.

12. What difficulties did you experience when designing and implementing your digital technologies and computational thinking lessons in your classes?____
13. What pedagogical strategies (if any) did you use when designing and implementing your digital technologies and computational thinking lessons, and how successful were they?______________
14. What assistance would you like in order to design and implement effective digital technologies and computational thinking lessons in your future classes?_____________________
15. Please enter your NESA registration number:____
16. What was the main reason or reasons that you did not design and implement your digital technologies computational thinking lesson or module?___________________________________