# Game-coding workshops in New Zealand public libraries

## EVALUATION OF A PILOT PROJECT

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# Executive summary

## What was the project?

This report evaluates a learning-to-code-a-game workshop pilot project offered in seven public libraries around New Zealand. The project was funded through the Unlocking Curious Minds fund administered by the Ministry of Business, Innovation, and Employment (MBIE). The project was created and delivered through a partnership between Public Libraries of New Zealand, Gamelab, Hutt City Council, and public libraries in Dunedin, Timaru, Nelson, Hutt City, Gisborne, Porirua, and Wellington. Free one-day workshops were offered to adults, and young people aged 9–14 and 15–18, mostly during school holidays. Workshop participants were taken step-by-step through the process of creating their own simple 2D videogame, learning the basics of coding, computational thinking, and digital game design.

The New Zealand Council for Educational Research (NZCER) evaluated the project in relation to its key goals and aims of:
- engaging young New Zealanders with science, technology, engineering, and mathematics (STEM), and showing pathways into future careers involving STEM
- engaging young people with public libraries as places to extend their STEM learning
- testing and refining the effectiveness and sustainability of the pilot model and improving the usability of Gamefroot (a game-building platform) for novice users in community contexts.

The evaluation included elements of formative, process, and impact evaluation (limited to short and medium-term impact for participants, due to scope).

## Who came to the workshops?

In total, 426 people attended game coding workshops in seven locations: 90 adult participants and 336 young people (18 years or under). Eighty-five percent of participants completed an online evaluation form at the end of the workshop.

The workshops were mostly attended by young people aged 10–12 (accounting for 59 percent of all youth participants). The student workshop participants were predominantly boys (74 percent boys compared with 26 percent girls). Conversely, adult workshop participants were predominantly women (68 percent female and 25 percent male). Sixty-nine percent of participants identified themselves as New Zealand European/Pākehā, and 18 percent identified as New Zealand Māori. Smaller proportions identified as having other ethnic backgrounds.

The most common reason adults came to the workshop was so they could learn enough to support young people to learn coding or game design. Just under a third of adult participants were primary school teachers (Years 1–8). Other participants included staff from public libraries, secondary school teachers, people who worked for a regional council, and people from a range of other jobs. Some adults were doing the workshop for other reasons including their own learning and fun, because it was good for their career, or to support their children/whānau to learn through coding and game design.

## What was their prior experience with coding and game design?

Overall, 56 percent of participants said they had never made a digital game before, and 36 percent said they had never done any kind of coding or programming prior to the workshop. Young people were much more likely than adults to say they *had* made a digital game before, and boys were more likely than girls to say this. Women and girls were less likely to say they had prior coding or programming experience than men and boys. Regardless of whether they had prior coding or game-building experience, most of the young people said they had prior experience with Minecraft (84 percent). Adults were far less likely than young people to have used Minecraft (22 percent).

## What did participants think about the workshops?

Most participants agreed with a series of statements about the workshops, including that it was fun, they learned a lot, and that they had at least one "aha" moment during the day. Younger participants were more likely than adults to agree or strongly agree that the workshop had inspired them to try to make their own games or apps to sell, and boosted their interest in a possible future career in game design, coding, or programming. Adults were more likely than young people to agree that the workshop helped them see how maths is relevant for coding and game design, and that they learned more about the terminology (words) people use to talk about coding and game design.

## What did they think they could do by the end of the workshop?

By the end of the workshop, young people overall appeared more confident than adults about what they would be able to do easily on their own with Gamefroot, including making their own games, and teaching someone else what they had learned. Young people and adults who had prior experience making a digital game were also more likely to say by the end of the workshop that they could make a different kind of game in Gamefroot, publish a game in Gamefroot, or teach someone else how to use Gamefroot.

Between 80 and 90 percent of those who identified as primary or secondary teachers said they would apply what they had learned in the workshop in their work with young people.

## Participants' views about learning, coding, and game design

Both adults and young people tended to agree that:
- public libraries are a good place to run workshops about coding and game design
- public libraries are a good place to find out about careers involving STEM
- all students should learn coding and game design at secondary school.

There was less agreement that all students should learn coding and game design at primary school, although a third of teachers (and just under a third of young people) strongly agreed that they should. Most participants thought that playing and/or making games could help them to learn. Most participants tended to think they learned about technology and computer programming, how to be creative, and solve

problems. Adults had a stronger tendency than young people to say they learned how to solve problems, how to design, that they learned about maths, or that they learned persistence. Young people were more likely to say they learned to be a team player, how to react fast, and about other people through games.

Participants could offer an example of something they thought they had learned through making or playing games. While many young people restated the fact that learning to code a game helped them learn about coding (27 percent of respondents) and game design (24 percent of respondents), some gave more detailed insight into young people's views of their own learning. Distinct themes in young people's answers included the ideas that:

- making and playing games helped them learn to think strategically, logically, and creatively (15 percent of respondents)
- coding and making games is harder than you might think; making a game helped to "demystify" computers and coding (8 percent)
- you learn things about yourself through playing and making games (5 percent).

In discussing their own learning through playing or making games, adults most commonly mentioned:

- logic and problem-solving (30 percent of respondents)
- coding, scripting, and programming (24 percent of respondents)
- challenges/difficulty of coding and making games (12 percent of respondents).

## What did adult participants do after the workshop?

Thirty-five adult participants gave permission for NZCER to contact them for research purposes after the workshops, and 16 responded to a brief follow-up survey. Of the 16 respondents, all said the workshop had been useful for their professional practice, and about half had used Gamefroot or done other activities related to coding and game-making since the workshop. Of those who had not, the most common explanation was that they had not yet had time to do so.

Adults were asked to give their views on possible areas for improvement. There was reasonably high support for the suggestion of longer workshops or two-day workshops for adults. They also suggested additional resources such as videos and further print resources would help adults and their students get the most out of Gamefroot. Other suggestions included ongoing support from the facilitators/Gamefroot, and the possibility of crowd-sourced resources.

## Conclusion: How effective was the project in meeting its goals?

Based on the data gathered for this evaluation, the final chapter of the report draws some preliminary conclusions about the effectiveness of the project in meeting its key goals, and identifies areas for improvement. These include continuing to use formative and process evaluation for improvement-focused purposes, and strengthening the engagement of girls, Māori, and Pasifika in learning to code and design games.

# 1.

# Introduction

## What was the project?

This report evaluates a learning-to-code-a-game workshop pilot project offered in seven public libraries around New Zealand between September 2015 and February 2016.[1] The project was made possible through funding from the Unlocking Curious Minds fund administered by the Ministry of Business, Innovation, and Employment (MBIE). This contestable fund supports "innovative projects that will excite and engage New Zealanders, particularly young people (aged 18 years and under), who have fewer opportunities to be involved with science and technology". The project[2] sought to achieve this goal by providing entry-level game-building workshops in public libraries, using an accessible visual coding platform (Gamefroot) that requires no prior coding knowledge.

One of the goals for the project was to increase access and opportunity for young people who might not otherwise have the chance to engage with coding, computer science, and game design. It was hoped that the project would particularly reach young people from economically and socially disadvantaged backgrounds, as well as those typically underrepresented in computer science and STEM (including girls, Māori, and Pasifika). Where possible, the project sought to promote the workshops to communities and schools to support these goals. However, promotional strategies were also designed to reach a wide general audience, and the workshops were open to all interested parties.

The project was created and delivered through a partnership between Public Libraries of New Zealand, Gamelab (the makers of Gamefroot), and Hutt City Council. Implementation was supported by staff at the seven regional public libraries and satellite locations[3] where workshops were offered: Dunedin, Timaru, Nelson, Hutt City, Gisborne, Porirua, and Wellington City. In each region, a series of one-day workshops (9am–3pm) was offered over the course of a week (see Figures 1 and 2). The typical schedule for each region was as follows:

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1   Workshops were originally planned for libraries in eight centres; however, one public library was not able to follow through to be part of the pilot project.
2   The project's original working title was "Code Red".
3    In Gisborne, workshops were convened at the Mindlab, as the public library did not have an appropriate space and setup.

- Day 1: a workshop for adults[4]
- Days 2 and 3: two one-day workshops for 9–14 year olds[5]
- Day 4: a workshop for 15 to 18-year-olds.

At the end of the week, all participants and their families were invited to a community celebration event to show the games they had created.

The workshops were advertised through posters, local newspapers, emails to local schools, and social media. Up to 25 places were available in each workshop, and participants were required to enrol ahead of time using an online form. Public library staff tracked actual attendance rates by signing enrolled participants in on the day of their workshops.

## What did participants do in the workshops?

The workshops introduced participants to Gamefroot, a free game-building platform developed in Wellington by Gamelab. The platform allows participants to create any 2D digital game, using a mixture of drag-and-drop interface and visual script editing powered by Google Blockly.[6] The platform is cloud-based, requiring only an internet connection and web browser. Users can create and publish their games on the Gamefroot site, and it is also possible for users to export their finished games to the online app marketplace.

Over the course of the workshop, participants were taken step-by-step through the process of creating their own simple game, based on the core game mechanic in a popular game called *Flappy Bird,* created by Dong Nguyen.[7] This game mechanic was chosen for teaching in the workshops because participants learn a variety of coding principles that have wider application and can be used in other game or app coding. The game involves a flying character (a bird, a plane, or any other character chosen or created by the game-maker) which the game-maker must programme so that it flies along, and changes altitude in response to clicks or taps. The character must be programmed to be affected by gravity (i.e., not clicking or tapping results in the character falling out of the sky). To make a fun and challenging game, the game creators must create a terrain which the character must fly through, without hitting objects in their path. They must also create a series of commands (code) that "tell" the flying character what to do. (See Figures 3 and 4.)

## What were the logistical requirements for the workshops?

**Hardware:** Participants could either bring their own laptop, or use one supplied by the library if they could not provide their own. Libraries in Dunedin, Timaru, and Nelson sourced additional laptops from local schools, and Hutt City Libraries supplied additional laptops for the workshops in Hutt City, Porirua, and Wellington Central library to ensure all participants were able to participate. The minimum requirement for laptops was to have at least a 13-inch screen, 2 GB of RAM, and Google Chrome browser installed.

**Infrastructure:** The workshops required table space for up to 25 participants and a stable wifi connection. The workshops highlighted inadequacies in the infrastructure and layout of some public libraries. In particular, some locations had problems related to the speed, stability, and reliability of the internet and

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4  The adult workshops were particularly aimed at teachers, library staff, and others who work with young people, or wished to upskill themselves in coding or game design. However any adult could enrol, even if they weren't a teacher or someone who worked with youth.

5  The workshops were originally promoted for 10 to14-year-olds. However, this was later extended to allow 9-year-olds, due to strong demand from this age group.

6  Blockly is a visual editor that allows users to write programs by plugging blocks together. Developers can integrate the Blockly editor into their own web applications to create a great UI for novice users. See https://developers.google.com/blockly/about/faq

7  See http://flappybird.io/about/

wifi, and too few power points to cater for multiple devices which needed to be plugged in for at least some of the day.

**Facilitation:** The lead facilitator from Gamefroot used his own laptop and a projector to demonstrate the key steps and moved around to assist participants. Local library staff provided additional on-site logistical and administrative support. It was originally hoped that the adult workshops at the beginning of each week might support a "train the trainers" model, and that adults in the local community, particularly those with some ICT and coding expertise, might come forward to provide additional support for the young people's workshops later in the week. However, approaches to finding ICT sector mentors to help supplement the workshop delivery were largely unsuccessful. Technology sector companies which were contacted in Dunedin, Nelson, Wellington, Porirua, and Hutt City indicated they were busy or had no knowledge/interest in game programming, or did not respond at all. However, library staff often attended the adult coding workshops and helped out as mentors in the youth workshops where possible (depending on availability and skill). Reflections from the lead facilitator and library staff during and at the end of the 6-month project indicated that this involvement and availability of library staff made a big difference. Where these additional staff members were available, participants' small queries and issues could be sorted out more easily and more time could be spent on getting through the planned coding and game development teaching programme.

## Why teach people to code their own video games?

The New Zealand government is interested in developing young people's skills and knowledge in the digital space. Ideally, young people should have opportunities to learn not only how to use technology, but how to be creative users of technology.

Digital games are popular among most New Zealanders, and can be a particularly engaging medium for young people. Recent research shows that the profile of the gamer and the gaming household is nearly synonymous with the profile of the typical New Zealander and the normal New Zealand household (Brand, Lorentz, & Mathew, 2014); multiple screens and game devices are commonplace in homes, and games have expanded from the lounge-room to the pocket, played frequently and for longer durations. Digital games therefore present one way to introduce people of all ages to basic coding and computing principles (data, variables, lists, coordinates, logical operators, control flow, functions and parameters, objects and instances, beginner-level artificial intelligence), as well as game design principles and concepts (sprites, sounds, animations). Workshop participants apply these concepts in practice through making a game (designing a level, placing a character or characters, adding score and "game over" states). Participants can also learn how to launch the games they create into the app marketplace.

There is significant research interest in investigating what, and how, young people learn when they learn how to code and/or design games, whether in school, or in other community-based contexts (Bamford, 2016; CNR-TD, 2008; Falloon, 2016; Salen, 2007; Taub, Armoni, & Ben-Ari, 2012; Tindle, 2015; Weintrop, Holbert, Horn, & Wilensky, 2016). This evaluation contributes to the small New Zealand research base in this area by exploring questions that will be of interest to schools and other community organisations wanting to support young people to learn coding, game design, and computer science.

In addition to learning potentially transferable skills in design, coding, and computational thinking, the workshops also give both young people and adults greater insight into the game development industry and potential pathways for study and career pathways in this industry. Recent statistics indicate that the games industry in New Zealand provides a total 2,305 full-time equivalent jobs (1,024 direct) and has a total impact on GDP of $239 million ($98 million direct) (PWC, 2015). Globally, the games industry is worth hundreds of billions of dollars each year.

FIGURE 1    **A 9 to 14-year-old youth workshop (Nelson)**



FIGURE 2    **Adult workshop (Gisborne)**

FIGURE 3    **"Tappy plane" creator view in Gamefroot**
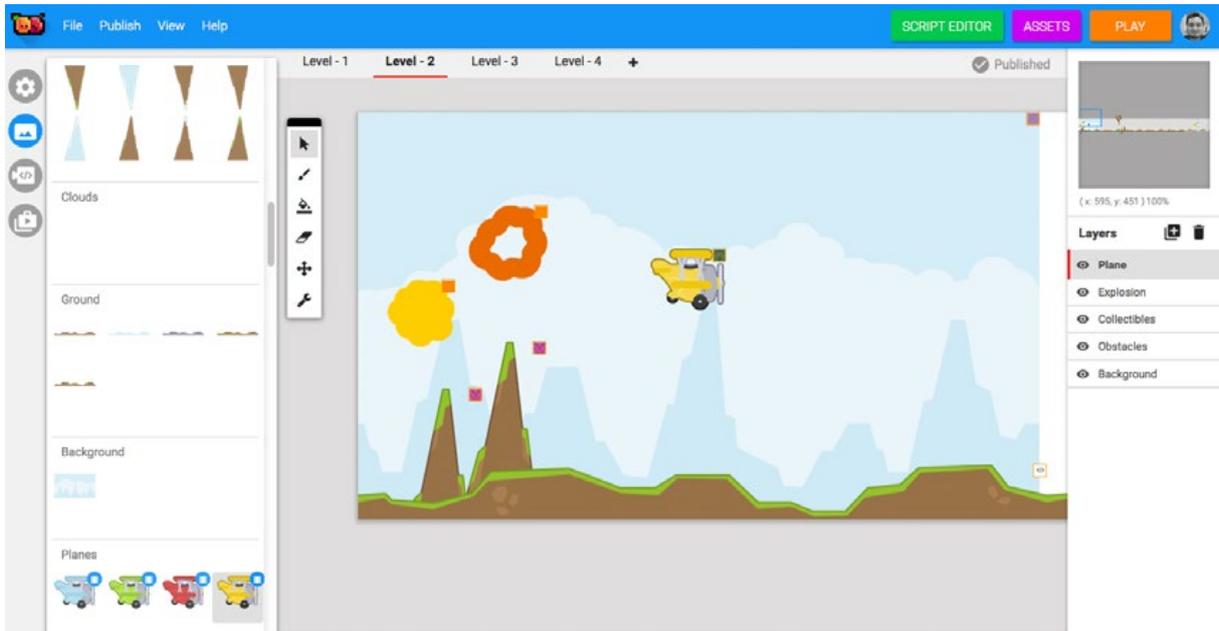


FIGURE 4    **"Tappy plane" creator view showing scripts (code)**
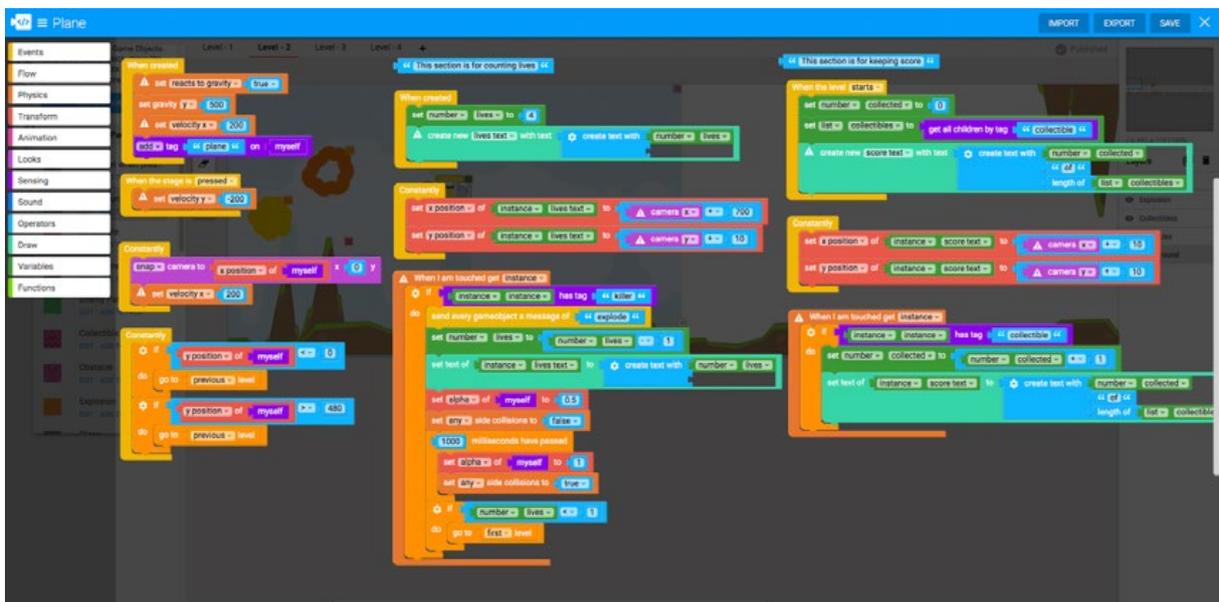
# 2.

# Evaluation methodology

An evaluation plan was designed and implemented by NZCER to reflect the key goals and aims of each of the key stakeholders in the project (see Appendix 1). At a high level, these included:

- engaging young New Zealanders with STEM, and showing pathways into future careers involving STEM
- engaging young people with public libraries as places to initiate or extend their STEM learning
- testing and refining the effectiveness and sustainability of the pilot project model and improving the usability of Gamefroot for novice users in community contexts (e.g., libraries) or schools.

The evaluation included elements of formative, process, and impact evaluation, guided by questions including those outlined in Table 1. Key data sources for the formative and process evaluation questions were:

- a reflective log kept by the lead workshop facilitator
- workshop attendance counts undertaken by library staff at each site
- a weekly written summary from the lead library liaison person at each site, including:
  - any technical or logistical issues
  - what worked well and any issues or challenges
  - any comments or feedback received from participants during or after the workshops
  - any other relevant information, including whether there was local press interest and coverage of the workshops
- data from participants via
  - an online evaluation form which all participants were invited to complete at the end of the day of their workshop
  - a brief follow-up survey sent to adult participants who gave permission to be contacted for research purposes
- additional incidental impact and outcome data including emails or personal correspondence spontaneously received from participants (or their parents) after the workshops.

The impact/outcome evaluation was limited to looking at short- and medium-term impact for participants (see Table 2).

TABLE 1    **Evaluation questions**

| Formative/process evaluation questions | |
|---|---|
| **Attendance, uptake, visibility** | Were the workshops publicised as planned? |
| | Were the workshops delivered as planned? |
| | Did the workshops reach the target groups? |
| | Did attendance uptake meet the targets? |
| | Did the workshops receive the press coverage anticipated? |
| **Delivery** | Did the facilitators carry out the intended activities as planned? |
| | Were the sessions pitched right/paced right for the target groups? |
| | Were community volunteers recruited and trained? |
| | Were the activity goals of the workshop achieved (i.e., did participants complete all the planned activities/complete a game/showcase game at celebratory event, and so on). |
| | What issues or challenges arose and how could this be improved? |
| **Impact/outcome questions** | Did the project achieve its goals? |
| | What were the short- and medium-term impact/outcomes for participants? (see Table 2) |
| | What can be learned about the impact and value of community-based (library) game-building workshops? |

TABLE 2    **Short- and medium-term impacts/outcomes for participants**

| | Short term (day of workshop) | Medium term (weeks/months after workshop) |
|---|---|---|
| **Adults** | Enjoyment/satisfaction with workshop<br><br>Knowledge/skills gained<br><br>Intended activities successfully completed<br><br>Views about the value of learning coding and/or game design<br><br>Interest in future careers involving coding and/or game design<br><br>Intention to use what they learned to support other young people's learning | Did they build on the skills and knowledge gained in the workshop?<br><br><br><br>Did they use the coding/game-building skills and knowledge gained to teach other young people? |
| **Young people** | Enjoyment/satisfaction with workshop<br><br>Knowledge/skills gained<br><br>Intended activities successfully completed<br><br>Views about the value of learning coding and/or game design<br><br>Interest in future careers involving coding and/or game design | For pragmatic reasons we did not seek to gather follow-up data from youth participants. |

## Data analysis

Incoming data from the evaluation were regularly shared with the project leaders to identify issues, successes, and areas for continuous improvement over the course of the project. Surveys were conducted using SurveyMonkey. Generation of data summaries and further analysis was carried out using R.[8] Associations between variables explored using chi-square tests of association; all results reported were significant at the 5 percent level (where the probability of such a strong association occurring by chance alone is less than 5 percent). Margins of error are 6 percent for student survey results and 11 percent and for adult survey results. In this report, percentage data is rounded to the nearest percent.

## Limitations of the evaluation

Data collection and analysis was designed to fit within an allocated budget. The evaluation was designed to be cost-effective and generate re-usable evaluation tools that the project leaders could use to support continuous evaluation and improvement beyond the pilot project. The limitations of the evaluation are that it is largely based on participants' self-reporting, and that it can comment only on short-term outcomes for young people, and short- to medium-term outcomes for adult participants. In addition, it was not feasible to collect pre-workshop data from participants other than the basic details required for their registration, so pre- and post-measures were not implemented.

Additional methods which were considered but excluded for budget, practical, or ethical reasons included:
  · detailed user analytics to look at participants' ongoing use of Gamefroot beyond the workshop, and the products of their digital work
  · participant interviews during or after the workshops
  · longitudinal follow-up of participants.

While these methods could not be used in this evaluation, they could prove useful in the event of future research work in this area.

8    See R Core Team, 2015.

# 3.

# Who attended the workshops?

This chapter describes the workshop attendees in terms of their demographics and prior experience with coding or digital game-making. It also looks at how "digitally connected" the youth participants were, and the adult participants' professional roles and reasons for attending the workshop.

## Workshop attendance and evaluation response rates

In total, 426 people attended Gamefroot workshops in seven locations. This included 90 adult participants, and 336 young people (18 years or under). Completion of evaluation forms was voluntary. An overall response rate of 85 percent was achieved (see Table 3). Evaluation response rates were lowest for young people aged 15–18. Workshop spaces for this age group also proved the most difficult to fill, compared with the younger 9–14 age bracket.

TABLE 3　**Number of participants, and evaluation response rate**

| Workshop type | Number of attendees | Evaluations received | Response rate[1] (%) |
|---|---|---|---|
| 9 to 14-year-olds | 279 | 248 | 89 |
| 15 to 18-year-olds | 57 | 39 | 68 |
| Adults | 90 | 76 | 84 |
| Total | 426 | 363 | 85 |

The remainder of this report discusses data from the 76 adults and 287 young people who completed an evaluation.

## Age and gender distribution

Figures 5 and 6 show the age distributions and genders of participants in both the youth and adult workshops.[9] The workshops were attended most by young people aged 10–12 (accounting for 59 percent of all youth participants). There was unequal gender representation in both youth and adult workshops. Interestingly, while student workshop participants were predominantly male (74 percent male compared with 26 percent female), the gender disparity was reversed in the adult workshops, where 68 percent of participants were female and 25 percent male.[10]

FIGURE 5 **Number of youth workshop participants by age and gender (*n* = 287)**
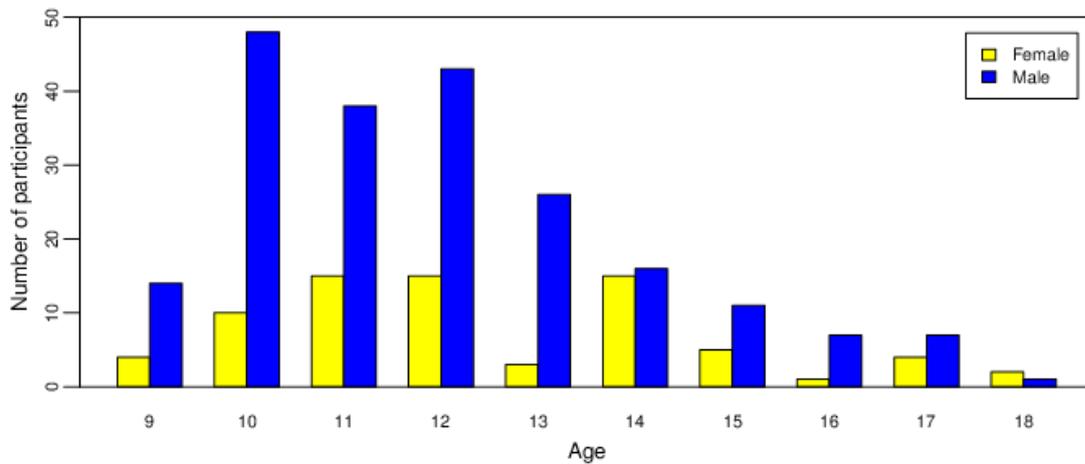


FIGURE 6 **Number of adult workshop participants by age and gender (*n* = 76)**



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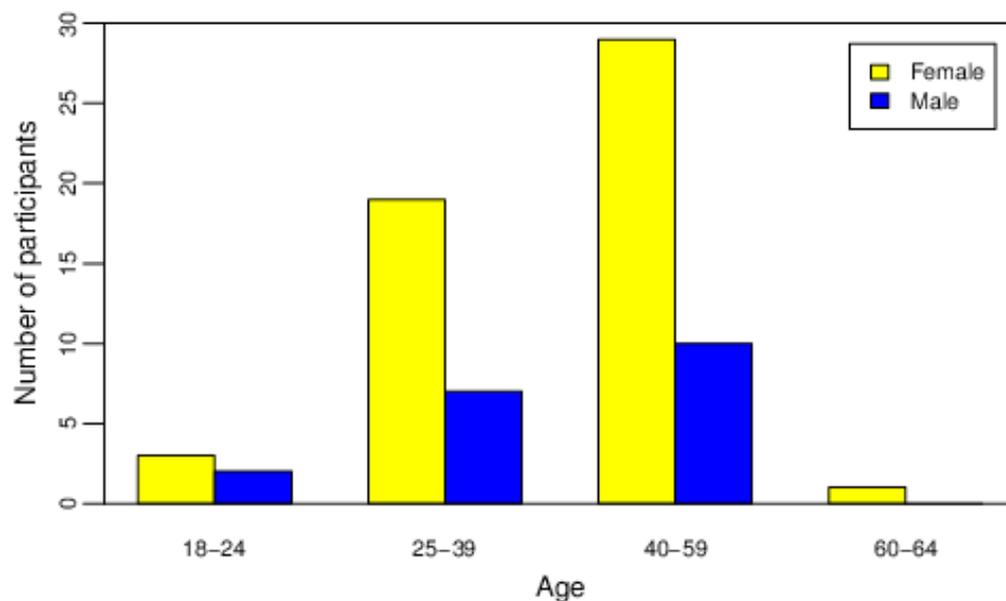
9   While the workshops were targeted at students ages 10 and above, some 9-year-old participants were permitted to take part.

10  Seven percent of adult respondents did not indicate their gender.

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## Ethnicity

Participants could identify one or more ethnic groups to which they belonged. As Table 4 shows, 69 percent of participants identified themselves as New Zealand European/Pākehā, and 18 percent identified as New Zealand Māori. Smaller proportions identified as having Chinese, Indian, or Pasifika backgrounds. Those who identified as "other" included people identifying as British, North and South American, and belonging to various Asian and European ethnicities. Seven percent of the youth participants chose not to indicate their ethnicity or had stopped answering the survey before this question, and nearly a fifth of the young participants selected two to four different ethnic identities.

TABLE 4 **Percentage of participants by self-identified ethnic group(s)[11] (*n* = 363)**

| Ethnicity | Total (%) | Youth (9–18 years) (%) | Adults (%) |
|---|---|---|---|
| New Zealand European | 69 | 70 | 64 |
| New Zealand Māori | 18 | 18 | 18 |
| Samoan | 1 | 1 | 1 |
| Cook Island Māori | 2 | 2 | 3 |
| Tongan | 1 | 1 | 1 |
| Niuean | 0 | 0 | 0 |
| Chinese | 3 | 3 | 1 |
| Indian | 2 | 3 | 1 |
| Other | 17 | 14 | 13 |

## Prior experience with coding and game design

Tables 5 and 6 shows participants' prior experiences with coding/programming, digital game design, and a selection of common apps or software they may have already used. It is likely that experience with any of the apps or software listed in Table 6 could help participants learn how to use Gamefroot, as some concepts, operations, and terminology are similar across these programmes.

Overall, 56 percent of participants said they had never made a digital game before, and 36 percent said they had never done any kind of coding or programming before the workshop. Young people were much more likely than adults to say they had made a digital game before. Those who had previously made games also had more experience with some of the apps/software shown in Table 6. For example, students who had made a digital game before were three times more likely to have used Scratch (79 percent, compared with 26 percent who had never made a game before). The students with prior game-making experience were also slightly more likely to have used Photoshop and/or Gamefroot than other students. Most of the young people said they had prior experience with Minecraft (84 percent), regardless of whether they had prior game-building experience.

Adults were far less likely than young people to have used Minecraft (22 percent). However, just over a third had used Scratch (36 percent), and more than half had used photo editing programmes such as Photoshop.

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11  Participants could identify with more than one ethnic group, therefore percentages in the table do not necessarily equal 100.

TABLE 5    **Participants' prior experience with coding and/or digital game design (*n* = 363)**

|  | Had coded or programmed before workshop (%) | Had made a digital game before workshop (%) | Had never made a digital game nor coded (%) |
|---|---|---|---|
| Youth participants (*n* = 287) | 67 | 51 | 29 |
| Adult participants (*n* = 76) | 55 | 18 | 45 |

TABLE 6    **Participants' prior experience with selected software/apps/games**

|  | Minecraft (%) | Scratch (%) | Photoshop or similar (%) | Gamefroot (%) |
|---|---|---|---|---|
| Youth participants (*n* = 287) | 84 | 53 | 51 | 14 |
| Adult participants (*n* = 76) | 22 | 36 | 58 | 5 |

## Gender differences in prior coding and game design experience

There were some significant gender differences in students' prior experience with game design and coding. For example, 62 percent of girls had never made a digital game before, compared with 44 percent of boys. Similarly, 43 percent of girls had never coded or programmed before, compared with 30 percent of boys. There were no significant gender differences in students' prior reported use of Minecraft, Scratch, Photoshop, or Gamefroot.

Among adult participants, 84 percent of adult male participants said they had some prior coding or programming experience, while only 42 percent of adult female participants claimed prior experience in this area. There were no gender differences in adult participants' prior experience with making digital games (which was uncommon among both male and female adults).

## Where had young people done coding or game design previously?

Of those students who had previously made a game or done coding, just over half said they had mostly done these things at home or at a friend's house (making a game: 54 percent; coding: 53 percent). Just under half said they had done this at school (making a game: 46 percent; coding: 49 percent). Around 10 percent said they had done this at the public library,[12] or somewhere else such as at The Mind Lab by Unitec, at a coding club, or organised workshops elsewhere.

Of the young people who said they had previously made a game at home or at a friend's house:
 • 87 percent were boys and just 11 percent were girls
 • 84 percent identified as Pākehā, while only 9 percent identified as Māori.

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12   Twenty-two percent of young people from the Hutt City workshops had previously done coding at the public library.

TABLE 7    **Where had students previously coded or made games?**

|  | Coding (n = 147) (%) | Game-building (n = 191) (%) |
|---|---|---|
| At home or a friend's house | 54 | 53 |
| At school | 46 | 49 |
| At the public library | 9 | 8 |
| Somewhere else | 11 | 10 |

## How "digitally connected" were the young people?

While gender and ethnicity data is relatively easy to collect through participant self-reports, as is prior experience in coding and game design, it is more difficult to collect data on participants' relative levels of social, economic, or digital disadvantage. Because data were gathered from youth participants, questions about their backgrounds and home/school lives had to be easy to answer and not overly invasive. Data on what school(s) students attended was not requested, on advice from NZCER's statistical team.[13]

However, as a rough indicator of young people's access to digital technologies, they were asked what sort of devices they regularly used at home and at school, and for what proportion of their school classes (if any) they typically used digital technology to support their learning. Over half said they had access to an iPad, tablet, laptop, or Chromebook at home, and 56 percent said they had access to three or more device types at home (see Figure 7). Over half said they had access to laptops or Chromebooks at school, and 18 percent said they had access to three or more of the listed device types at school. It was most common for young people to say they used digital technologies in a few classes (40 percent), or in most classes (38 percent). Only 13 percent said they used digital technology in all their classes, and 4 percent said they never did (Figure 8).

There were some regional differences in reported school-based use of digital technologies. Wellington students were the most likely to say they used digital devices in all or most classes (61 percent), followed by students in Nelson (51 percent) and Otago (50 percent). Regional patterns of difference, and what can be inferred about the reach of the project in closing a "digital divide", will be discussed further in Chapter 6.

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13  Previous experience has shown that it is time-consuming to convert young people's self-reported school name data into something useable and it is particularly problematic when the expected number of participants and the potential spread of their schools are unclear. Self-reports of school names include locally known acronyms that can be difficult to interpret correctly. Finally, using school decile as a proxy for students' socioeconomic status may be inaccurate for any particular individual student.

FIGURE 7    **Which devices did the young people regularly use at school and at home?**
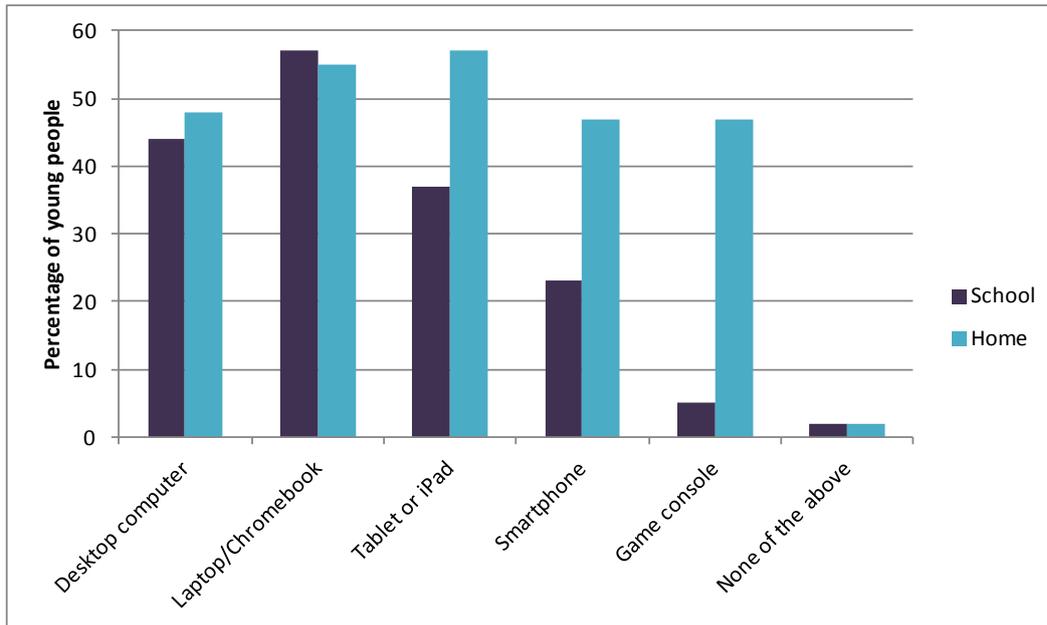


FIGURE 8    **How often did students use digital technology as part of their school learning?**
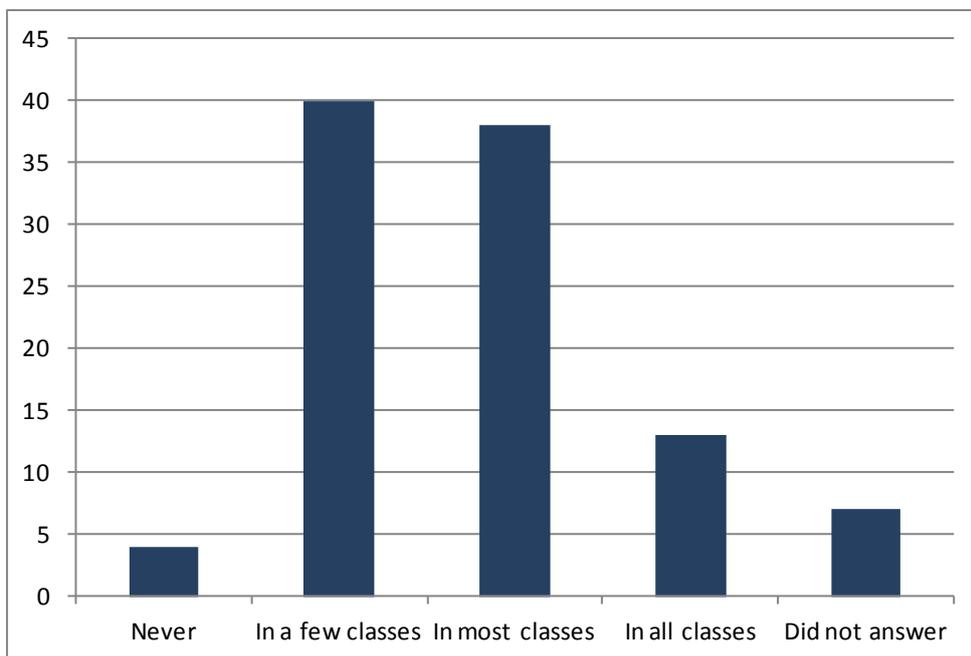


## Adult participants' roles and positions

Adult participants included people who were employed full time (65 percent), employed part time or on a casual basis (15 percent) as well as people who were studying full time (4 percent) or part time (4 percent). A few were between jobs or not in paid employment. Just under a third of participants were primary school teachers (teaching Years 1–8). Other participants included staff from the public libraries, secondary

school teachers, people who worked for a regional council, retirees, and people from a range of other jobs including government employees, people in small or large businesses, an author, a construction contractor, a planetarium presenter, and parents of home-schooled children.

TABLE 8    **Adult participants' roles (*n* = 76)**

|  | Percentage of participants |
|---|---|
| Teacher (primary) | 32 |
| Teacher (secondary) | 12 |
| Work for public libraries | 15 |
| Local/regional council | 3 |
| I work somewhere else | 24 |

# Adults' reasons for attending the workshops

Adults were asked to identify their reasons for attending the workshops, and could select as many reasons as they liked from the list shown in Table 9. The most common reason was to support young people they worked with to learn coding or game design. Almost all the teacher participants (90 percent) chose this option. Conversely, teachers were less likely than non-teachers to express an interest in working in digital game design as a reason for attending. Among the other possible reasons for attending the workshop, teachers' and non-teachers' responses were similar, and included doing it for their own learning and fun, because it was good for their career, or in order to support their children/whānau to learn through coding and game design.

TABLE 9    **Adult participants' reasons for attending the workshops (*n* = 76)**

|  | All adult participants (%) | Teachers (%) | Non-teachers (%) |
|---|---|---|---|
| I teach or work with young people, and want to support them to learn coding and/or game design | 57 | 90 | 30 |
| I did this for my own personal learning and fun | 42 | * | * |
| I want to be able to do these kinds of activities with my family/whānau | 40 | * | * |
| I want to upskill in coding and programming because it's good for my career | 36 | * | * |
| I'm interested in working in digital game design | 25 | 15 | 33 |

Note: Asterisk indicates no significant differences between teachers and non-teachers' responses.

# 4.

# What did participants say about the workshop?

## Overall views of the workshop

Figures 9 and 10 show participants' responses to a list of overall statements about the workshops. Participants could rate their agreement with each statement on a four-point scale ranging from strongly agree to strongly disagree. Overall agreement with the statements was high for both adults and young people: 90 percent of adults and 80 percent of young people either agreed or strongly agreed with most of the statements. As no "neutral" option was given, it is particularly useful to note the proportions of participants who selected either "strongly agree" or "strongly disagree".

Among adults, the most common "strongly agree" statements were that:
- I'd recommend this workshop to a friend (67 percent strongly agreed).
- I feel like I learned a lot (63 percent strongly agreed).
- I had at least one breakthrough or "aha!" moment (53 percent strongly agreed).
- The workshop was fun (53 percent strongly agreed).

Adults were less likely to agree or strongly agree the workshop had inspired them to try to make their own games or apps to sell, or that it had boosted their interest in a possible future career in game design, coding, or programming. Teachers were even less likely than non-teachers to agree with these statements, in line with their reasons for doing the workshop being more about wanting to support *students* to learn coding and game design. The few adults who said they had some prior experience making digital games were much more likely to strongly agree that the workshop inspired them to make their own apps and games to sell.

FIGURE 9    **Adult participants' opinions of the workshop (*n* = 76)**
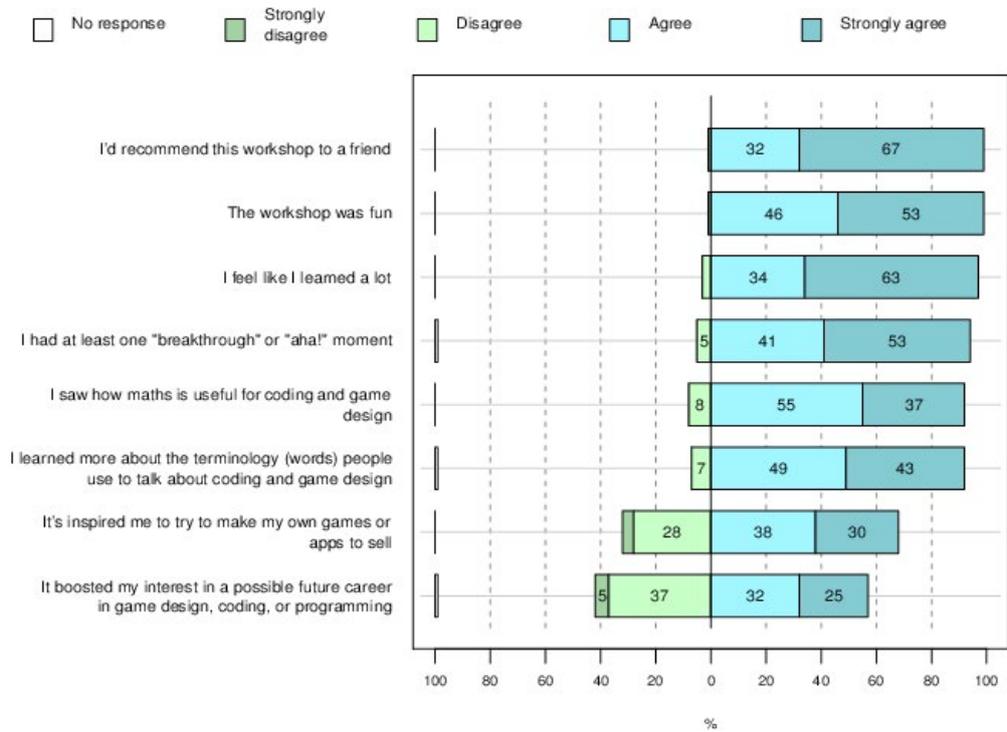


FIGURE 10  **Young people's opinions of the workshop (*n* = 287)**
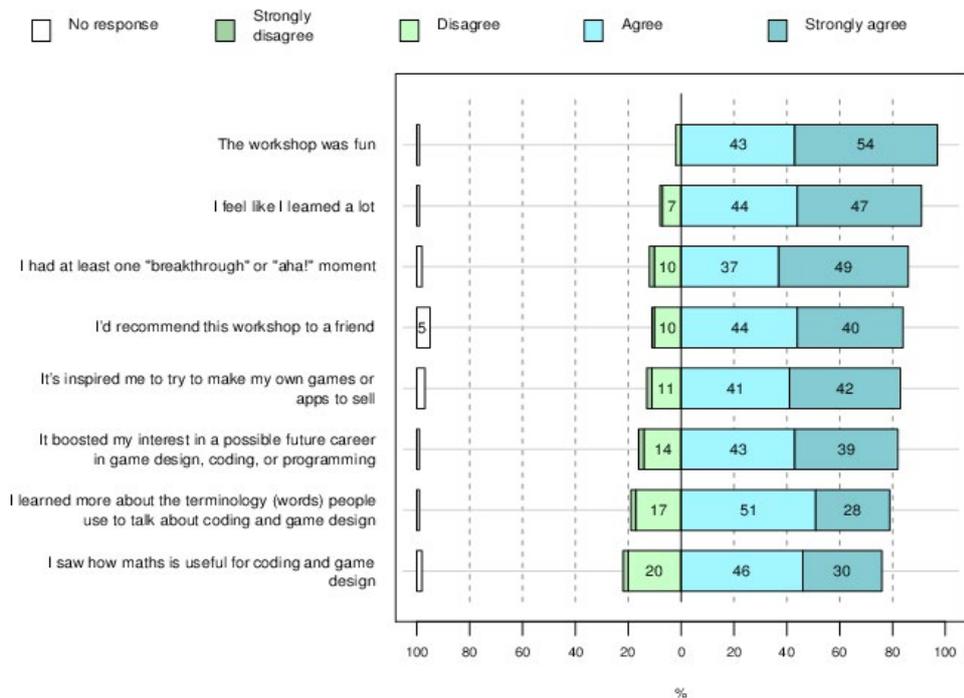
Compared with adults, young people were more likely to agree (than strongly agree) with most of the statements. Young people were most likely to strongly agree that:
- the workshop was fun (54 percent strongly agreed)
- I had at least one breakthrough or "aha!" moment (49 percent strongly agreed)
- I feel like I learned a lot (47 percent strongly agreed).

Young people were more likely than adults to agree or strongly agree that the workshop had:
- inspired them to try to make their own games or apps to sell (83 percent of young people compared with 68 percent of adults)
- boosted their interest in a possible future career in game design, coding, or programming (82 percent of young people compared with 57 percent of adults).

Older students (15–18 years old) were slightly more likely than younger students (9–14) to agree or strongly agree with the latter statement about future careers. However, it is worth noting that 42 percent of 9 to 14-year-olds did strongly agree with this statement.

Conversely, adults were more likely than young people to agree that:
- the workshop helped them see how maths is relevant for coding and game design (92 percent of adults compared with 76 percent of young people)
- they learned more about the terminology (words) people use to talk about coding and game design (92 percent of adults compared with 79 percent of young people).

About one in five students *disagreed* with the two statements above.

There were no gender differences in adults' or young participants' responses to the overall questions about the workshop. However, among young people, there were some small differences in responses between those who said they had prior experience making digital games and those who said they did not. Overall, those who had not previously made a digital game gave more positive responses to the statements shown in Figure 11.

FIGURE 11 **Differences between young people's responses in relation to previous experience making a game (*n* = 140 and 147)**
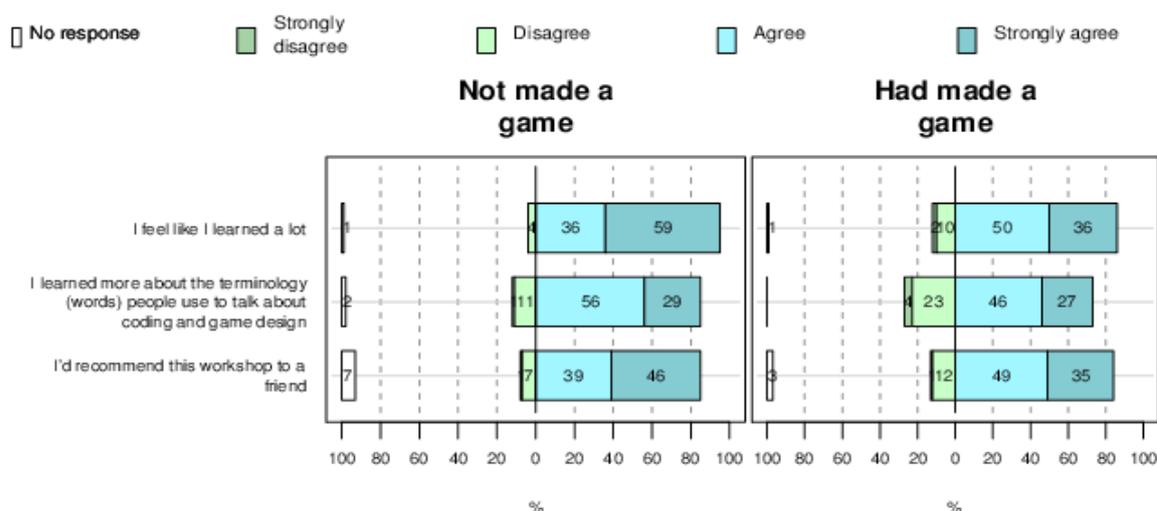
## What participants felt they could do by the end of the workshop

Figures 12 and 13 show what participants thought they could do by the end of the workshop. Most participants thought they would be able to do all of the things listed with the exception of being able to publish a game to the app store so they could sell it. Overall, young people appeared somewhat more confident than adults, and were more likely to strongly agree that they could do each of the things listed. Students who had prior experience making a digital game were more likely than students with no prior game making experience to say they could make a different kind of game in Gamefroot, publish a game in Gamefroot, and teach someone else how to use Gamefroot. Similar patterns were evident among adults; those who had some prior experience making a digital game tended to express more confidence in what they could do by the end of the workshop, than those without prior experience (Figure 14).

FIGURE 12 **What adults felt they could do by the end of the workshop (*n* = 76)**
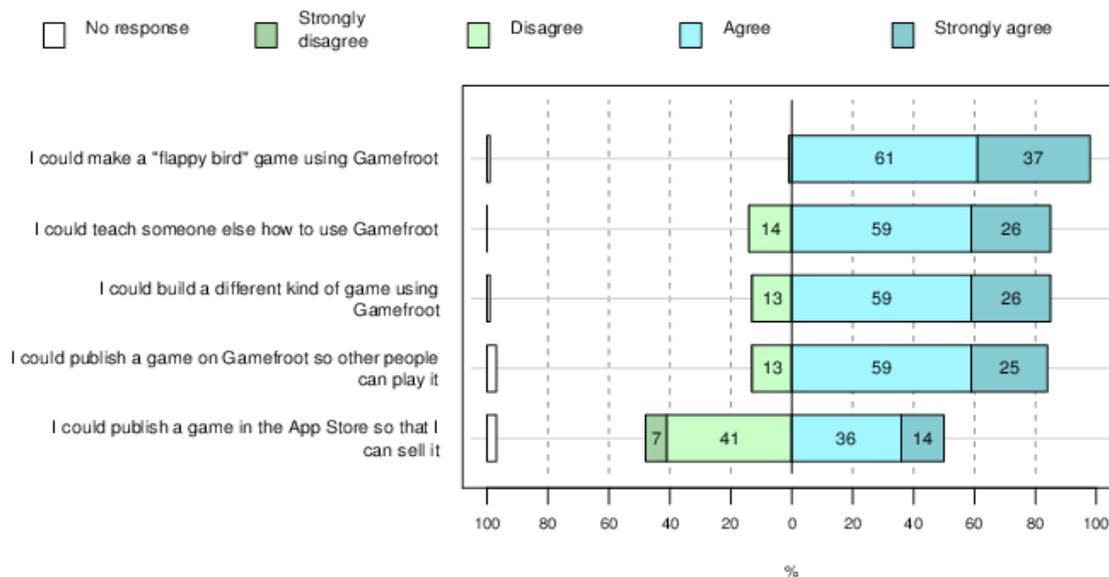


FIGURE 13 **What young people felt they could do by the end of the workshop (*n* = 287)**
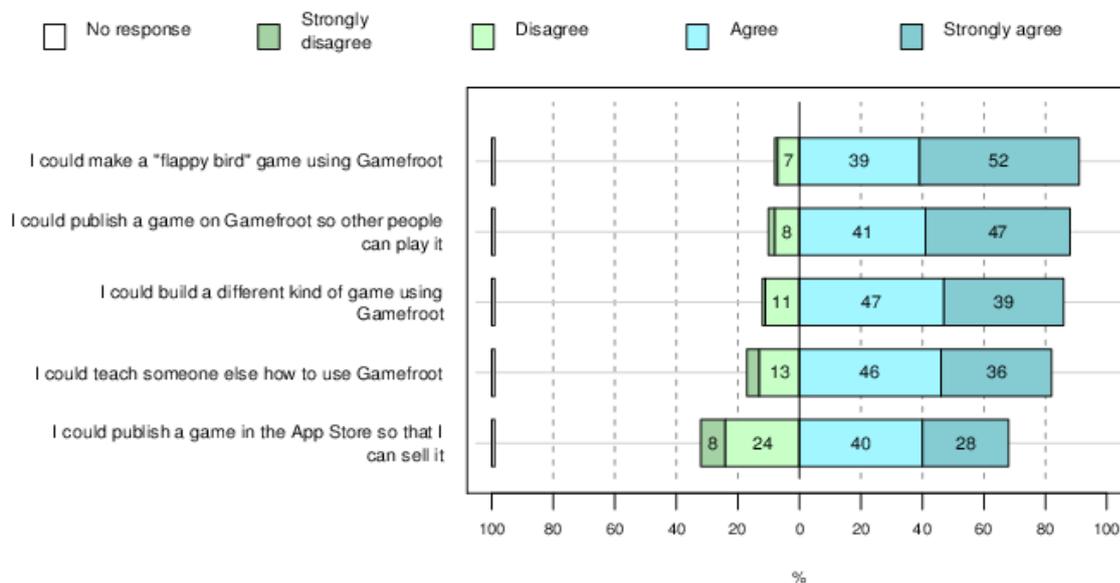
FIGURE 14 **What young people could do by end of workshop: Difference by previous game-making experience (*n* = 140 and 147)**
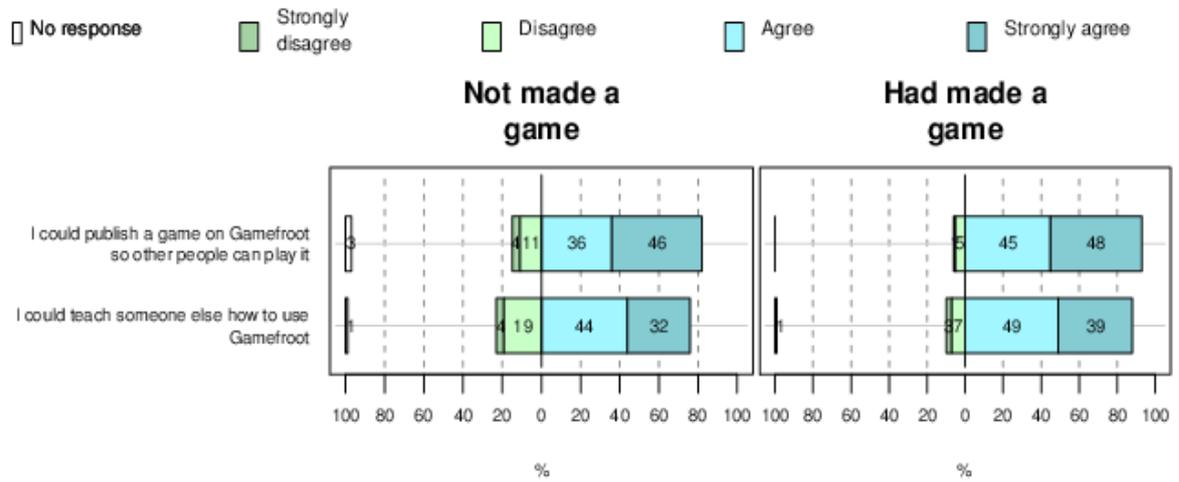
# 5.

# Participants' views about learning, coding, and game design

Figures 15 and 16 show how much participants agreed or disagreed with a series of statements about whether it was important for young people to learn coding and game design, and if so, where learners should have opportunities for these kinds of learning. Both adults and students tended to agree that:

- public libraries are a good place to run workshops about coding and game design
- public libraries are a good place to find out about careers involving STEM
- all students should learn coding and game design at secondary school.

There was less agreement that all students should learn coding and game design at primary school, although a third of teachers (and just under a third of young people) strongly agreed that they should. Overall, adults seemed to ascribe slightly more importance to coding and game design being available at school than the young people did, as indicated by the mixed responses to the statement "coding and game design is not important to do at school because you can learn it at home if you are interested". While most adults disagreed with this statement—suggesting that they thought coding and game design *was* important to learn at school—young people were more evenly divided as to whether they agreed or disagreed with this statement.

FIGURE 15  **Adults' views about learning coding and digital game design at school and elsewhere (*n* = 76)**
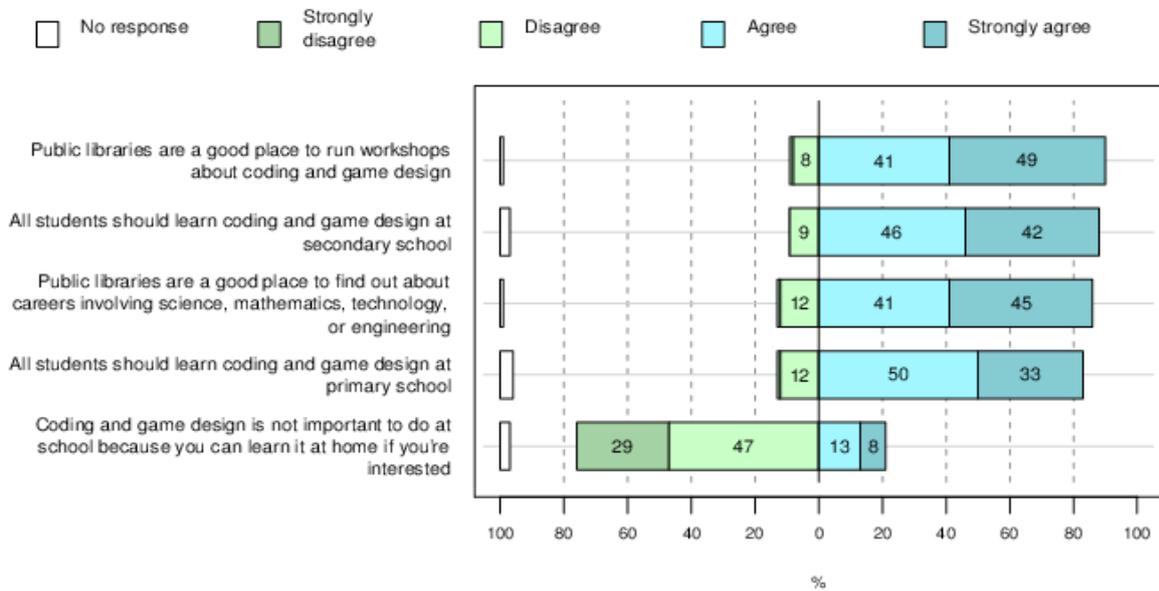


FIGURE 16  **Young people's views about learning coding and digital game design at school and elsewhere (*n* = 287)**
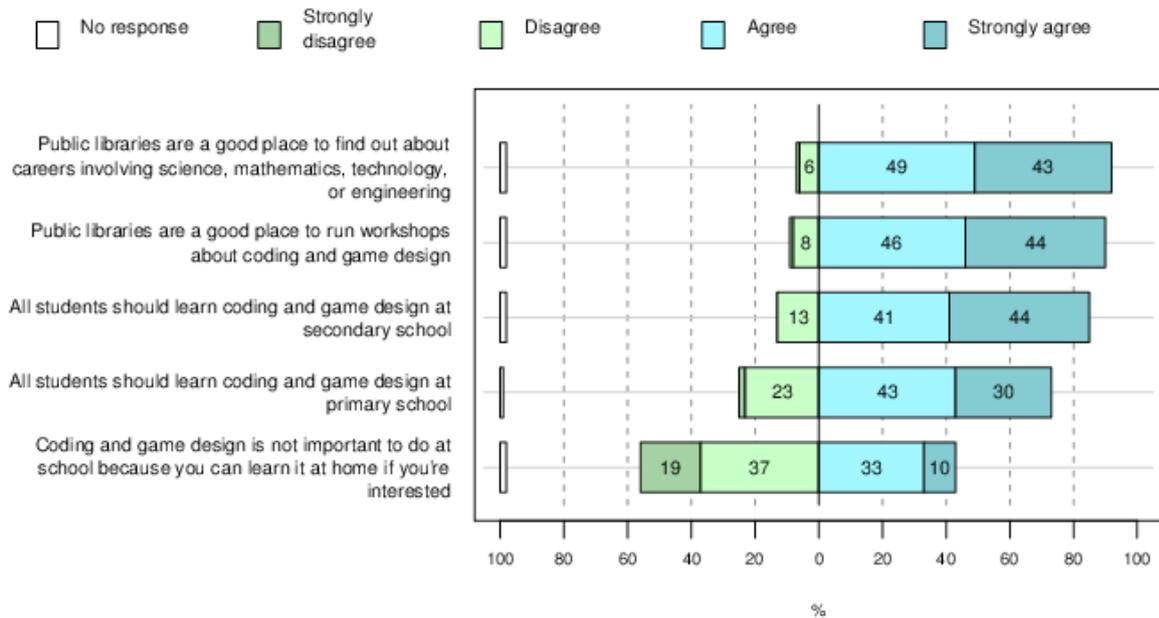


## What do you think you learn through playing or making games?

All participants were asked whether they thought that playing and/or making games helps them to learn. Interestingly, adults were more likely to say "yes" than young people (Table 10). One explanation for this may be that young people might assume "learning" refers to what they think of as "school learning", whereas adults may take a broader view of what learning means.

TABLE 10  **Do you think that playing and/or making digital games helps you to learn? (*n* = 363)**

|  | Yes (%) | Not sure (%) | No (%) |
|---|---|---|---|
| Youth participants (*n* = 287) | 78 | 17 | 2 |
| Adult participants (*n* = 76) | 95 | 5 | - |

Figure 17 shows what people thought they learned through making and playing games. Most participants tended to think they learned about technology and computer programming, how to be creative, and how to solve problems. Adults had a stronger tendency than young people to say they learned how to solve problems, how to design, that they learned about maths, or that they learned persistence. Fewer people thought they learned about other people, or things like science, language, life, or history. It is interesting that those who did think they learned about history through games tended to be young people rather than adults. Young people were also more likely to say they learned to be a team player, how to react fast, and about other people through games. These differences may reflect the different kinds of games played and enjoyed by different people, including people of different ages.

Young people, but not adults, were asked to name their current favourite game. Since they could write any game at all, this question demonstrated the overwhelming popularity of Minecraft— named as a favourite game by 30 percent of young people, and standing out far ahead of the next most common favourite, Clash of Clans (5 percent). Games named by about 3 percent of young people included: Black Ops (Call of Duty); games related to Star Wars; FIFA, Roblox, and Undertale. That said, there was a clear age-related difference in young people's affinity for Minecraft, with most of those selecting this game being aged 9–14. Young people most commonly played their favourite game(s) on a desktop or laptop (59 percent), and less commonly on an iPad or tablet (42 percent), game console (38 percent), or mobile phone (30 percent).

FIGURE 17  **What do you think you learn from making and playing games? (*n* = 363)**
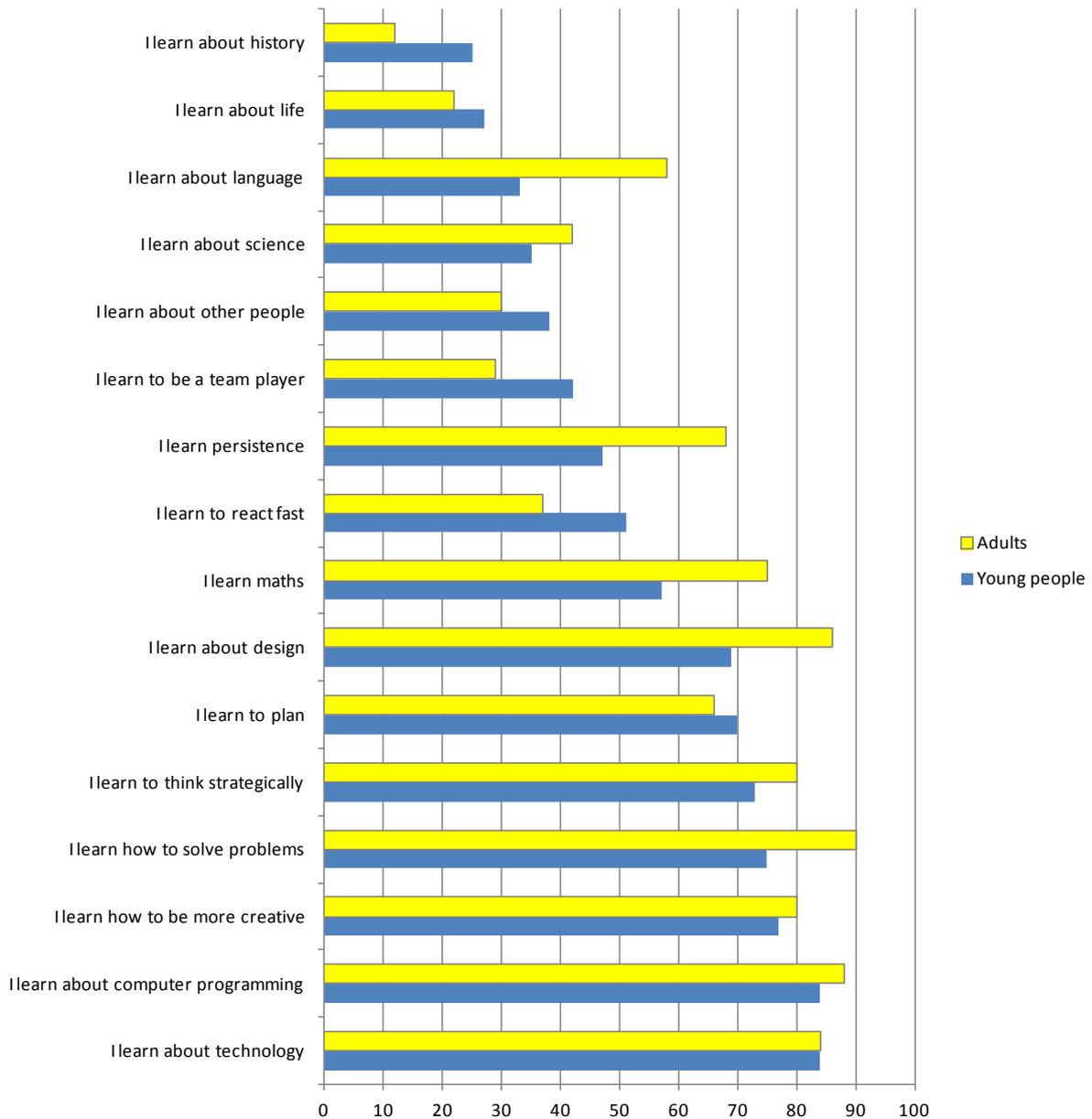


## Describing a specific instance of game-based learning

Both adults and young people were asked if they could describe one example in which they felt game-making or game-playing had helped them to learn. Figure 18 shows what kind of activity the chosen example related to.

FIGURE 18 **What were you doing in the example you are thinking of?**
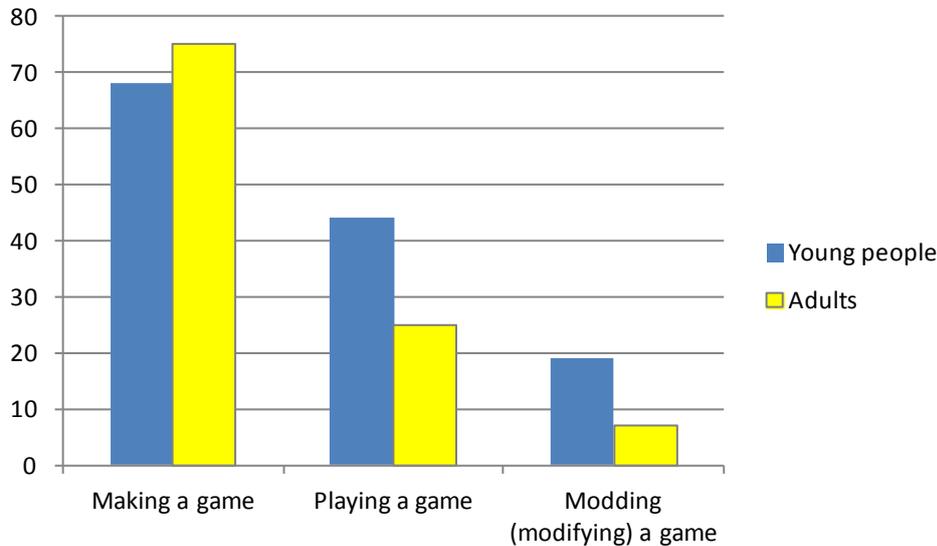


## What students said they learned from playing or making games

Students could write an open response to describe what it was that they learned in the example they chose to share. Of those who wrote an answer (80 percent), the most common responses were about coding/programming or game design. While many young people more or less restated the fact that learning to code a game helped them learn about coding (27 percent of respondents) and game design (24 percent of respondents), some gave more detailed insight into young people's views of their own learning. Distinct themes in young people's answers included the ideas that:

- making and playing games helped them learn to think strategically, logically, and creatively (15 percent of respondents)
- coding and making games is harder than you might think; making a game helped to "demystify" computers and coding (8 percent)
- you learn things about yourself through playing and making games (5 percent); for example, persistence and careful attention to detail is important.

Some examples of young people's answers include:

Coding makes me think about the complexity of computers in general and how we came to invent them. (Female, 14 years old)

Making a Game, I have learned how to think ahead about what I want, using logic and mathematics to get things right, and to appreciate how much time and effort gets put into things. Playing a Game I have learned many Skills, Language Math, Science, Life, etc. (Male, 12 years old)

[Through games I have learned] Logic. Creativity. Coding. Creating. Custermising. (sorry I Don't know how to spell it ...) Friendship. New things/animals! And more things this would take 10000000 years for me to tell. (Female, 11 years old)

Through making games I have learnt about the careful placement of commands and what they do etc. Through playing games I have increased my strategic thinking and making a more accurate muscle movement. Through modifying a game I have learnt that there are many many bugs that can ruin everything). (Male, 17 years old)

I saw a bug and realized that it is important to properly identify every part of the level. (Male, 13 years old)

If at first you fail, Try, Try, and Try again. (Male, 12 years old)

You get very good reflections (or need very good reflections), got to think more strategically, You also have to think of the consequences of your next move/step very fast because it could be good for you or it could also be bad. (Male, 14 years old)

I ako ahau te whakamahi gamefroot me te whakamahi te rorohiko notemea kaore au he maha o te maramatanga I roto te mahi rorohiko [I learned how to use Gamefroot and how to use the computer since I didn't know much about how to use the computer]. (Male, 12 years old)

I learnt how hard/easy it is to design a full game and now I know how much work you have to do. (Female, 10 years old)

## What adults said they learned from playing or making games

When describing what they learned through making or playing games, adults most commonly mentioned:
- logic and problem-solving (30 percent of respondents)
- coding, scripting, and programming (24 percent of respondents)
- the difficulty/challenges of coding and making games (12 percent of respondents).

Like young people, some adults talked about making a game as helping to demystify coding and computer operations for them. Adults also referred to things they had learned about themselves, including persistence and how to find their way through challenges (including challenges they faced in learning to code a game with Gamefroot). Some of the adults' comments are shown below.

[I learned] the need of planning. To go with the flow. To be happy with what I achieved. (Adult participant)

Problem solving—something didn't work and I needed to find out how to make it work—asked questions, searched the net, trial and error, and finally got it. (Adult participant)

How to troubleshoot myself without instantly asking someone else, how to be persistent when something isn't working—thinking outside the box. (Adult participant)

I forgot to save along the way and I accidentally lost everything. It was good to try making the game again without following along. This showed me how much I had actually learned and what I obviously did not learn that well. (Adult participant)

Learnt that gaming design doesn't necessarily require an in depth understanding of syntax and games can actually be built with user-friendly GUI front-end browser, which is ideal. (Adult participant)

I learnt to apply logic even if it is a foreign thing that you are doing. Perseverance is also something I found that I had to adapt too. I was wrapped [sic] when logic and perseverance paid off!!! (Adult participant)

How in order to make a game you have to instruct the computer to do everything using special commands that it understands, it is more thought out than it appears when you are just playing a game and think that the computer is the doing everything by itself. (Adult participant)

I revisited my knowledge of the x and y axis (despite the y flip), using positive and negative numbers, how 2 negatives make a positive which may cancel out what you are trying to do. I learned how different people react differently to challenges etc. Just to name a few. (Adult participant)

A few participants (mostly teachers) talked about what they had learned about *learning* (and teaching), and how they expected they might apply this learning in their work with students. For example:

I learnt about different student learning styles just through the adults that were participating in the workshop. I could see how this style of teaching would work in the classroom with the varying degrees of ability. (Adult participant)

I've learned more about the structure of coding (specifically) and also how to problem solve (generally). It's also given me more confidence to help my kids (and others) how to code. (Adult participant)

Interestingly, at least one participant had misunderstood what the workshop was going to be about.

I learnt that coding was not what I thought it to be as it was a course offered through the public library and expected it to have more to do with coding library itinerary. (Adult participant)

# 6.
# Patterns of difference between locations

The student data were analysed to look for statistically significant differences between participants who attended workshops in each of the regions (Table 11).[14] Key differences by region include the following:

- Gisborne had the highest proportion of Māori students (64 percent), followed by Wellington and Canterbury (14 percent each).
- Gisborne had the highest proportion of young people from rural areas (33 percent), followed by Canterbury (24 percent).
- Dunedin had the highest proportion of young people who lived in a city (60 percent, presumably Dunedin), followed by Wellington region (48 percent).
- Young people from Nelson and Dunedin were the most likely to have previously made a digital game before, made a digital game at home, coded or programmed before, and used Scratch before. Students in the Gisborne or Canterbury workshops were only about half as likely to have done each of these things. Young people from Wellington fell somewhere in between.
- Students in the Wellington region were the most likely to say they used digital technology in all or most of their school classes, followed by students in Nelson and Dunedin.

These data suggest there could be an inverse relationship between previous coding and gaming experience, and how much students think they benefited from the workshop. For example, where prior experience was higher (Dunedin, Nelson), positive views of the workshop were slightly lower. Conversely, where prior experience was lower (Canterbury, Gisborne), positive views of the workshop were higher. This general pattern was evident when *all* students with prior game-making experience were compared with all students who had not made a game before (see Figure 11). As discussed previously, students' prior experiences with gaming and coding also correlated with higher levels of confidence by the end of the workshop about what they could easily do next using Gamefroot.

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14  The Wellington region sample is higher than the other regions because it includes participants who attended workshops across three locations: Wellington City, Hutt City, and Porirua.

Positive views about the workshops may also have had some relationship to how smoothly the workshops ran. The Otago workshop at Dunedin Public Library had wifi connectivity issues which some of the adult and student participants commented on in their evaluations. This was also the first workshop to be run. Towards the end of the project, many small kinks had been ironed out of the workshop process and this may have also contributed to higher positive feedback in the final few workshops of the series.

TABLE 11 **Differences in young people's responses by region (percentage of participants per region)**

| Demographics | Canterbury (Timaru) | Gisborne | Nelson | Otago (Dunedin) | Wellington (Wellington City, Hutt City, Porirua) | No region indicated |
|---|---|---|---|---|---|---|
| | (*n* = 42) | (*n* = 42) | (*n* = 35) | (*n* = 30) | (*n* = 112) | (*n* = 26) |
| Is between 9–14 years old | 79 | 76 | 94 | 80 | 91 | 92 |
| Identifies as Pākehā | 86 | 52 | 89 | 83 | 73 | 23 |
| Identifies as Māori | 14 | 64 | 3 | 3 | 14 | 8 |
| Lives in a rural area | 24 | 33 | 14 | 13 | 10 | 0 |
| Lives in a town | 67 | 38 | 63 | 27 | 42 | 19 |
| Lives in a city | 10 | 24 | 23 | 60 | 48 | 12 |
| **Prior game and coding** | | | | | | |
| Has made a digital game before today | 29 | 41 | 63 | 70 | 58 | 39 |
| Has made a digital game at home | 19 | 19 | 51 | 40 | 27 | 12 |
| Has coded or programmed before today | 43 | 55 | 80 | 83 | 74 | 54 |
| Has used Scratch before | 36 | 29 | 69 | 70 | 63 | 42 |
| **School-based used of digital technologies** | | | | | | |
| Uses digital technology "in all classes" or "in most classes" at school | 43 | 38 | 51 | 50 | 61 | 35 |
| **Views about the workshop** | | | | | | |
| Feels that they learned a lot from the workshop | 100 | 95 | 77 | 73 | 92 | 100 |
| Would recommend the workshop to a friend | 93 | 74 | 54 | 73 | 89 | 85 |
| Could build a different kind of game in Gamefroot | 90 | 83 | 91 | 73 | 92 | 73 |
| Thinks all students should learn coding and game design at secondary school | 90 | 81 | 80 | 73 | 90 | 81 |

Beyond the statistical data, the evaluative information gathered continuously and reviewed by the team leading the project provides insight into region-by-region stories. For example, in Gisborne, a large group of students and teachers from a kura kaupapa Māori in a remote rural area drove 3 hours in each direction to attend the workshop. Feedback from one of the kaiako (teachers) received by email a few days later stated:

> A huge thanks to the reps from Public Libraries New Zealand who sponsored our staff and students from [name of kura] to attend the Coding workshops in Mindlab Gisborne on 9–10 February. Your generosity has led our children to realise that they too CAN make digital games and that they don't have to be JUST the players of someone else creations. They can be creators of games in the Māori language with cultural essence that help learning in all essential learning areas.

An end-of week summary report from one of the library coordinators for the Timaru (Canterbury) workshop noted that:

> In the Wednesday group, out of 20 students only 2 had used coding at their school. Whereas 6 students had been playing around/experimenting with coding at home. All the students were very interested in coding and wanted to know more. After the session and asking this group "who would be interested in working with coding," all hands when up … Overall a very successful workshop that certainly "unlocked curious minds" and gave our young people of South Canterbury a great insight into the possibilities of game coding and what the future could hold for them within this world. (Timaru District Libraries summary report)

Other emails also indicated personal impact of the workshops for some participants.

> … both I and my son [name] (11) who attended one of the Gamefroot coding workshops wanted to say how much we appreciated Public Libraries organizing and supporting this initiative. It was a wonderful opportunity for my son [name] to interact and learn from experienced game developers. He really enjoyed the experience and got a lot out of it. As a single mother on a limited income I really appreciated that fact that it was free. (Mother of young participant)

> It was fantastic! I filled it the survey and am looking forward to any workshop like this one. If there is any other way I can help, I would love to hear from you. Wellington and all these amazing opportunities here are fantastic! (Adult participant)

## Differences by ethnicity

In the data set, young people's ethnicity is strongly confounded with region and prior experience with coding and game design. An analysis of all young people who identified as Māori or from a Pasifika ethnic group compared with all other young people showed that Māori and Pasifika students were less likely to have previously coded or made a game and less likely to have used Scratch. They were slightly more likely to say they learned a lot from the workshop, learned more about the terminology used in game design, had at least one breakthrough or "aha" moment. They were slightly less confident by the end of the workshop about what they could easily do by themselves using Gamefroot. They were less likely to use digital technology in all or most of their school classes.

# 7.

# What did the adults think they gained from the workshop?

Adults were asked whether they intended to use what they had learned in the workshop in their work with young people. Some adults skipped this question as it did not apply to them, but of those who answered, most said they would apply their learning, including their intention to use Gamefroot and/or other coding and game design tools with young people (Figure 19). Between 80 and 90 percent of those who identified as primary or secondary teachers agreed with each of the statements.

FIGURE 19  **Adults' intentions to use what they learned in their work with young people (*n* = 79)**

Adults were invited to provide any further comments or suggestions about the workshops. The most common responses were:

· overall positive comments, including thanks for the opportunity to do the workshop (43 percent of adults made comments of this nature)
· a request for more workshops (20 percent)
· comments about the pacing and length of the workshop (16 percent)
· feedback, largely positive, about the facilitator (15 percent)
· comments about the venue or technological infrastructure (including issues and challenges) (15 percent)
· other suggestions for improvement (10 percent).

Some examples of adults' positive comments are given below:

I found this course really well delivered. Instructions were clear, and having the Google doc as an aid was good if I fell behind. I never thought I would be able to make a game until today! I think this will be great to introduce to my kids as a) it is an interest they have and b) it teaches some awesome skills of problem solving, creativity, and perseverance. Thank you! (Primary school teacher)

This is a great way to enter a sometimes intimidating area of learning. (Adult, retired)

I was extremely impressed with the presenter. He was easy to understand and made the learning so much easier. I would recommend him to any institution or individual. The notes were precise and clear, very easy to follow. Thoroughly enjoyed the day. (Library/council staff)

This was great, would be wonderful to have workshops for just teachers as well. Maybe a beginners course and advanced course. (Primary school teacher)

Suggestions for improvement included slowing the pace, lengthening the workshops, and more targeted promotion and advertising.

It was a one day workshop which was great to be part of however, I wondered if it spanned over two days (spending longer on trickier coding sections) then it might be easier to retain everything learned. There is a lot of information to take in. [The facilitator] did a great job of explaining and being patient which each person. (Primary school teacher)

I think that the course could have benefited from being another 90 minutes. There is a lot of content but the majority of people attending were either teachers or non-coders, so we needed to go over things a few times. (Primary school teacher)

I found it very difficult today. The laptop and internet connection I was using was far too slow and my ability was lacking too much to be able to keep up with the tutor. (Library staff member)

In advertising the event it could have made clearer that the event focuses on game development rather than coding. That part of the tutorial was weaker than expected. (Library staff member)

A few workshops were hampered by technical or space-related issues, and some adults commented on these.

The Gamefroot platform is still obviously in its beta phase and I saw the frustration of participants whose computers did not have the latest updates for their browsers. Many of those with unsuitable devices (provided by the library) dropped out after lunch understandably. (Primary school teacher).

Fast internet and reliable hardware would help participants. (Primary school teacher)

## Following up: What did adult participants *actually* do after the workshop?

Thirty-five adult participants gave permission for NZCER to contact them for research purposes after the workshops. A brief survey was sent out to these participants in March 2016, and 16 responses were received. The survey asked participants about their ongoing use of Gamefroot or any of the knowledge and skills gained from the workshop. Of the 16 respondents,

- thirteen said the workshop had been "useful" or "very useful" for their professional practice (three said "slightly useful". No one said it was "not useful")
- eight had used Gamefroot since the workshop, and eight had not
- seven had done other activities related to coding and game-making since the workshop; nine had not.

### Why was it useful for their professional practice?

Fifteen people explained why the workshop had been useful for their professional practice. Five respondents indicated that the workshops had been a useful entry point for their learning, saying they learned a lot, the tool was easy to use, and now they feel they "know the basics" and "can understand what a couple of the kids are talking about now when they talk about coding".

Four gave more specific comments about what had been useful to learn.

> I was introduced to the concept of visual coding which was new to me and makes this topic much more approachable.

> Learnt how to use the software and Blockly.

> It helps me to explore the game coding industry and broaden my horizon in this field. It is a good way to learn more related skills and increase my confidence.

> Transfer of ideas. Learning about maths & science does not have to just be in maths/ science class. Coding broadens the way people learn.

Three explained how they intended to use their new knowledge in their professional practice:

> I'm going to use it in class. It was useful.

> The workshop was well-run and made it easy for learners of different abilities to progress at different paces, something I hope to replicate in class.

> As a library manager I can see intrinsic value of coding and can be more supportive re developing other workshops. Also informs strategic planning for library programmes for young or older people.

Two commented on strengths and weaknesses of Gamefroot as a platform for beginners to learn to code.

> I think the concepts of computer science are best explained through other already designed programs for primary aged kids—but Gamefroot proves a valuable and highly motivational playground for them to practise their skills.

> Interesting facts and concepts (such as how the x-axis and y-axis work in the world of coding) were explained to us at the workshop; but, because it was a workshop that was highly dependent on the tutor, I don't feel as though we learned how to code. We mostly copied what the tutor did. I wouldn't be able to reproduce what we did at the workshop without going through the step-by-step "how-to" instructions.

### Why participants had or had not used Gamefroot since the workshop

Of those who had used Gamefroot since the workshop, four had used it for themselves (for example, to revisit their game or to practice making the game unassisted), three had used it with their students, two with family or whānau, and one had shown their colleagues. Those who had used it with students described what they had done:

> Been doing some coding workshops with 2 classes of intermediate aged students. I began teaching them code using studio.code.org workshops and after they completed an introductory course there, I have let them loose on Gamefroot. They've only had an hour or so to use it—and all chose to use it over Scratch when I showed them both platforms. It remains to be seen how they go. Most are just designing their backgrounds still and have yet to program their characters. (Year 7–8 teacher)

> I tried to use it with Year 10. Unfortunately, the website didn't seem that stable when there was a lot of traffic from one site, going to it. Some students had a wait of up to 10 minutes before being able to open their projects and others had their entire profile corrupted (didn't work at their home either). It seems like it would be a really good tool, but unfortunately has stability/speed issues. It's not our school network. I can have 30 kids each watching a 1080p video tutorial on YouTube with no buffering. … Had to switch from Gamefroot to App Inventor. I also use Scratch, GameMaker, Unity (C#), Visual Studio (C#). (Secondary school teacher)

Gamelab responded to incoming evaluation feedback through further development work to stabilise and improve the Gamefroot platform.

Those who had not used Gamefroot most commonly explained that they had not had time to do so yet.

> I have been a bit busy recently after attending the seminar as I work in 2 jobs. It is always the busiest time of the year for my work. However I have got Gamefroot log in details at the seminar and will definitely continue to work on this game program whenever I have spare time in the future. I want to show my family about the game that I created one day. (Adult participant)

> I plan to use it in class throughout the year, but am playing catch-up at the moment, as I had 2 weeks of Paternity leave at the start of the term. Ideally, it will link into our current unit of character development and narrative. (Adult participant)

> I haven't had the time to sit down and have a "good play" with Gamefroot and explore what is possible. I am not as motivated as I thought I would be to use Gamefroot. I think this is because, from the workshop, Gamefroot seemed limited—i.e., essentially the same game with just different images. (Adult participant)

### What else had participants done since the workshop?

Adults who said they had done other coding and game-related activities since the workshop included one adult who was studying programming at a polytechnic, one teacher who had designed a unit for her students on coding and enrolled in a postgraduate degree in coding herself, and another adult who had looked around at what "learn to code" courses and resources were available for themselves and their family.

## Participants' suggestions for improving the workshops

Adults were asked to give their views on possible areas for improvement of the workshops, including whether they thought the adult workshops should be longer (e.g., 2 days), what else could be covered, and what kinds of further resources or support they would find useful.

### Extending the workshops for adults

There was reasonably high support for longer workshops. Teacher participants made the following comments:

> Separate [workshops for] beginner and competent people? Maybe two tutors in separate rooms or something. I and my colleague were able to move very far ahead but others were stuck on the first few steps. (Secondary teacher)

I don't know that most schools would approve of releasing staff for 2 days for PD—unless it were done in teacher's own time in the holidays (like the course that I did during the end of the summer hols). Most don't mind 1 day of PD out, but otherwise it is likely to break the budget. (Primary teacher)

I think that by the afternoon, the enthusiasm had worn off for the single type of game (flappy bird), so if longer workshops were offered, I would love to cover a range of games, maybe for 1/2 day each, but with the option of utilising the step-by-step Google docs later on to extend my games. (Primary teacher)

Yes. It would really reinforce what you have learnt and allow you to finish creating a more complex game. (Primary teacher)

Non-teacher participants were also largely in favour of extending workshops.

I would love if this kind of workshop could be longer. (Adult participant, non-teacher)

I felt the day-long course could have been condensed into an intense 5 hours. Two days would allow for all the notes to be covered with time for discussion. (Adult participant, non-teacher)

Yes, the 2-day seminar sounds great and practical to me, especially for the teachers and facilitators. I personally think the seminar should cover basic theory and practice and leave some time for the teachers/facilitators to have a go on the second day. They can then go back to the school and share the precious knowledge with their students. However I think 1-day seminar is enough for non-teachers/facilitators learners. (Adult participant, non-teacher)

Longer workshops would be better. It would be great to have the time to learn, practice and build on this knowledge. I would have liked to have walked away feeling as though I could code rather than being competent at watching and then copying someone. (Adult participant, non-teacher)

There is so much to learn in one day. If you miss one step you are stuck. Stretching the course out with more time to explain each step and checking that everyone understands etc. (Adult participant, non-teacher)

Two participants specified additional things they would like to have covered in a longer workshop.

Uploading a game so that students could earn money from it. (Secondary teacher)

Adding music and weapons/shooting Art/image design definitely. (Adult, non-teacher)

One participant suggested follow-up courses could be an option for those who wanted to take their learning further once some time had elapsed.

I would suggest a one-day course is fine but with some online tutorials for those who want more to follow-up training, then followed by another one day course say a month later. Bit labour intensive. One is a good intro, but maybe a follow-up one day course for original participants, not necessarily grouped by age. (Adult, non-teacher)

## Additional resources and support

The most common suggested support resources were videos and print resources:

The notes very great. Record the workshop so that it can be replayed and revisited when learning. It would be audio and visual learning supports. Rewindable education! (Primary teacher)

Videos—currently I get the students to watch some of the videos on Scratch to understand how to program their characters. (Primary teacher)

Printed handouts or video tutorials (Adult, non-teacher)

Printed step-by-step basic instructions with a small booklet with a glossary. (Adult, non-teacher)

The shared Google doc with step-by-step instructions was great, as I was able to read ahead and do extra work while others were progressing at their own pace. More of these tutorial/step-by-step docs would be great, especially for developing different types of games. (Primary teacher)

If you provide lesson plans and ready made tasks for teachers to roll out in their classes I think you'd get a bit more traction in the educational sector. I did see some curriculum/assessment links on your site but they were for Media Studies. Most of this stuff happens in Digital Tech. (Secondary teacher)

Two participants mentioned having more activities or game types to work through:

It would be great to be given a series of activities that build on each other and that build skills. (Adult, non-teacher)

Lots of example games to make. (Secondary teacher)

Other suggestions included ongoing support from the facilitators/Gamefroot, and the possibility of crowd-sourced resources.

Contact person from Gamefroot being available on weekdays for teachers and other adult facilitators to get hold of. (Adult, non-teacher)

The facilitators were very helpful, so more of that please. (Adult, non-teacher)

The entry level resources are very good. I can't comment on higher level resources but I suspect as the community grows people could publish their own wiki pages. … Keep using passionate & knowledgeable instructors. (Adult, non-teacher)

# 8.

# Conclusion: How effective was the pilot project in meeting its goals?

Based on the data gathered for this evaluation, some preliminary conclusions can be drawn about the effectiveness of the pilot project in meeting its key goals.

## Engaging young New Zealanders with STEM and showing pathways into future careers involving STEM

The intended outcomes of the Unlocking Curious Minds fund include more science and technology-competent learners, and more choosing STEM-related career pathways. The pilot project evaluated in this report is an example of an "entry point" learning opportunity that could provide young New Zealanders with their first encounter with coding, as well as an opportunity to meet and learn from young adult game designers and learn about the game design industry. The evaluation feedback suggests high levels of engagement and enjoyment both from young people and adults. While it is difficult to draw conclusions about the long-term impact of the workshops for participants' future career choices without longitudinal data, it is worth noting that most of the young people agreed or strongly agreed that the workshop had inspired them to try to make their own games or apps to sell (83 percent), and that it had boosted their interest in a possible future career in game design, coding, or programming (82 percent).

Unlocking Curious Minds also seeks to target young New Zealanders "who have had fewer opportunities to learn about and engage with science and technology". Although some participants came to the workshop

with some prior coding or game-making experience, others had no such prior experience. Novice coders tended to say they got more out of the workshops, and their comments indicated that the workshop had helped to demystify computers and programming for some. Young people who were female, Māori or Pasifika, or from rural area (or combinations of these) were more likely to come without prior coding or game-making experience. These findings suggest that the workshop provided a learning opportunity that some of these young people may not otherwise have encountered at home or at their schools. The obvious next questions are: What happens next for these young people? What kinds of ongoing support or access to further learning might they need in order to continue to develop their interests in coding and/or game design? While the answers to these questions lie beyond the scope of this evaluation, they are nevertheless important questions to consider in the design of future initiatives like this project, as well as other initiatives to enable more school-, community- and home-based coding and computer science learning for young people.

## Redressing the gender imbalance?

The gender imbalance of the workshops is of some concern, since women are strongly underrepresented in the fields of computer science/information technology.[15] The proportion of women in the New Zealand game development sector is also known to be low.[16] It is worth noting that the girls in the data sample were less likely to have previously done coding or programming than the boys.

The gender imbalance issues in STEM are not a new problem. Several decades of research on female underrepresentation in STEM fields shows that there are many factors that contribute to these inequalities. These include conscious and unconscious sexism, stereotyping, as well as structural features of the STEM system and workplace environments that reduce equity in pay and career progression opportunities for women as well as people who identify as gender diverse (Dixon, 2000; Yoder & Mattheis, 2015). While a great deal is known about what factors contribute to the gender inequalities in these fields, the unfortunate fact is that progress towards closing these gaps is slow. Solutions often tend towards seeking to "fix" the women and girls so that they can compete on an equal footing with men and boys, rather than addressing some of the structural factors and gender biases that perpetuate these inequalities.

Interestingly, more of the adult workshop participants were women than men. This gender imbalance likely reflects the gender imbalances in the primary teaching and public library professions, both of which are among the most female-dominated occupations.[17] The uneven gender distribution across different professional fields is one of the reasons for a persistent gender pay gap, with both occupational segregation and vertical segregation[18] playing a role. Previous New Zealand research (Dixon, 2000) found that

> … most of the gender pay gap (between 40 and 80 percent) could be "explained" by differences in four variables: differences in occupation and industry of employment, differences in the amount of work experience between women and men, and women's qualifications relative to men. The remainder was

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15 The 2013 New Zealand census showed that women make up only 23 percent of people employed in IT occupations and only 28 percent of people in all roles across the tech sector. The number of women planning to enter the sector is also declining with only 3 percent of 15-year-olds in New Zealand considering a career in computing professions (NZTech, 2015).

16 The New Zealand Game Developers' Association does not currently collect data on gender in the NZGDA annual survey, but estimates the proportion of women to be around 20 percent.

17 According to the *Women at Work* study based on census data, in 2013, 90.4 percent of primary and early childhood teaching professionals were female, and 81.6 percent of library, mail, and related clerks were female. See also Shute (2013). Conversely, other professions that are extremely male-dominated (fewer than 15 percent female) include building and trades-related occupations, electrical and electronics workers, motor vehicle drivers, and engineering and architecture professionals.

18 That is, where there are a higher proportion of men than women in senior better-paid positions.

"unexplained", which is commonly thought to include some level of discrimination that works against women. However, the "explained" portion of the gender pay gap can also be influenced by societal expectations of women, including that women will be the primary care-givers in families, and the appropriateness of different types of work for women and men.[19]

The fact that women in education and libraries are attracted to the workshops is one positive feature of this evaluation, particularly if it enables women in these professions to grow their capability to support and encourage other young people with coding, computer science, and game design in their homes, schools, and libraries. However, simply having more women championing computer science and game design in the education and library sectors likely isn't enough to overcome all the factors that lead to more boys than girls engaging with and pursuing learning and employment in these fields. "Developing future talent" is one of several strategies for working towards greater gender equality in STEM, and this project has the potential to be a critical entry point experience for girls. However, evidence suggests that many initiatives are needed to address the multiple challenges that work against equality. Strategic connections across these initiatives are also important.

Possible strategies for an initiative like this to further address gender inequality could include the following:
- Offering workshops that are particularly aimed at girls. This could mean having girls-only workshops, but also from a workshop design perspective, might involve working with different content or styles of working/challenges that connect with girls identities and interests. It is important to avoid stereotyping about "what girls like", but strategies that can be effective include encouraging girls to see that computer science can be used creatively and collaboratively, to tell different kinds of stories, or solve problems that are of interest to them.[20]
- Seeking more female role models in the computer science and game design sectors to inspire young women and girls and help them to see a pathway for themselves in these sectors.
- Explicitly addressing the existing gender inequality issues in the IT and game design sectors. in the adult workshops (particularly with teachers and librarians) to encourage conversation and further discussion about how to counteract unconscious biases and structural challenges that may reduce girls' inclination to learn about computer science, coding, or game design relative to boys.

## Supporting young Māori into information technology

The challenge of achieving representative cultural diversity in STEM fields raises similar issues to the gender inequality challenges outlined above. Biases and structural/institutional barriers often lead to an underrepresentation of minority cultures in many STEM fields, both in New Zealand and internationally. People who are both female and part of a minority culture can face double discrimination and barriers to their participation in these sectors.

There is interest both from the Government and from iwi in encouraging and supporting more Māori into the information technology sector (Knowles, 2015; Weber, 2015). By giving young Māori learners the opportunity to learn about coding and game design, this project has the potential to contribute in the same way that it does for girls—that is, opening up an opportunity for learning that the young person may not otherwise encounter due to what is or is not available to them at home or at school. The evaluation shows that young Māori and adult Māori were among those attracted by the workshops, particularly in some regions (Gisborne and, to a lesser extent, Timaru and Wellington). It is heartening that kaiako of

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19  See http://women.govt.nz/our-work/utilising-womens-skills/income/gender-pay-gap
20  See Bolstad & Hipkins (2008) for a detailed discussion of identity issues in relation to young New Zealanders' interests in science. See also http://ww2.kqed.org/mindshift/2013/09/20/how-to-grab-and-keep-girls-interest-in-computer-coding/.

a kura kaupapa Māori which attended the Gisborne workshops thought the workshop learning could support their rangatahi to become the creators of digital content and strengthen their language and cultural identities in the process. An adult participant from one of the other regions indicated that one of her reasons for attending was a desire "to create games to encourage the learning of Te Reo Māori".

Possible strategies for an initiative like this to further encourage and support Māori could include:
- targeted marketing and promotion to reach more Māori young people and adults
- building on what has been learned thus far to further tweak workshop content or styles of working/ challenges to connect with Māori identities, interests, and aspirations (again, it is important to avoid stereotyping)[21]
- building on the opportunities for Gamefroot to be explicitly used to support Māori language revitalisation (including use by fluent and novice speakers of te reo Māori to create their own games with Māori language and culturally relevant content)
- collaborations with Māori community partners (including in libraries and schools, as well as whānau and hapū) to further develop and tailor workshops that address the aspirations of Māori[22]
- using Māori mentors and role models to inspire rangatahi and help them to see a pathway for themselves in these sectors.

### Support for Pasifika young people

Relatively few workshop participants identified as coming from Pasifika backgrounds. Given their small numbers it is difficult to draw any conclusions about what aspects of the project were more effective or less effective in engaging these communities. However, as there are also various national strategies to support better educational, employment, economic and social outcomes for Pasifika people, most of the key concepts outlined above (i.e., working through community partnerships to reach these young people, consideration of young Pasifika people's culture, languages, identities, and aspirations in the design of programmes) could be applied to ensure that the project model is effective in meeting the needs of young people and adults from Pasifika communities.

## Engaging young people with public libraries as places to extend their STEM learning

The evaluation suggests that there is an appetite for learning how to programme games and engage with coding, and that both adults and children are interested in taking up these opportunities when they are available in public libraries. It is very positive to note that 90 percent agreed or strongly agreed that "public libraries are a good place to run workshops about coding and game design", and 91 percent agreed or strongly agreed that "public libraries are a good place to find out about careers involving science, mathematics, technology, or engineering". Without longitudinal data it is hard to estimate the medium- and long-term impact of the workshops on participants' engagement with libraries as the place to grow and extend their STEM knowledge. However, the request for further workshops from both young people and adults suggests that public libraries are a place they would now look to for these kinds of learning opportunities.

The formative aspects of the evaluation showed that most of the library branches that hosted the game-coding workshops were enthused and have started to develop their own capability to support these kinds of learning opportunities in an ongoing way. The evaluation also highlighted some of the infrastructural

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21 Some preliminary thought was given to this for the Gisborne workshops, and advice was solicited from an online Māori ICT network—see final section of this report.
22 For a summary of research that investigated whānau educational aspirations for Māori, see Bright, Barnes, and Hutchings (2015).

barriers that libraries will need to overcome in order to do so, including having more consistently reliable technical infrastructure, appropriate spaces to work in, and provision of staff time to support the administration and delivery of these kinds of programmes.

## Testing and refining the effectiveness and sustainability of the project model

The formative use of evaluation data provided a feedback loop to Gamefroot and public libraries that allowed for continuous improvement to the workshops. Sustainability challenges that become clear through the evaluation include the following:

- The dependence on one key facilitator to run all the workshops, and limitations of library staff time and sufficient expertise to support workshop participants—while the single facilitator model worked well for the pilot, the project leaders concluded that having a team of facilitators would ensure broader reach and spread of workshops.
- The ratios of participants to facilitators (capped at 25 participants), which reduced the ability of the facilitator to work one-to-one with participants. The length of the workshops was also challenging for some participants. Shorter workshops, smaller classes, and workshops spread out in a series, could all be alternatives for future workshops.
- Infrastructure issues for some branch libraries (see subsection above), and the administrative workload associated with the workshops,23 highlighting the importance of having a user-friendly and administrator-friendly registration platform and sufficient administrator time.
- Variable attendance at the community events at the end of each week—although these were useful for showcasing the work done by workshop participants, and for them to hear more about the game industry and future pathways.

## Improving the usability of Gamefroot for novice users in community contexts

Participant feedback on the Gamefroot platform as well as the game assets and content led to the following improvements being made:

- making Gamefroot faster and less reliant on needing a live internet connection in the workshops
- improving the user interface and other backend work to make Gamefroot even easier to use
- using participant feedback to help improve the workshop resource materials
- designing bespoke sprites (game assets/characters) for the Gisborne workshops based on suggestions from an online Māori ICT network about incorporating culturally and locally developed digital content into the "flappy bird" game design template.

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23  The registration process was a significant piece of work. The team's initial registration platform proved inadequate and was changed after the first two weeks of workshops. The project administrators learned that it was essential to have someone who could respond to queries, send reminders to registered participants, and deal with cancellations or wait-listing.

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# Appendix 1:
# Key stakeholder goals for the project

| Stakeholder | Key goals and objectives |
| --- | --- |
| **MBIE (Funders of Unlocking Curious Minds)** | To fund projects that use innovative and/or best-practice approaches to help New Zealanders that have had fewer opportunities to learn about and engage with science, in particular young people aged 18 years and under, by:<br><br>• funding education and community outreach initiatives that focus on science and technology<br>• broadening their ability to engage with science and technology promoting the relevance of science and technology in their lives<br>• supporting them to engage in societal debate about science and technology issues facing the country.<br><br>The intended outcomes of the fund are:<br><br>• more science and technology-competent learners, and more choosing STEM-related (science, technology, engineering, and mathematics) career pathways<br>• a more scientifically and technologically engaged public and a more publicly engaged science sector<br>• a more skilled workforce and more responsive science and technology. |
| **Public Libraries of New Zealand** | Young people and communities are engaged with local libraries.<br><br>Libraries supporting young people and community engagement with STEM.<br><br>Public awareness of libraries being places to engage with STEM and lifelong learning.<br><br>Workshop model is pilot-tested and can be scaled for wider national reach.<br><br>A "train the trainer" model is tested and refined to support sustainability of impact beyond the initial workshops. |
| **Gamelab objectives** | Workshop model is pilot-tested and can be scaled for wider national reach.<br><br>Gamefroot coding resources are tested and improved through user feedback.<br><br>Adult participants are confident to go beyond the initial workshop resources and begin to use more advanced Gamefroot learning resources to support. students<br><br>A "train the trainer" model is tested and refined to support sustainability of impact beyond the initial workshops. |