An evaluation of Code Club: Summary report

Contents

Executive summary

Code Club is a global network of coding clubs for young people to build digital skills and confidence. Open to all school-aged youth, Code Club is designed to be inclusive and accessible, particularly for those experiencing educational disadvantage or from backgrounds underrepresented in technology.

As part of the Raspberry Pi Foundation's commitment to using evidence to improve our programmes, we commissioned Durham University Evidence Centre for Education to conduct an independent evaluation of Code Clubs in the UK. The evaluation used a quasi-experimental design, comparing Code Club members to non-members using pre- and post-intervention surveys. The primary outcomes measured were resilience, confidence to learn independently, belonging, and coding skills. The evaluation also considered a range of other outcomes and factors influencing participation and learning.

Key findings:

- Code Club members showed positive gains in coding skills, attitudes towards coding, and broader learning attitudes compared to non-members
- Code Club was a positive learning environment, with club members enjoying the activities and developing skills independently and collaboratively
- Mentorship and support from volunteers and club leaders played a crucial role in club members' engagement and skill development
- Young people were intrinsically motivated to join Code Club, driven by a desire to learn coding and recognising its value
- Code Club leaders found the experience rewarding, though they noted challenges related to support from school staff, resources, and information about learners' needs

The evaluation provides further evidence of Code Club's positive impact on young people, and affirms our approach to developing and growing the Code Club programme.

What is Code Club?

Code Club is a global movement of coding clubs where young people develop the skills and confidence to create with digital technologies. It is open to all school-aged young people and is designed to be accessible and inclusive to youth from all backgrounds. Individual clubs set an age range that is appropriate for their context, and can adapt their approach to reflect their context and culture, to ensure that it is as meaningful as possible for young people. We actively encourage participation by young people who experience educational disadvantage or come from backgrounds that are underrepresented in technology careers.

The Raspberry Pi Foundation supports Code Clubs in various ways in addition to creating and maintaining the brand. We provide 100s of free, online coding and computing projects with step-by-step instructions designed to be used in Code Clubs. We also support Code Clubs by promoting safeguarding for young people at clubs, providing online resources and training for mentors, organising challenges and incentives for participants, translating resources into different languages, supporting a network of partner organisations, and engaging with the community.

The outcomes we help young people achieve through Code Club are:

- Skills and independence in programming and digital making
- Mindsets that enable them to engage with technology, such as confidence, interest, and a sense of belonging
- A wider set of life skills like problem solving and communication

Why this evaluation?

A key value for the Raspberry Pi Foundation is our commitment to impact, which means we use evidence to test and improve everything that we do.

We already know a lot about Code Clubs and their impact. A review of previous studies synthesised findings from 24 selected articles suggesting that coding activities can improve children's computational thinking in early childhood years and that there are no specific gender differences in motivation for learning coding (Bati, 2022). There are educational benefits for teaching young children coding, and problem-solving skills, from using diverse interfaces and styles (Rose et al., 2017). However, studies give very mixed results on the effectiveness of coding tools on learners' actual learning outcomes (Stamatios, 2024).

A review by Papadakis (2022) suggested a positive impact of coding apps on learners' thinking skills. Another systematic review by Popat and Starkey (2019) synthesised findings from 10 selected studies and indicated positive outcomes from coding on children's non-cognitive skills. However, these reviews were based on relatively weak evaluations, and so results for learners' non-cognitive outcomes cannot be considered conclusive.

We know from our annual survey of Code Club leaders that clubs provide a positive community where young people feel safe and included, and are able to share their ideas and support other young people. Volunteers' perceptions suggest positive impacts on learners' skills and confidence in coding and on a set of skills including problem solving, personal confidence, and creative thinking.

A previous independent evaluation of Code Clubs found a small positive effect (+0.04) on learners' computational logic, and a bigger impact (0.17) on their coding skills (Straw et al., 2017). The evaluation also suggested a promising impact on learners' attitudes to use of computers, coding for personal development, and coding for future aspirations and careers. Since this evaluation, we have significantly developed the resources and support we provide to clubs, and the Code Club community has been through a significant period of disruption caused by the COVID-19 pandemic.

We therefore commissioned Durham University Evidence Centre for Education (DECE) to build on this evidence base by bringing the independence and the rigour of an external, academic evaluation, and to enable us to further build our evidence base and maximise our impact.

This evaluation focused on Code Clubs in the UK, and its objectives were:

- To deepen our understanding of the impact Code Clubs have on young people and the outcomes that are most affected
- To test and refine how we can measure the impact of Code Clubs on young people
- To learn how we can continue to improve Code Clubs and the support we provide

This summary report provides an overview of the evaluation and its findings, and is based on the full report by DECE (Siddiqui et al., 2024).

Acknowledgements

Evaluations like this only happen through the expertise, commitment, and generosity of a huge range of people. We would like to thank:

- The students who completed the surveys and provided their feedback to the evaluation team
- The schools, teachers, and club leaders who volunteered to participate in this evaluation
- The team at DECE for conducting this evaluation
- Atlassian Foundation International Limited for providing the funding that made the evaluation possible

Methodology

Evaluation study design

The DECE team adopted a difference-in-difference (DiD) design for this evaluation study, assessing learners who chose to attend Code Clubs compared to their peers who did not (including from one school not running a Code Club). To take account of initial differences between Code Club members and non-members, the team focused on progress scores between pre- and post-intervention surveys.

An invitation was issued to Code Club leaders in the UK to participate in the evaluation. 60 primary and secondary schools and other settings sent in expressions of interest. 412 learners in Years 4 to 10 from 15 schools and 1 community library completed the pre-survey. At the post-survey phase, 13 schools participated and 274 learners completed the survey.

Learners attended Code Club, at least in part, in the period from October 2023 to April 2024, whereas their non-attending counterparts and the school without a Code Club continued business as usual.

Outcomes

The evaluation focused on a set of pre-agreed primary outcomes to measure, in addition to a range of other outcomes, listed in the table below. It also considered the experiences of learners and club leaders, the extent of learners' engagement with Code Clubs, implementation models, use of Code Club resources, organisation of learner groups/pairs, length of the sessions, and the support provided for running the club.

Aims of Code Clubs	Primary outcomes measured in this evaluation	Other outcomes measured in this evaluation
Skills and independence in programming and digital making	• Coding skills	
Mindsets that enable young people to engage with technology	• Confidence to learn independently • Belonging	• Interest
Attitudes to learning and wider life skills	• Resilience	• Problem solving • Communication • Creative thinking

Data collection

Learners' attitudes were assessed by a set of survey questions adapted from a combination of previous evaluations conducted by Durham University and the Student Computer Science Attitude Survey (SCSAS). Questions were reviewed using a text readability calculator and piloted to ensure that learners could respond with minimal assistance and as appropriate for the reading age of Year 4 learners and above.

We also developed a coding skills quiz consisting of 25 multiple choice questions based on Scratch and Python. The quiz had two slightly different versions at the same level, to be administered at pre- and post-survey stages. The survey also included questions on the frequency of learners' use of programming languages (Scratch, Python, and HTML).

The DECE team conducted interviews with five Code Club leaders about their experiences running the clubs, held informal interviews with learners and parents, and observed Code Club sessions.

Limitations

There are some important limitations to this evaluation study. Its design was a quasi-experiment, meaning students attending Code Clubs were self-selecting and may differ in motivation and other important characteristics from the comparison group. The Difference-in-Difference approach attempts to address this, but is not as rigorous as a randomised design. The dropout rate from pre- to post-survey was high, which may also have introduced bias and affected the representativeness of the final sample. Finally, the clubs participating in this evaluation are a small proportion of the thousands of Code Clubs globally, and so the findings may not necessarily be generalisable to all clubs.

What is the impact of Code Club?

For the main analysis of the impact of Code Club on learners' learning, we draw comparison between two sub-groups: those who reported being a member in both the pre- and post-survey (57 learners, the intervention group), and their counterparts who reported no membership in either survey (166 learners, the comparison group). The analysis compares changes between the intervention and comparison group, and changes are reported as 'effect sizes'.

Effect sizes are a common way of comparing the impact of educational interventions that can be standardised across different outcome measures. Although lots of factors can influence an effect size, 0–0.2 is often considered a small effect, between 0.2 and 0.4 a moderate effect, and greater than 0.4 a large effect.

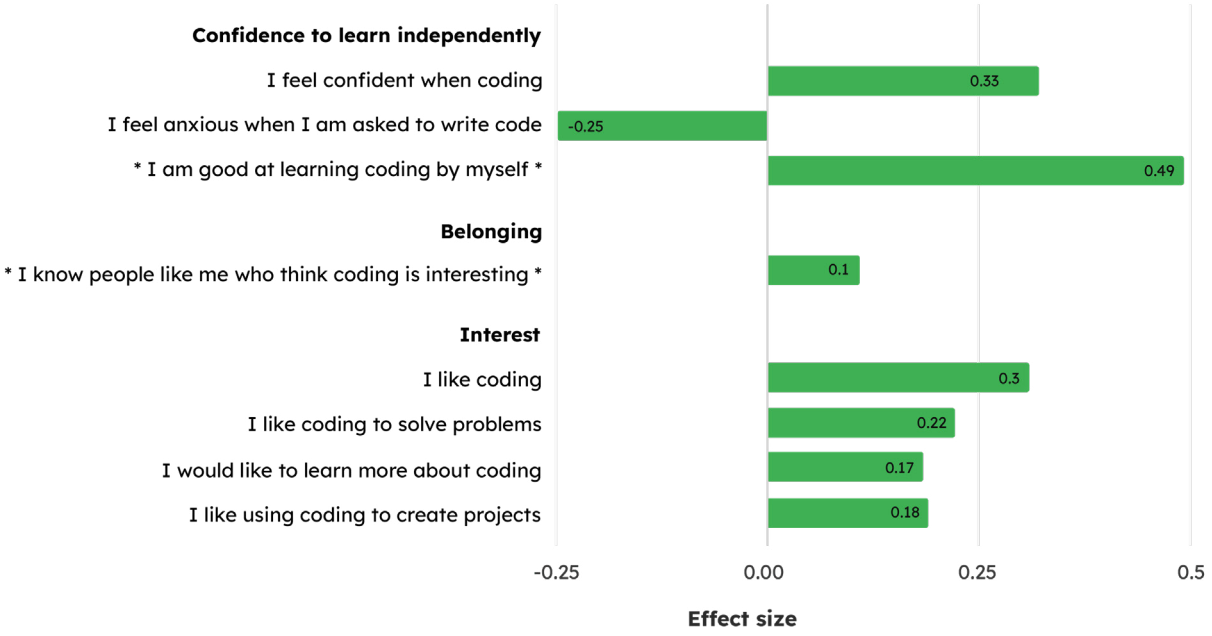
Coding skills and attitudes to coding

When comparing the coding skills quiz results for learners who participated in Code Club in both pre- and post-surveys against those who reported no membership, the effect size for Code Club members was +0.24, suggesting a higher gain for Code Club members.

In their observations, the DECE team saw that learners primarily worked on their individual projects, and explored the Code Club projects website. Some of the older learners were more experienced in coding than others, so the Code Club leader thoughtfully mixed the learners with different levels of experience, facilitating a conducive environment for the more experienced coders to share their knowledge and skills with newcomers.

The evaluation found that on average, Code Club members made greater improvements in all 'attitude to coding' items (once the negatively phrased item is reversed, see bar chart). This included the two pre-specified primary outcome measures for confidence to learn independently (effect size 0.49) and belonging (effect size 0.1).

Effect size of attitudes to learning coding



* Pre-selected as a primary outcome measure

Each young person had their individual projects to work on, promoting a sense of ownership and personalised learning. This setup encouraged active engagement and collaboration among the learners. Researchers also observed how towards the end of a session, learners showed their projects to the group, demonstrating their learning and celebrating their achievements. The Code Club leader provided positive feedback, highlighted key learning points, and encouraged participants to reflect on what they learned and discuss any challenges they faced.

Learners interviewed in the session commented on their learning experiences:

> **'Coding is really fun when I know what to do but sometimes it is hard but I always keep trying.'**

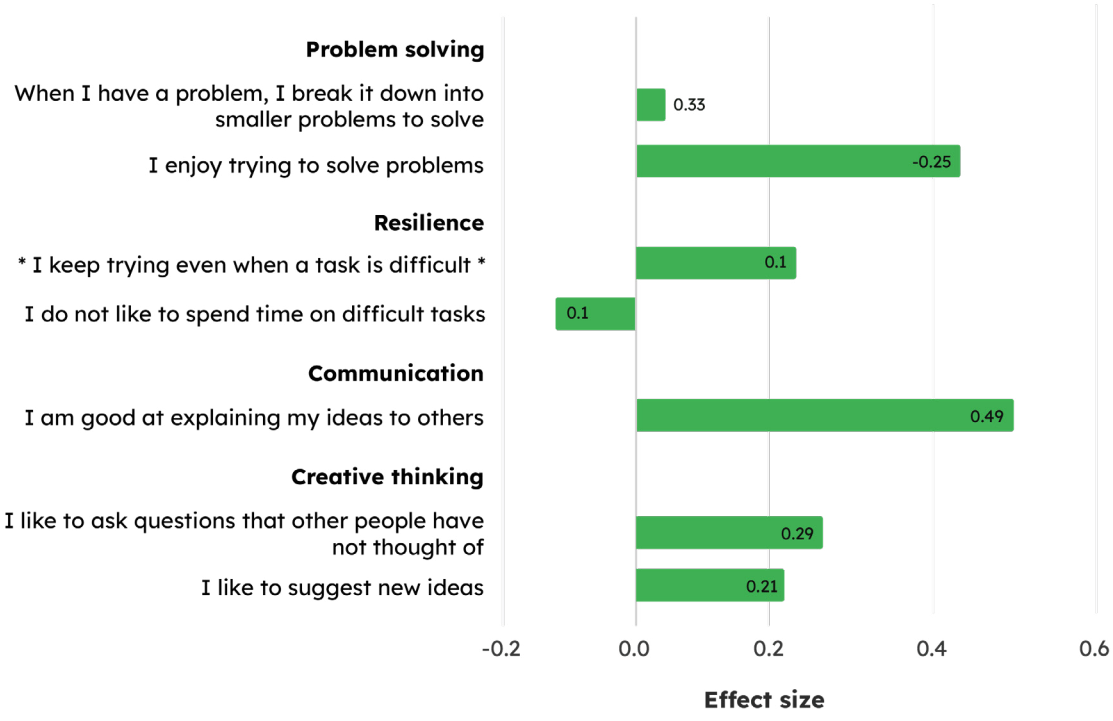
> **'Coding is fun but sometimes it is so hard as well.'**

> **'Code Club gives me more knowledge of how to code.'**

Code Club members' attitudes to learning

As indicated in the chart below, after considering the negative phrasing of one item, Code Club members show higher gains in their attitudes to general learning than non-members in all items. This includes the pre-specified resilience item, which had an effect size of +0.24.

Effect size of gains in attitudes to general learning



* Pre-selected as a primary outcome measure

These findings were supported by the interviews and Code Club observations. Learners and Code Club leaders stated that after-school clubs provided them with opportunities to engage in enjoyable activities with friends. They observed that traditional classroom activities often lack interactive elements that involve friends, whereas extracurricular activities allow them to collaborate with peers.

School leaders noted that participation in after-school clubs significantly boosts learners' confidence in verbal communication. They have observed learners taking initiative and assuming leadership roles, particularly in group projects, which strengthens their bonds of friendship. According to some school leaders, these activities showcase learners' capabilities in roles that may not be apparent in traditional classroom settings.

Teachers provide support during these activities, but learners largely lead their own activities. Achieving tasks independently contributes greatly to learners' self-esteem, as they take ownership of their accomplishments. Working collaboratively in groups fosters trust among peers and further enhances their sense of camaraderie and friendship.

> **'We see pupils in completely different roles when they are doing these Code Club activities. They enjoy more, and you can see they have skills to do things that we otherwise don't notice.'**

> **'In these Code Club activities, teachers are there to support and pupils lead their own social actions. It gives a lot of confidence to these pupils when they see any task successfully accomplished and they can actually own it in the end. This is what helps their self-esteem.'**

> **'Pupils see things achieved by themselves in Code Club. They work in groups and develop more trust and friendship when they do things on their own.'**

The value and role of mentoring and support was a dominant theme. Volunteers and club leaders offered guidance and encouragement, assisting participants in navigating challenges and enhancing their coding skills. Beyond technical instruction, this mentorship focused on fostering learning attitudes and development of skills. It involved fostering creativity, problem solving, and confidence.

Code Club leaders perceived that learners became engaged, focused, and less disruptive. In the interviews several of them indicated that the club accommodates a mix of learners including those who lack confidence, are socially isolated, or have extensive coding experience. There are no strict rules on how Code Club members should learn, and they are motivated to complete tasks and be innovative, often choosing to work on their own projects and even continuing their efforts at home.

Club leaders commented:

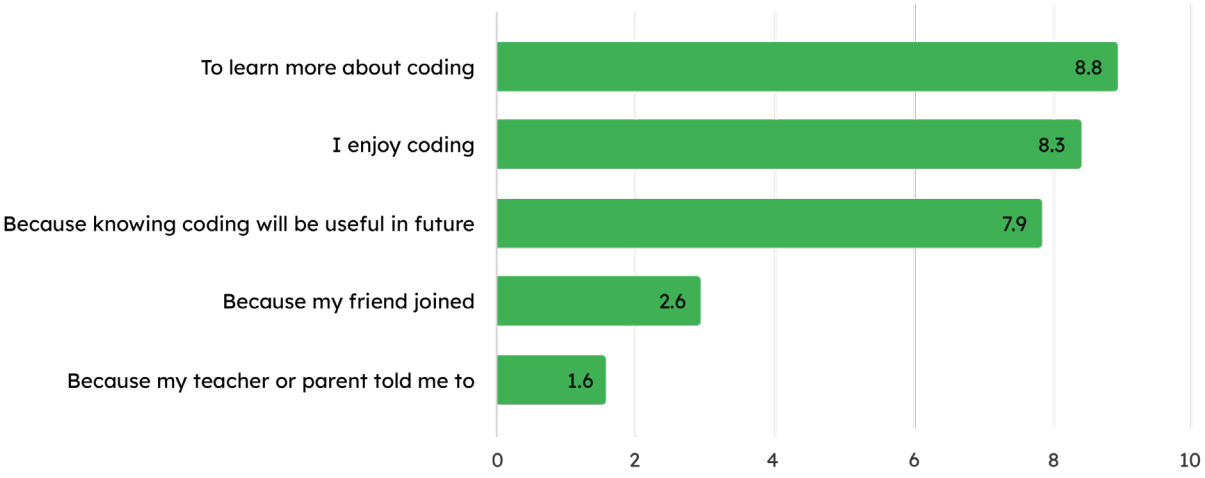
> **'We invited pupils to participate in the Code Club and we received a good response from Year 5 to 9 pupils who we knew had interest in computers and programming. Our Year 9 and 10 have been doing Code Club for about three years so we matched mentors for younger pupils. We found this very successful for pupils' social development and engagement.'**

> **'In my club, pupils' behaviour is very different from their normal classroom as the teacher says. In the club they are totally different, engaged, not disruptive. They are more focused. I have a child who lacks confidence, and he won a competition. It's a mixture of kids. I have got loners as well. I have got some kids who are super smart kids but in the normal classroom learning their actual potential is not recognised.'**

Motivation and experiences of young people

The evaluation found that most learners joined a Code Club for intrinsic reasons related to learning programming skills, and not because others told them to.

Why join Code Club?

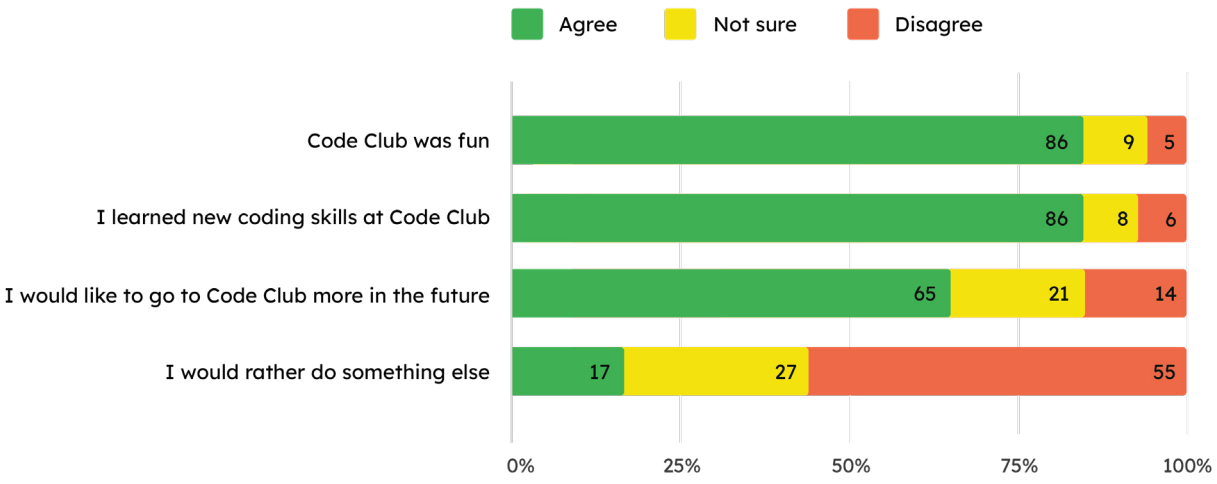


Most young people agreed Code Club was fun and they learned new skills. They commented:

> **'I love creating animations.'**

> **'I like this session because I work on my own projects. I like creating my own games and animated movies.'**

Why join Code Club?



All Code Club leaders commented on voluntary participation of learners as a key ingredient of success in learning. This demonstrates their genuine interest and high level of engagement. Young people's willingness to engage without compulsion highlights their enthusiasm for coding and innovation. By allowing them to select tasks and work on personal projects, Code Club cultivates an environment where learners feel empowered to direct their own learning, enhancing both their technical skills and their self-confidence.

Volunteering for Code Club

In the interviews with Code Club leaders, the most motivating experience to act as a volunteer was when they observed learners exploring interests such as music, art, or electronics, and creating something they were proud of. This approach makes the experience meaningful and engaging. Volunteering with Code Club also provided a sense of purpose and fulfilment, allowing Code Club leaders to feel like valuable members of society, demonstrating that the benefits of the programme extended beyond the learners to the volunteers as well.

> **'...volunteering with Code Club has helped me feel I'm a useful member of society in my old age, so the benefits have been good for me too.'**

There were also some challenges reported by Code Club leaders. They were not all trained teachers with experience working in schools, and they depended on support from school staff to assist them in running after-school programmes in the school premises. Some of them reported difficulties arising when the school could not assign a staff member to support their activities. Another issue was the lack of information about certain learners' specific needs from school staff.

Internet connectivity and availability of computers or other devices to access Code Club projects were also mentioned as a challenge.

> **'Connectivity issues with the internet have also impacted our activities in the past, though recent experiences have been more reliable.'**

Conclusions

Participation in Code Club has been beneficial for learners in multiple ways. This evaluation suggests that it positively influences attitudes towards learning in general, fostering qualities such as resilience. Moreover, learners show increased confidence and a sense of belonging in relation to coding tasks. They also show notable improvement in wider life skills, such as problem solving, communication, and creative thinking. Furthermore, learners' performance in quizzes assessing their coding skills showed promising results.

Code Clubs are led by dedicated leaders who ensure enjoyable experiences for participating learners. The enthusiasm and enjoyment expressed by Code Club members underscores their engagement in coding and their passion. Young people are intrinsically motivated to attend Code Club, out of enjoyment of coding and a recognition that it will be a useful skill in the future. The approach not only enhances technical skills but also nurtures a positive learning environment that promotes broader personal and cognitive growth.

What's next?

The main takeaway from this evaluation for the Raspberry Pi Foundation is additional confidence in the effectiveness of the Code Club programme. The evaluation provides a firm evidence base for continuing our approach to supporting volunteers, and to providing resources for setting up and running clubs, and high-quality, accessible learning experiences.

The evaluation has also confirmed that we should continue to focus our efforts, and future evaluation, on three outcome areas: coding skills; attitudes to coding; and wider life skills and attitudes to learning.

Another important finding is teachers' recognition of the value of creating a place in school where young people who struggle in class can thrive, in a way that isn't found elsewhere. The positive findings for resilience, problem solving, communication, and creativity are especially encouraging for these groups. This suggests there is an opportunity to increase our reach to schools in more disadvantaged areas (in the UK, and globally), in order to grow our impact for such young people.

There are some questions that this evaluation has not been able to answer, and which could be addressed by further research. These include:

- Are there other relevant life skills that mentors rate highly for club attendees that we did not measure in this evaluation?
- Are some models for running Code Clubs more likely to lead to positive outcomes than others, and does this vary according to young people's characteristics?
- How could we improve our support to club leaders to differentiate the Code Club experience for young people depending on their skills and interests?
- Would results be similar in other contexts, such as community-based clubs or clubs outside of the UK?

Building on the findings and lessons from this evaluation, and the measurement tools developed, we will continue to strengthen the evidence base for Code Clubs as we grow our reach and impact.

References

Bati, K. (2022). A systematic literature review regarding computational thinking and programming in early childhood education. *Education and Information Technologies*, 27(2), 2059–2082. https://doi.org/10.1007/s10639-021-10700-2

Papadakis, S. (2022). Apps to promote computational thinking concepts and coding skills in children of preschool and pre-primary school age. In *Research Anthology on Computational Thinking, Programming, and Robotics in the Classroom* (pp. 610–630). IGI Global. https://doi.org/10.4018/978-1-6684-2411-7.ch028

Popat, S. & Starkey, L. (2019). Learning to code or coding to learn? A systematic review. *Computers & Education*, 128, 365–376. https://doi.org/10.1016/j.compedu.2018.10.005

Rose, S., Habgood, J., & Jay, T. (2017). An exploration of the role of visual programming tools in the development of young children's computational thinking. *Electronic Journal of e-Learning*, 15(4), 297–309. https://doi.org/10.34190/ejel.15.4.2368

Siddiqui, N., Gorard, S., See, B. H., & Gazmuri, C. (2024). An evaluation of Code Club. Durham University Evidence Centre for Education. https://durham-repository.worktribe.com/output/2744322

Stamatios, P. (2024). Can preschoolers learn computational thinking and coding skills with ScratchJr? A systematic literature review. *International Journal of Educational Reform*, 33(1), 28–61. https://doi.org/10.1177/1056787922107607

Straw, S., Bamford, S., & Styles, B. (2017). Randomised control trial and process evaluation of Code Clubs. National Foundation for Educational Research. https://www.raspberrypi.org/app/uploads/2017/03/Randomised-Controlled-Trial-and-Process-Evaluation-of-Code-Clubs.pdf

Raspberry Pi
Foundation

Code Club is part of the Raspberry Pi Foundation.

Raspberry Pi Foundation UK Registered Charity 1129409