Raspberry Pi Foundation

Report

Our teaching and learning design principles

Summary

This report outlines the core design principles guiding the Raspberry Pi Foundation's educational content creation, ensuring all our resources are effective, engaging, and meet the needs of a diverse global audience. Our content is designed according to five interconnected themes:

High-quality content

Our content is reliable, accurate, and rigorously quality-assured by subject matter experts. AI-generated content is meticulously checked and edited. We continuously improve based on educator and learner feedback, ensuring practical, relevant, and effective content. Learning experiences include targeted feedback and assessments linked to clear objectives for lasting impact, reinforcing understanding, and addressing misconceptions.

Research-informed

Our content is based on diverse evidence, including academic research, evaluation data, user research, and project insights. It follows research-backed pedagogical principles, such as those in *The Big Book of Computing Pedagogy*, including models like PRIMM and semantic waves. We actively collaborate with the research community, including our internal team and the Raspberry Pi Computing Education Research Centre at the University of Cambridge, to apply current evidence.

Consistent

Our resources align with our 11-strand computing taxonomy, a curriculum-agnostic framework for content categorisation (e.g. programming, networks, safety). Each learning experience has clear, logically connected objectives, often modeled with learning graphs, creating a coherent journey where each step builds on the last. Programming examples follow established, language-agnostic conventions, prioritising clean, readable, transferable code and avoiding confusing language-specific shortcuts.

Inclusive by design

Our resources follow UDL principles, using accessible fonts, colors, and layouts to avoid cognitive overload. Content is written in simplified English (CEFR B1 for learners, B2 for educators) to reduce literacy barriers globally. We apply culturally relevant pedagogy, ensuring examples reflect diversity, explore ethical issues, and challenge stereotypes.

Adaptable

Our educational content is openly licensed (CC BY-NC-SA 4.0) and provided in editable formats (plain text, markdown, no embedded image text) to empower educators to customise materials. We prioritise localisation by avoiding idioms, using common fonts, and offering separate video voiceovers and transcripts.

The design principles encompassed in these five themes ensure that we can scale our global impact while providing trustworthy, pedagogically sound, and evolving resources, ultimately reducing the burden on educators and delivering an exceptional computing education to all young people.

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Introduction

At the Raspberry Pi Foundation, we are committed to providing high-quality learning experiences that enable young people to realise their full potential through the power of computing and digital technologies. We develop a wide range of educational content, including classroom resources, professional development for educators and creative projects for young people to follow independently. Every educational resource we create is designed with a consistent, evidence-based approach to make learning engaging, effective, and accessible for our global audience.

For over a decade, we have created content to help learners and educators grow their knowledge and capabilities in computing, programming, and digital making. While our origins are in the UK, our team now develops content that serves a global community, reaching people in many different countries and across a wide variety of contexts. These range from classrooms with reliable technical infrastructure to rural and remote locations where consistent access to technology may vary.

Our resources are used by a diverse range of people, spanning different languages and cultural norms. Our approach aims to balance the need to localise our content with the need to deliver consistent and high-quality experiences. After ten years of developing our practice and pedagogy to meet these varied needs, we have invested time in formally setting out the design principles that guide this work. As we continue to grow and address new challenges in computer science, AI, and digital literacy, it is crucial that we continue to follow these foundational principles. By making them explicit, we both communicate the intent and expertise behind our work and hold ourselves accountable to the high standards they represent.

This report is for anyone interested in high-quality learning design. It is for educators, instructional designers, and partner organisations who want to understand the depth of thought, intent, and expertise that underpins the Foundation's educational content.

The design principles detailed in this report are organised into five themes, which represent the core of our teaching and learning philosophy:

- Our content is **high quality**
- Our content is **research-informed**
- Our content is **consistent**
- Our content is **inclusive by design**
- Our content is **designed to be adaptable**

The goal of this report is to provide a clear and transparent insight into our approach. We hope that by sharing our design principles, we not only demonstrate our commitment to excellence but also offer a valuable framework that other educators and organisations can adapt and use in their own work.

Themes of teaching and learning design

Our design principles for teaching and learning are organised into five interconnected and overlapping themes (fig. 1), which represent our priorities for the learning content we produce. The following subsections explore each theme and the principles that align with them, and provide examples of the principles in practice.

Figure 1: Our five themes for teaching and learning design.

Theme 1: Our content is high quality

High-quality content builds trust. We recognise that educators around the world are under constant pressure and often developing their own subject knowledge and skills, in parallel to developing the same skills and knowledge in their learners. They want access to resources that they can trust to be accurate and reliable. Likewise, independent learners and adults that support them (parents and volunteers) want projects and content that they can rely on. Therefore, it is paramount that the resources we provide are both high quality and effective. This theme establishes our commitment to producing dependable content that empowers educators and learners alike and enables meaningful learning.

1.1 All content is reliable, accurate, and free from errors.

This design principle speaks to our rigorous internal quality assurance processes. Subject matter experts within the Foundation thoroughly review every piece of content to ensure it is technically and conceptually sound. Accuracy is always appropriate for the learner's stage of development; we may use analogies or simplify complex topics to communicate the core ideas, but we do so in a pedagogically deliberate way.

We have developed principles and processes to make sure that, where we use generative AI (artificial intelligence) tools to support drafting, our teaching and learning experts meticulously check all draft content and ensure that the final copy is accurate and of the highest quality.

1.2 To ensure continuous improvement, educator and learner feedback informs content development.

While many of our staff are experienced educators, we know the education landscape is always evolving. This means gathering feedback from practising educators and learners is a crucial part of our design process. We test our content with end users to understand how it works in different learning contexts and whether it meets users' needs. This feedback loop is vital; it allows us to ensure our content is not only technically accurate but also practical, relevant, and serves the widest possible range of learners and educators.

Alongside our initial testing practices, we collect and act upon ongoing feedback for all our learning products ensuring that they stay functional, relevant, and impactful.

1.3. Our content is designed to reinforce understanding and support learners' development with meaningful assessments and targeted feedback.

Together, our range of learning experiences are designed for lasting impact, not just one-off engagement. We help learners build practical skills and deeper understanding, anticipating and addressing misconceptions along the way. Our learning designers ensure that every learning experience includes opportunities for learners to demonstrate their understanding, and we also design our explanations and activities carefully to avoid introducing new misconceptions.

Where appropriate, we integrate meaningful assessments that are directly linked to learning objectives. This allows learning to be demonstrated, measured, and reinforced, and it provides learners with feedback that helps build confidence and allows them to progress.

Theme 2: Our content is research-informed

In the emerging field of computing education, we are committed to ensuring our work is underpinned by the best and most credible evidence available. This provides a strong foundation for our learning design and helps our content stand out. Our understanding of evidence is broad and holistic, creating a rich picture of what works for learners and educators.

2.1 We gather insights from a range of sources, including academic research, monitoring and evaluation evidence, exploratory projects and market and user research.

We use various sources to inform our work (fig. 2). This includes academic research, which provides a crucial evidence base. Recent years have seen a greater emphasis on research with school-aged learners, rather than undergraduates, providing more directly applicable findings.

We combine academic research with our own monitoring and evaluation data, using analytics and direct feedback to understand how our digital products are used and whether they are having the intended or desired impact.

User and market research helps us understand the specific needs and contexts of our audiences, enabling us to tailor our learning experiences to suit either a specific audience or be applicable to the widest audience possible.

Where evidence and empirical data are sparse, we will innovate and develop exploratory projects, piloting, testing, and learning from the outcome. Our skilled learning designers combine these insights alongside their experience and "craft knowledge"[1] to design the very best learning experiences possible.

[1] Leinhardt, G. (1990) Capturing Craft Knowledge in Teaching. Educational Researcher. [Online] 19 (2), 18.

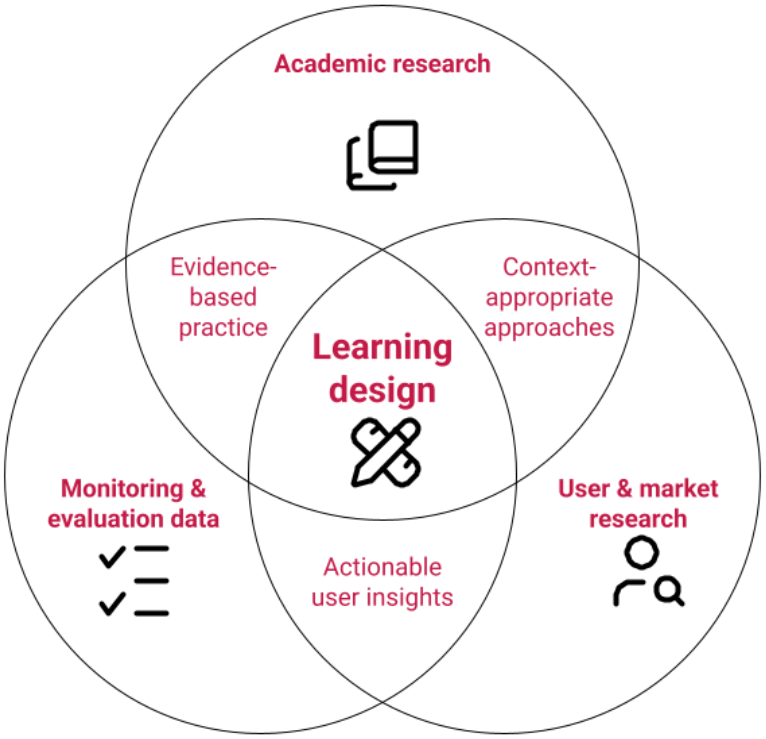


Figure 2: We combine multiple insights into effective learning design.

2.2 Research underpins everything we create.

Our commitment to evidence is embedded in our processes. For each project, we review available research evidence. At the start, we map out and analyse the evidence that will inform our design and development choices. This is especially important where our learning experiences venture into new areas, whether they be new contexts, new approaches, or whole new areas of computing (e.g. AI).

A concrete example of this approach is the significant preparatory work undertaken before a single lesson of our first Experience AI unit was written. Building on earlier work to understand the landscape[2], our learning designers and researchers collaborated to develop design principles[3], adopt the SEAME framework[4], and eventually outline a learning graph (see 3.2). This close collaboration between learning designers and researchers led to a learning experience rooted in current research evidence.

This approach ensures that every product is built on a solid foundation of research from the outset.

[2]Towards a Framework for Learning Content Analysis in K-12 AI/ML Education https://ieeexplore.ieee.org/document/10343368
[3] https://computingeducationresearch.org/projects/experience-ai-design-principles-study/
[4] Waite, J., & Garside, B. (2023, November). From ethics to engines, framing AI Literacy (including Algorithm Literacy and Data Literacy) through the SEAME framework. Submitted and accepted as an extended abstract to UNESCO 2023 call for evidence https://computingeducationresearch.org/wp-content/uploads/2024/11/UNESCO_submission-20.pdf

2.3 All our content is grounded in research-informed principles of pedagogy.

Starting in 2019, as we developed the first comprehensive computing curriculum for students aged 5 to 16 in England, we began to document our pedagogical approaches. We translated research for teachers and embedded these practices in our work, eventually organising these approaches into twelve pedagogy principles[5] (fig. 3). These principles are captured and shared in *The Big Book of Computing Pedagogy*[6] (fig. 4), a collection of research articles and related teacher stories.

This book and the principles within are a key resource for our team and educators around the world. We actively incorporate these key underlying practices into our content to make learning experiences effective and evidence-informed. This includes approaches such as using semantic waves to unpack complex topics and applying the PRIMM model to structure programming lessons.

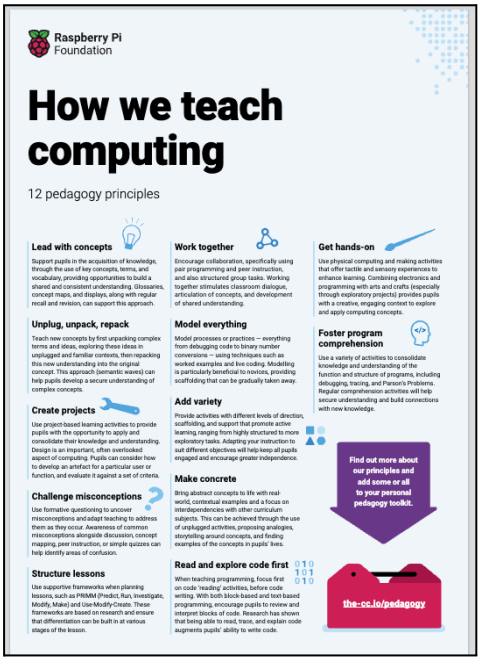


Figure 3: Our twelve pedagogical principles.

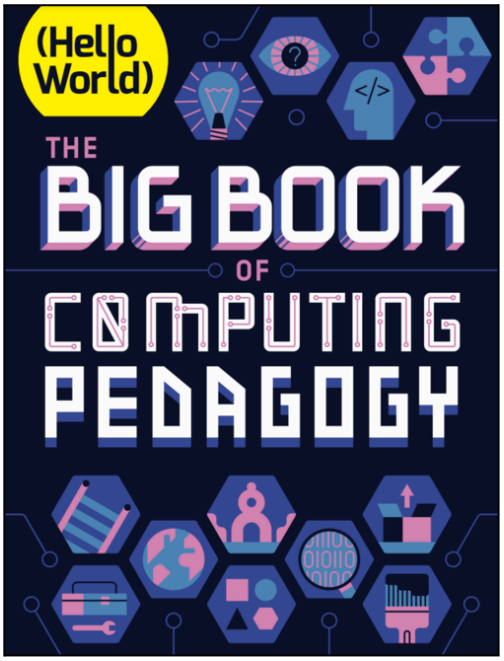


Figure 4: *The Big Book of Computing Pedagogy*.

2.4 We actively collaborate with academic researchers.

We work closely with the research community to ensure our products are tied to the latest evidence and that we are contributing to the field.

- Our own academic research team conducts studies aligned to our strategic priorities.

[5] the-cc.io/pedagogy_poster
[6] helloworld.cc/bigbook

They work closely with the Raspberry Pi Computing Education Research Centre[7] at the University of Cambridge to publish high-quality research, and share insights with our learning designers and the wider community.

- The Raspberry Pi Computing Education Research Centre engages in a range of research projects exploring a broad set of topics, with a focus on underrepresentation and educational disadvantage. It supports PhD students conducting research, runs an action research programme for teachers, and publishes research that directly impacts practices in schools.
- We regularly collaborate with education researchers around the world through our publications, seminars, events, and studies.

Our connection to academic research continues to help our learning designers apply the best and most recent evidence, which leads to impactful learning experiences.

2.5 We carry out small-scale pilots and exploratory projects to gather insights and evidence quickly.

Where strong evidence for a new idea does not yet exist, we use pilots and exploratory projects to test our instincts and existing evidence. This approach helps us innovate and develop new content through a process of rapid, evidence-informed iteration, ensuring that even our newest ideas are tested and validated.

[7] https://computingeducationresearch.org/

Theme 3: Our content is consistent

As our range of learning products grows to serve different audiences and contexts, consistency is essential to ensure they are all working towards the same goal and enabling young people to realise their full potential through the power of computing and digital technologies. A consistent approach prevents us from presenting ideas in conflicting or confusing ways, creating a more unified experience for our users.

3.1 All our content is aligned to our computing taxonomy.

Our content taxonomy provides a nuanced, eleven-strand framework for understanding the breadth of computing (fig. 5). It moves beyond simple labels like ‘computer science’ or ‘IT’ to identify the key threads such as 'Programming' or 'Networks' that are present through a learner's entire journey. This taxonomy acts as a consistent reference point for categorising our content and is designed to be applicable to any curriculum, allowing us to map our resources to educational frameworks around the world. It also distinguishes between knowledge-rich strands and cross-cutting skills like 'Safety and security', which are woven throughout all our learning experiences.

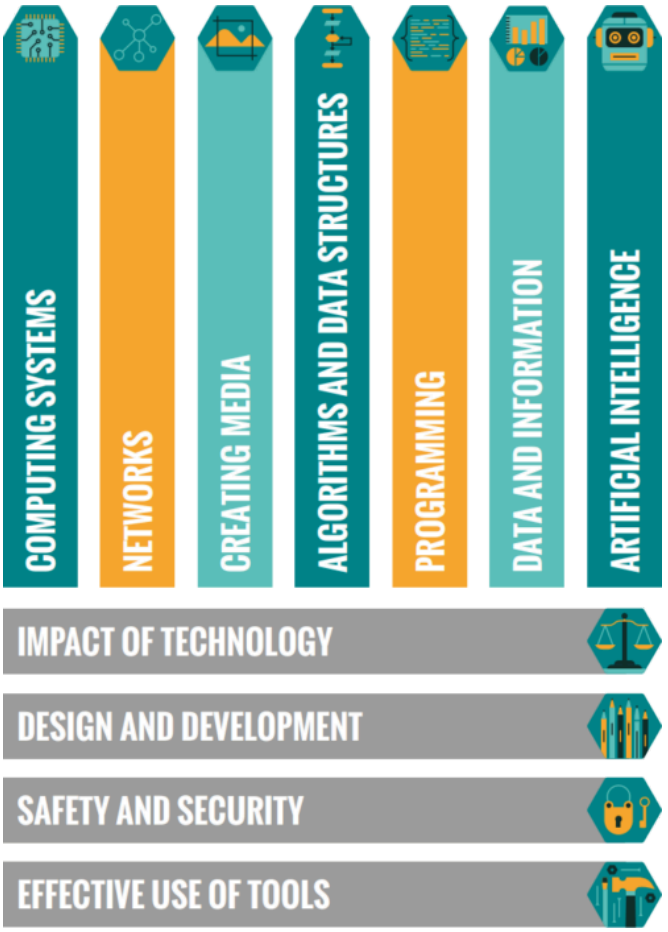


Figure 5: Our eleven-strand content taxonomy for computing.

3.2 Every learning experience is guided by clear learning objectives within a broader progression.

Clear learning objectives frame every learning experience. They provide a clear goal, helping our learning designers and educators to stay focused on the core intent of a resource. Importantly, these objectives are designed to connect to each other, creating a coherent and logical learning journey where each step builds upon the last. We don't always explicitly share objectives with learners, but when they are guided through a specific learning journey, we use learning graphs (Fig. 6) to show how skills and concepts connect. These graphs then guide the design of our learning experiences.

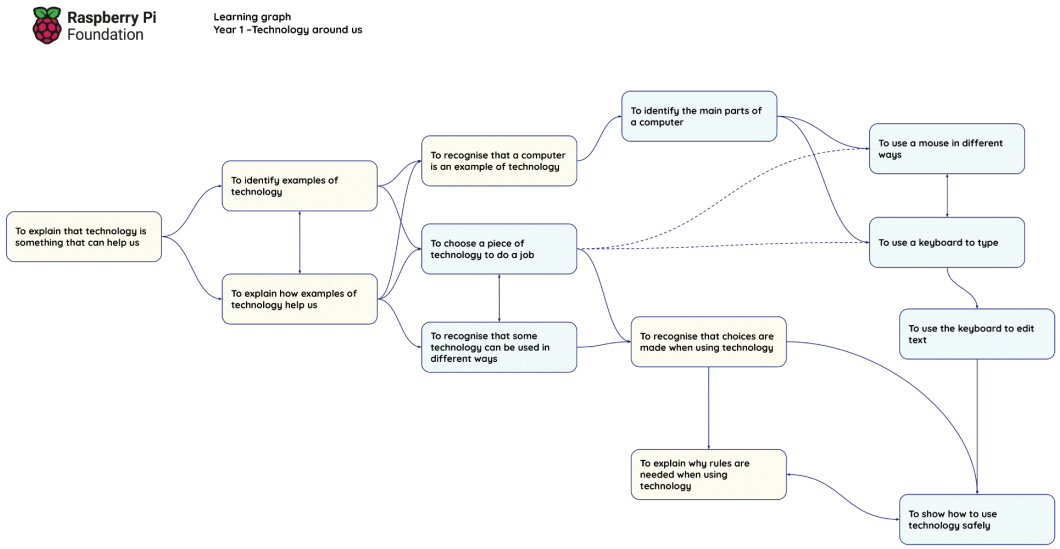


Figure 6: A learning graph sequencing skills and concepts within a curriculum unit connecting concepts (yellow) and skills (blue).

3.3 All programming examples follow established conventions.

Across our learning experiences, learners will encounter a lot of program code and algorithms in a variety of languages including text-based and block-based code and representations, including pseudocode and flowcharts. In programming, there are usually multiple ways to achieve the same goal, as well as methods to combine multiple lines of code and some language specific shortcuts.

Our goal is to help learners understand programming concepts, not just how to code in a specific language. Therefore, we have developed a set of coding standards[8] that we follow wherever possible. These conventions, illustrated in table 1, prioritise:

1. Writing code that is clean and easy to read and understand. For example, we may

[8] Raspberry Pi Foundation (2025) *Coding standards*. Available at: https://github.com/raspberrypilearning/ada-code-samples/wiki (Accessed: 24 October 2025).

break instructions over multiple lines of code rather than condense in a single line.

2. Avoiding approaches that may lead to misconceptions or confusion, such as concatenation through passing multiple parameters. This may suggest that other functions work in the same way, provide less control, and aren't common to all languages. Instead, code should model concatenation techniques.

3. Avoiding language-specific features or idiosyncrasies that learners may not easily be able to replicate in other languages, such as Python's chained comparison operators, which are convenient but fairly unique.

Our standards also include visual guidelines for code, such as the use of high-contrast Scratch blocks by default or the syntax-highlighting style for text-based languages.

The standards cover the eight different languages used in our resources.

Table 1: Examples of how we write programs and code snippets in our resources based on our coding standards

	To be avoided ✖		Good practice ✔

1	Python
	`print(int(input("Enter a number"))**2)`
		→	Python
			`num = input("Enter a number")`
			`num = int(num)`
			`sqr = num * num`
			`print(sqr)`

2	Python
	`print("Hello",name)`
		→	Python
			`#Add strings to end for trivial examples`
			`print("Hello " + name)`
			
			Python
			`#Use f strings for insertion`
			`print(f"Hello {name}, how are you")`

3	Python
	`# Uses one "chained" condition`
	`if 0 < x < 10:`
	`  print("x is between 0 and 10")`
		→	Python
			`# Uses two conditions with AND operator`
			`if x > 0 and x < 10:`
			`  print("x is between 0 and 10")`

3.4 Design choices and their rationale are documented.

To ensure consistency over time and across teams, we are committed to documenting the design decisions we make. Without documented design decisions, our reasoning, rationale and our mistakes and learning from them become institutional knowledge that can easily be lost. This makes it difficult to replicate successful designs or onboard new team members.

By ensuring we record our rationale, we make our design process more transparent and repeatable, which is crucial for maintaining consistency and quality as we grow.

Theme 4: Our content is inclusive by design

A core part of the Raspberry Pi Foundation's mission is our belief that computing education is for everyone. We see the skills and mindsets developed through computing, programming, and digital literacy as relevant and empowering for all young people, whatever their future path may be.

To achieve this, we are committed to making our content as accessible and inclusive as possible from the start of the design process. Following the principles of universal design for learning (UDL, fig. 7), we recognise that designing for a subset of learners ultimately benefits everyone. Providing multiple means of engagement, representation and action and expression promotes learners' agency.

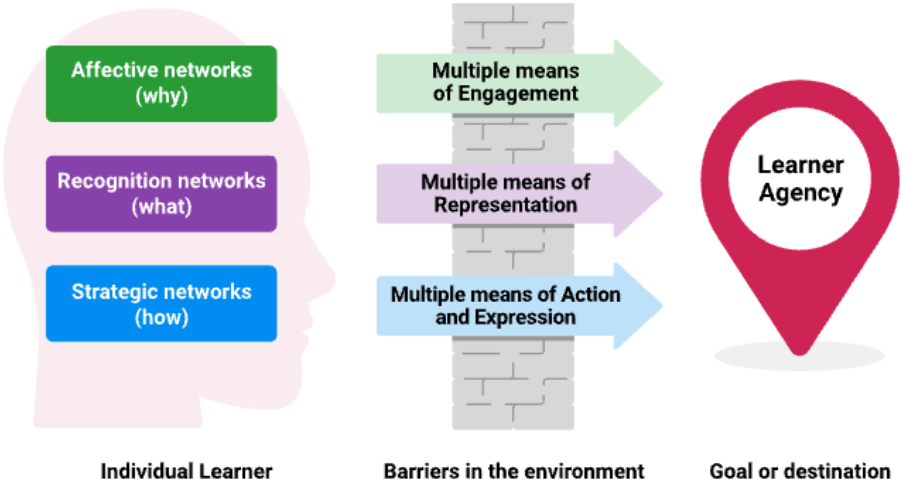


Figure 7: Universal design for learning principles help engage learners and build their agency.

While we strive to develop the most inclusive content possible, we recognise our limitations. Individual educators are best placed to tailor content to the specific needs of their learners, which is why we design our content to be adaptable (see theme 5).

4.1 All resources are visually consistent and use accessible fonts, colours, and layouts.

Visual design is a key part of our approach to accessibility, providing consistently clear content which supports all learners to develop their understanding and skills in computing.

Every design choice is made to support learners, including:

- We use colour if appropriate to highlight or signal key information for learners, with colour palettes that are more accessible for all (e.g. high-contrast Scratch blocks).

- We specifically choose fonts that are easier to read for all, including for people with dyslexia.
- We chunk and layout our content to avoid cognitive overload and avoid redundant information, helping the learner focus on what matters.
- We apply Meyer's principles of multiple learning[9] and related principles of dual coding to support learners.

4.2 All content is written in simplified English for clarity and inclusivity.

Computing is a subject domain filled with lots of technical language and abstract ideas which can create a barrier to learning. When we create our content, we write it in English. In some contexts, we may also translate some or all of the content of a resource into a local language.

However, to make sure our content written in English is accessible to a broad global audience, we use the Common European Framework of Reference for Languages (CEFR). By focusing on the language we use within our learning experiences, we aim to reduce the literacy barrier to learning.

We take an approach which we believe balances accessibility with accuracy:

- For learners, we aim to write content at level B1 (intermediate), which provides enough vocabulary to describe concepts without being overly complex.
- For educators, we aim for our material to be mostly B2 (upper intermediate) which allows us to describe both abstract and concrete concepts and use more specialised vocabulary.
- Some computing specific vocabulary belongs to higher levels C1+. We don't avoid or simplify these terms but explain them using appropriate levels of language. For example, the term "abstraction" is a C1 word, which we might explain as:
    - "Abstraction is a way of simplifying things. It means you only focus on the important parts of an idea or a tool and hide all the complicated details you don't need to see. For example, when you use a remote control, you don't need to know how the inside of it works, you just need to know which button to press." (B1 level)
    - "Abstraction is the process of reducing a complex system to its essential components to make it more manageable. It involves creating a simplified representation of an underlying process or object, allowing a user or another program to interact with it without needing to understand its internal complexity." (B2 level)

[9] Mayer, R. E. (2011). Applying the science of learning to multimedia instruction. In *Psychology of learning and motivation* (Vol. 55, pp. 77–108). Academic Press.

4.3 Examples and case studies in our content reflect cultural diversity and are culturally relevant for the intended audience.

We want every young person to feel that they can be part of the computing community, and that computing is an option for them. To this end, we actively work to include all learners in our content through the application of principles of culturally relevant pedagogy.

- Where we have a specific context in mind, we carefully consider the context and adapt our resources to better suit the interests, identities, and experiences of learners in that context
- In situations where we don't know or can't predict the context, we aim to select examples and scenarios that have the broadest appeal
- Our learning experiences actively explore issues of bias, ethics, social justice, and legal issues
- Throughout our resources we ensure that students of all backgrounds and experiences are represented positively and that we challenge stereotypes
- Our case studies and the imagery we use in our content reflect the true diversity of the global community we serve

Theme 5: Our content is designed to be adaptable

We recognise that to have the greatest impact, our content must be adaptable. No single resource can perfectly meet the needs of every learner and every educator in every context.

Adaptability is about ensuring our content has the right properties to be ready for adaptation. Some aspects of adaptability are supported by other themes and principles already discussed in this report. For example, using a B1 or B2 level of English may primarily be about making our content more accessible, but it also makes it more adaptable. This section focuses on design principles that specifically address adaptability.

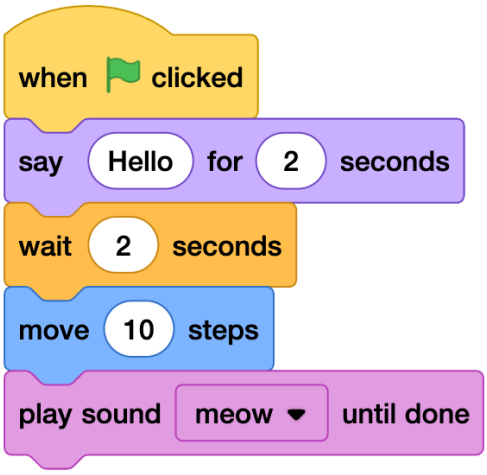
Adaptability not only empowers our community — it also streamlines our own work, and is fundamental to achieving our global mission.

5.1 All content is designed to be adaptable for new projects, audiences and contexts, whether the Foundation, its partners, or educators do this adaptation.

Adaptability doesn't happen by accident or by default, it needs to be intentional and planned, but it may look different for different learning experiences or products. However, there are a few common approaches that we apply across our content.

- A fundamental feature of our content is its publishing and licensing model. By publishing our resources for free under open or Creative Commons licenses (typically CC BY-NC-SA 4.0), we give educators the freedom to tailor materials to their specific learners' needs.
- We draft and store our text-based content in easily editable formats and ideally in plain text. Depending on the product, we store text in markdown, Google Docs and a few other formats, which can be opened and edited online or without special software.
- We use a range of version control tools from Google Docs to GitHub to manage and track changes. This allows us to easily "fork" content to create new versions.
- Images and other media enrich our content but add an additional challenge in terms of adaptability as editing this content may require specific software. To make this easier, we:
    - Avoid niche contexts or overly localising content as this means that images may not need to be replaced.
    - Avoid the inclusion of text within images. Instead, text is added using labels, layers, captions or alt text, making them easily edited.
    - We will store and share editable versions of images like diagrams.

- Ideally, when we use AI-generated images, it is for inspiration and to create an editable image. We do this because there is no direct link between the source (prompt) and the final result (image), which makes adaptation more difficult.
- Where appropriate, we use “diagrams as code” tools to predictably generate images from text. In particular, we use a Scratchblocks[10] tool for Scratch programs (fig. 8) and the mermaid diagram language for some diagrams.



→

When green flag clicked
say [Hello!] for (2) seconds
wait (2) seconds
move (10) steps
play sound (Meow v) until done

Figure 8: Scratch blocks in a slide deck link to scratchblocks.github.io and the text that generated them.

5.2 Specific consideration is made to accommodate future localisation and translation of content.

To reach a global audience, our content must be easy to localise and translate. This consideration informs many of our practical design choices. Many of the same techniques we use for general adaptability (5.1) also support localisation. Beyond these approaches, we also:

- Avoid idioms and colloquialisms in our text, which can be filled with nuance and hard to directly translate.
- Use of commonplace fonts ensures support for the symbols and accents of a wide range of languages.
- Use narrated videos or animations where possible, which can be overlaid with translated speech.
- Provide separate voiceovers, transcripts, and subtitles alongside video content, which can be translated.

[10] scratchblocks.github.io

- Provide English definitions of key concepts at different levels, which can be translated where appropriate.

These practices (alongside others already mentioned) support our in-house team and a global network of volunteer translators who help us make our content accessible to all.

Conclusion

The five themes outlined in this report — high quality, research-informed, consistent, inclusive by design, and adaptable — act as guidelines for impactful learning experiences. By embedding the described principles into our design and development processes, we strive to ensure that every piece of educational content we create is a trusted and transformative experience for both learners and educators.

In a field where educators are often under immense pressure and tasked with teaching a constantly evolving set of knowledge and skills, the need for dependable and pedagogically-backed materials has never been more critical. The international educational community has consistently highlighted the pressing need for robust professional development and high-quality resources to support educators who may be new to computing or struggling to keep pace with rapid technological advancements. Our design principles seek to address this call and reduce the burden on teachers, empowering them with the confidence to deliver an exceptional computing education.

We believe these design principles provide a solid but flexible foundation as we continue to develop new learning experiences for new markets and in the face of technological change. Our commitment to an evidence-based approach means that we will continuously refine this framework, learning from our community to make sure our content remains relevant and impactful.

We invite fellow educators, instructional designers, and partner organisations to not just adapt and use this framework, but to join us in a shared mission. Let us work together to ensure that a high-quality, inclusive, and empowering computing education is not a privilege but a right for every young person around the world.