

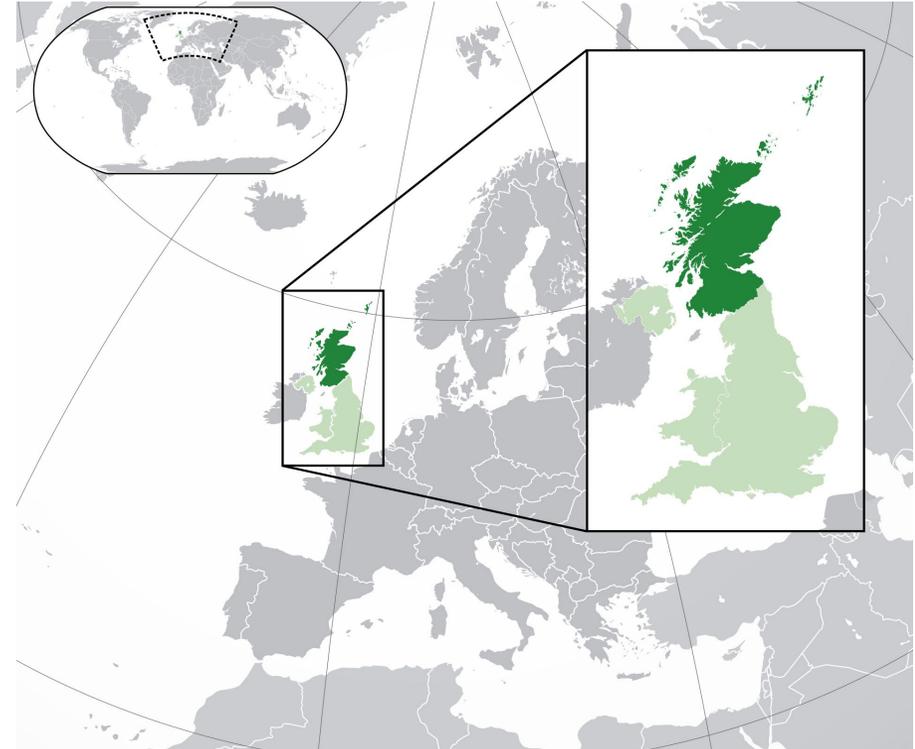
# Computing, Data and AI Education in Scotland

Kate Farrell, University of Edinburgh



# Education in Scotland

- Early years education from 3-5 years
- Primary school (P1-P7, ages 5–12)
- Secondary school (S1-S6, ages 12–18)
- Subject choices for qualifications at age 16
- Mandatory education ends at age 16
- Free college and university education for most Scottish residents.
- Education is ‘devolved’ in Scotland – decided by the Scottish Government not the UK Government



Primary schools: 1978  
Secondary schools: 360  
Special schools: 107  
Independent (fee-paying): 91

# Curriculum for Excellence



Languages and Literacy

Religious and Moral Education

Social Studies

Expressive Arts

Health and Wellbeing

Sciences

Technologies

Mathematics and Numeracy

# Computing Science within the National Curriculum

- CS taught in Secondary schools since 1980s.
- Ten years ago we updated the National Curriculum to include CS as an entitlement for all learners ages 3+
- Outcomes on CT concepts, understanding technology, and creating with computers.

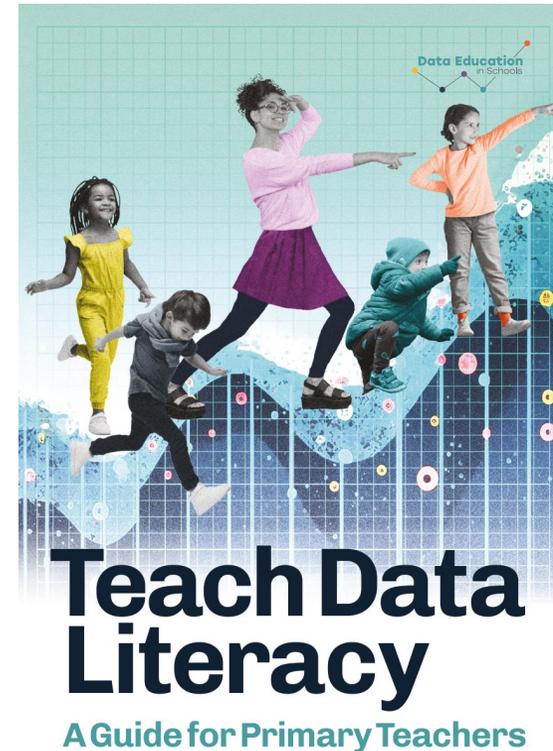
[teachCS.scot](https://teachCS.scot)



# Data Literacy across the National Curriculum

- Data literacy outcomes identified across the existing National Curriculum.
- Project in South-east Scotland to improve data literacy has had impact across Scotland and in 117 countries worldwide.

[Dataschools.education](https://dataschools.education)



# Data literacy is already in the curriculum!

Outcomes for **learning** core data literacy concepts include:



**Technologies**



**Numeracy  
and Maths**



**Literacy**



**Social Studies**



# Applying data skills across the curriculum



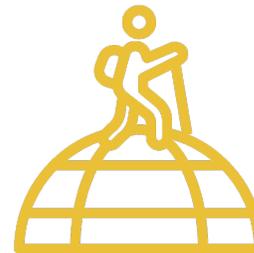
The journey of food, and  
calculating food miles  
More physical activity,  
better sleep and nutrition



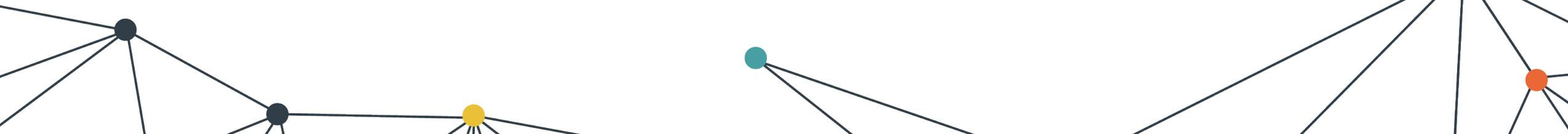
Energy use and  
conservation of materials



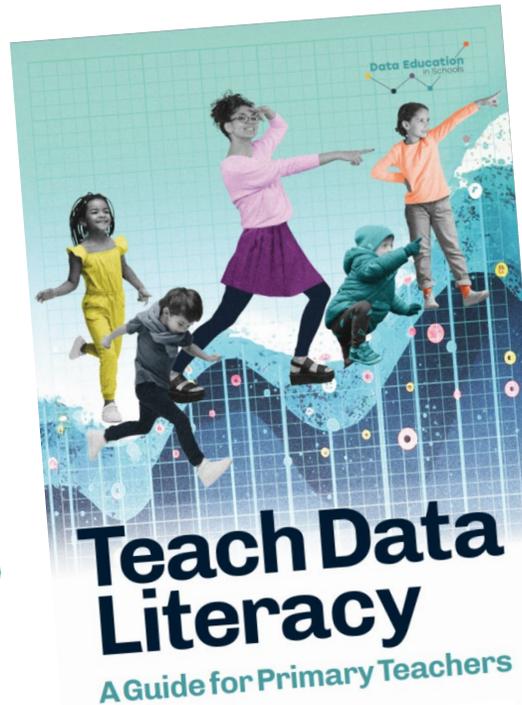
Water pollution and water  
conservation  
Using sensors to monitor  
plant growth



Environment and  
sustainability  
Weather and climate  
Journeys, travel and trade



# Guide for Primary Teachers



Resources and Activities: First Level 45

**Problem**  
**Ladybird count**

The learners are shown pictures of cards with ladybirds on them, and encouraged to think about what investigative questions using "What do you notice?" and "what questions would you like to ask?" prompts. Suitable for younger learners, but could be adapted for older learners by including different graphs.

**SKILLS & CONCEPTS**  
Ask an interesting question; create a data display.  
NRich Maths  
<https://nrich.ac.uk/>

**Plan**  
**Open or Closed**

A quick worksheet-style exercise about the difference between open and closed survey questions.

**SKILLS & CONCEPTS**  
Conduct investigations using the statistical enquiry cycle; posing and answering questions; gathering, sorting, and displaying category and whole-number data; communicating findings based on the data.  
NZ Maths  
<https://nzmaths.ac.nz/>

**Data**  
**Make a Guess Who Game**

Learners will probably be used to playing the Guess Who game - in this activity, they get to make their own version of the game. In doing so, they learn about categorical variables (for example hair colour, eye colour of the game characters).

**SKILLS & CONCEPTS**  
• Exploring variability in categorical variables  
• Structuring information  
Data Education in Schools  
<https://dataed.in/>

Data Literacy Concepts

## Data Literacy Concepts

"The biggest needs for every statistical cook, from the person who simply heats up TV dinners to the Michelin-star chef, are needs for conceptual understanding."

Data literacy overlaps with statistical literacy, and they share important concepts which will be familiar from the data and analysis, chance and uncertainty strands of the maths curriculum. There are three main statistical concepts which learners should informally explore at primary school: data types, variability and probability.

Knowing about the "big ideas" in statistics and how conceptual understanding progresses is useful for teachers when planning for and supporting learning (diagnosing learners' difficulties). It isn't necessary for learners to use statistical vocabulary.

Similarly, supporting the ability to think about data and draw valid conclusions is more valuable than rehearsing mechanical formulae or tests. It makes sense to use software tools for calculations and drawing graphs to give the learners more time to think about what the results mean, particularly when working with larger datasets.

**Learners should explore three main statistical concepts at primary school: data types, variability and probability.**



Data Literacy Concepts

## Data Types and Variables

A **dataset** is a collection of measurements or records about a group of related items or people. A weather dataset might consist of a collection of temperature recordings from cities in the UK, and an opinion poll is a dataset of a group of people's views of the same topic.

In statistics, a **variable** is a characteristic of interest that you measure, record, and analyse for all of the items in a dataset. A variable is an attribute that describes a person, place, thing, or idea. The value of the variable will be different for different items/records in the dataset which you measure - it will vary.

There are two main types of variables which learners will encounter in primary schools: numerical and categorical. Numerical variables record amounts, quantities, or measurements in the form of numbers, while categorical variables record categories or groups. Examples of numerical variables include height, income, age and temperature. Teachers can draw more experienced learners' attention to the fact that numerical variables can have different ranges of expected values. For example, temperature could be negative when it is cold outside, but height would not be zero or less.

Categorical variables are used to record ideas or characteristics which can be categorised but don't have an obvious numerical value e.g. colour, political party, or gender. It is possible to count how many items in the dataset belong in each category but it doesn't make sense to do arithmetic on the categories. For example, I can count that there are 5 people with brown eyes, 3 people with

green eyes and 2 people with blue eyes. I can even say that a total of 5 people have green eyes or blue eyes. But if I tried to add up the categories themselves (e.g. blue+green), it would have no meaning.

Developing an understanding of different types of data and how they can be measured by taking part in hands-on data problem-solving projects will lay the foundation for learners to move on to more formal statistical analysis in later stages of secondary school.

**There are two main types of variables which learners will encounter in primary schools: numerical and categorical.**

[dataed.in/TeachData](https://dataed.in/TeachData)

Data Education  
in Schools

# National Qualifications in Data Science



*Educators Guide to the NPA in  
Data Science*



*Learners Guide to the NPA in  
Data Science*

[teachdata.science](https://teachdata.science)

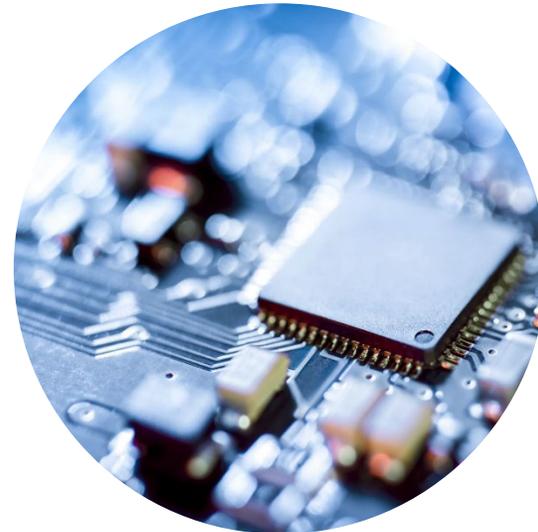
# Can be taught by a range of teachers



Maths



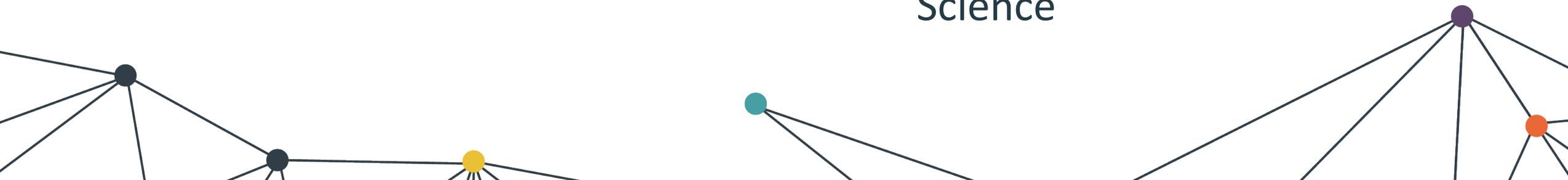
Geography



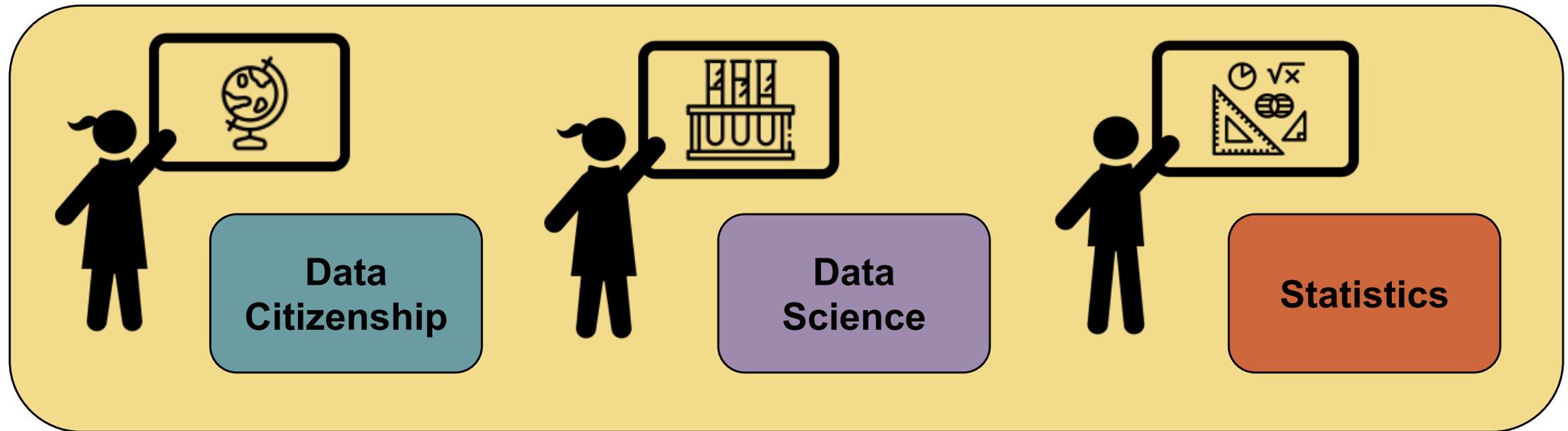
Computer  
Science



Modern Studies



# Designed for interdisciplinary delivery



# AI Literacy ...across and beyond the National Curriculum

AI literacy outcomes created based on the existing National Curriculum outcomes.



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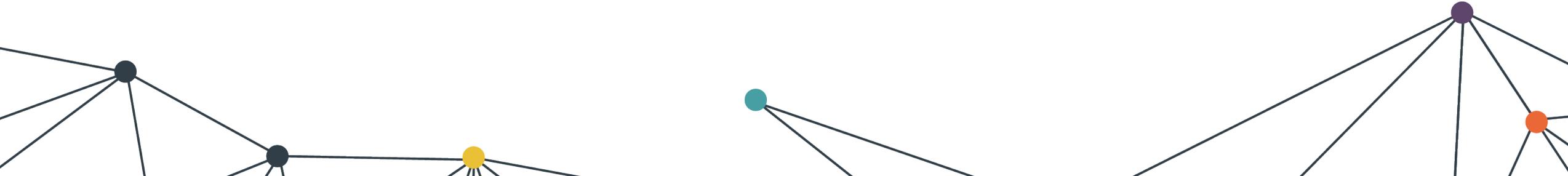


Scottish Government  
Riaghaltas na h-Alba  
gov.scot



Teaching Responsible AI Literacy in Schools

**TRAILS.scot**



# Young people want to learn about AI

“ **AI Should be in the curriculum.** AI will be in all our lives, so we need to learn and understand what it means before we grow up.

“ **The more we learn about AI, the more we'll know how to keep ourselves safe.**

[doi.org/10.1145/3754508.3754519](https://doi.org/10.1145/3754508.3754519)

(RESEARCH FROM CHILDREN'S PARLIAMENT AND ADES/HORIZON)



Explain **AI basics** in schools

Teachers should learn about **AI and children's rights** to support children's learning and help to keep them safe.

More discussion in schools about **safe usage** and **ethical issues**

Opportunities to **practice and play** with AI

Teachers can use AI systems to help make learning fun – **children learn better when it's fun.**

Immersive **AI experiences:** games, tutors, historic tours

TRAILS.scot

# CHILDREN'S RIGHTS & AI USE IN EDUCATION

A GUIDE FOR TEACHERS & SCHOOLS

## RIGHT TO BE HEARD

Children have the right to express their views, feelings and wishes in all matters affecting them and to have their views considered and duly weighted in decision making.

**GOOD PRACTICE:** A school uses an anonymous feedback box to gather learners' opinions on AI software used in classrooms, and school policies on acceptable AI use.

ARTICLE #12



## FREEDOM OF EXPRESSION

Children have the right to freely express their thoughts, ideas, and feelings.

This includes communicating in ways that suit their preference and needs - through speech, writing, art, or other forms. It also includes the right to express themselves with or (if they prefer) without the help of AI tools in educational settings.

**GOOD PRACTICE:** A teacher shows their learners how to use GenAI tools to formulate and express their ideas more clearly by suggesting edits to make text more readable. They illustrate how to overcome writer's block by asking a GenAI tool for a range of suggestions of what might happen next in a story. The teacher works with the class to write prompts and draw sketches as input to an age-appropriate image-generation tool, moderating the output before showing it to the class.

ARTICLE #13



## CHILDREN'S BEST INTERESTS

The child's best interests are a primary consideration in any decisions that apply to them.

**WATCH OUT FOR:** When considering whether to adopt an AI tool to save teachers time, consider whether it is in the learners' best interests. AI-generated feedback or lesson plans may contain mistakes or be of poorer quality than the teacher would normally provide.

**GOOD PRACTICE:** A teacher uses an GenAI tool to produce a lesson plan suitable for their class and suggestions for their differentiated activities. They check the output carefully for errors. The teacher informs the learners that they used GenAI for this purpose.

ARTICLE #18

## EDUCATION

Children have the right to a good education that helps them to reach their full potential.

Children's education should help them use and develop their personality, talents and abilities. Education should also help children learn to live peacefully, develop children's respect for the environment, and others. AI has the potential to help children with their learning, but it is not a replacement for highly skilled human teachers who will always be central to children's education.

**GOOD PRACTICE:** Schools work together (with learners and parents) on a clear policy about GenAI usage so everyone understands acceptable uses of AI to support learning. The teachers guide the learners in using AI tools to help them with learning tasks such as ideas generation, text editing, revision, or practising language skills.

They teach learners how to use AI tools critically and explain the basics of how AI technology works. The learners discuss ethics and the societal implications of AI.

ARTICLES #28 & #29



## ACCESS TO INFORMATION

Children have the right to access reliable information from diverse sources, especially information that promotes their well-being, understanding, and development. GenAI tools can be a useful information source but should be used with care.

**WATCH OUT FOR:** Make sure your learners know that GenAI tools often produce output which is incorrect.

**GOOD PRACTICE:** A teacher works with her class to explore how GenAI tools can help summarise information from diverse sources in easy-to-understand language. They learn how to fact-check GenAI output and compare it to other information sources, such as encyclopedias and search engines.

ARTICLES #17 & #19



## PRIVACY

Children have the right to privacy, and their personal data and communications must be protected.

**WATCH OUT FOR:** Ensure that any AI tool does not have access to learners' personal or sensitive data without consent from the child and their parents. For example, if using a GenAI writing tool to give personalised feedback on a student's essay, remove the student's name and any identifying details, ensuring the child's privacy is respected.

ARTICLE #16



## NON-DISCRIMINATION

All children's rights apply to every child equally, regardless of their differences and they should be able to exercise their rights without discrimination.

**WATCH OUT FOR:** If choosing an AI tool for personalised learning, ensure that it doesn't use biased racial or socio-demographic data to predict students likely to be "at-risk" for poor exam performance.

**WATCH OUT FOR:** If your school is considering purchasing 'AI detection software', be aware that such technology is currently not very effective and is more likely to incorrectly accuse people with poorer English writing skills of cheating with AI. This could potentially discriminate against students with English as a second language or those with neurodevelopmental disabilities.

**WATCH OUT FOR:** When choosing speech recognition tools, check whether they work well with diverse accents. If not, it would make it harder for some students to use voice-activated features effectively, potentially reducing their participation and making it harder for them to learn.

ARTICLE #2



## DISABILITY

Children have the right to special education and care if they have a disability, as well as all the other rights so that they can live a full life. Although AI as a concept may be beyond the cognitive capacities of some learners, this does not mean they should be excluded from experiences that use AI to enhance learning.

**GOOD PRACTICE:** An ASL teacher uses AI tools (assistive technology) to help children with diverse needs and abilities express themselves and engage in learning activities in school. She also gives her learners with neurodevelopmental disorders extra support to understand how AI-generated pictures and images might be biased.

ARTICLE #23

## EVOLVING CAPABILITIES

Children grow and develop at different paces, influenced by their age, experiences, and circumstances. Parents should guide and support children in making decisions that respect their agency and evolving capacities. Teachers also apply their expertise in children's development to guide appropriate AI usage.

**GOOD PRACTICE:** A primary teacher guides children in using GenAI tools by showing them how to use them effectively for tasks like brainstorming or editing. He initially starts by modelling how to use GenAI tools so that children do not use GenAI unsupervised. He and his colleagues provide close, step-by-step support for students and encourage critical thinking about GenAI output. As children's skills and maturity grow, the teachers in the school cluster plan to gradually reduce support and foster independence, aligning with the learners' experiences and evolving capacities.

ARTICLE #5



## PROTECTION FROM EXPLOITATION

Children have the right to protection from exploitation, including commercial exploitation. This could include software tools which profit from their data.

**WATCH OUT FOR:** Be careful not to use commercial GenAI tools that collect and use children's data to improve their models or services for companies' own profits without the children's or parents' consent. If you're choosing AI-driven assessment/marketing software, be careful that children's work and exams (without their consent) aren't used to improve new versions of the software without their consent.

ARTICLES #32-#36



## RIGHT TO BE KEPT SAFE

Children have the right to be protected from harm, being hurt and mistreated, in body or mind.

**WATCH OUT FOR:** Check the age-rating for any GenAI tool you use in school. Many image-generation tools are intended for a general audience, and although they often have guardrails to prevent inappropriate images, this can't be guaranteed. Also check that they don't suggest inappropriate images in recommended related content e.g. "if you like this image, you will also like these".

**GOOD PRACTICE:** A local authority installs AI-powered content filters to block harmful or inappropriate material in all schools to help children explore diverse topics safely. The content filters have school-level and parental controls to ensure that humans can appropriately intervene. The school staff are trained to watch for signs that children may be upset by encountering inappropriate AI-generated material.

ARTICLE #19



## FREEDOM OF THOUGHT

Children have the right to their own thoughts and beliefs and to choose their religion with guidance from their parents, consistent with their evolving capacities. This includes the right to views about AI and beliefs about how humans should use it.

**GOOD PRACTICE:** A young person does not want to use a GenAI tool for her school work because she believes it is morally wrong to use a tool that profits from the theft of copyrighted material and harms artists. Her teacher supports her in carrying out the task without using AI but ensures that she still learns about how AI works.

ARTICLE #15



## USEFUL LINKS & SOURCES

Remember: there are many more examples than we could fit on this poster! You probably have already developed good practice in your own school. For more information and resources, follow the QR code.

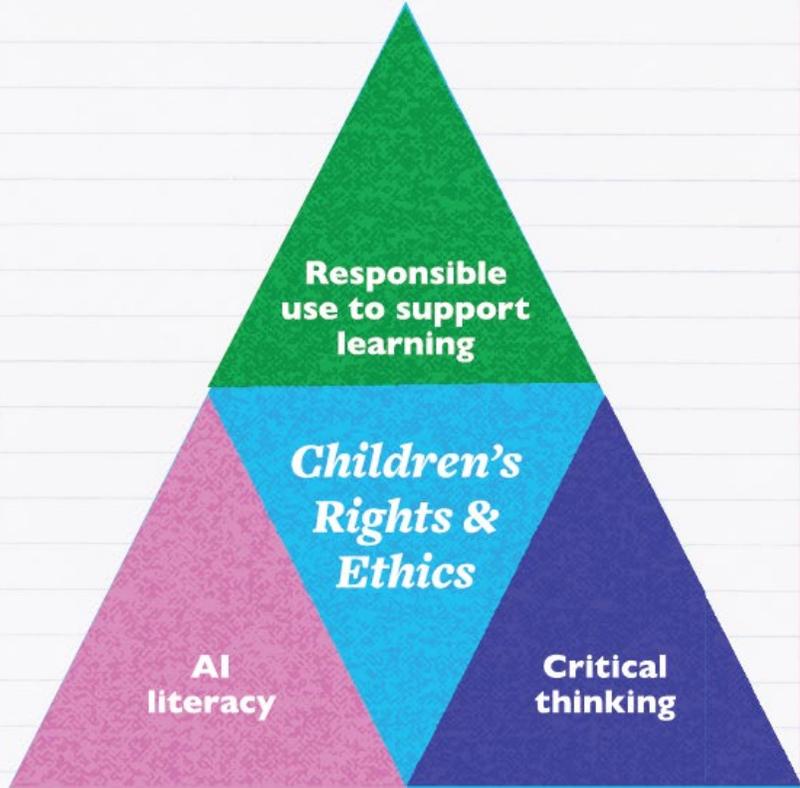


<https://trails.scot>



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This poster was created by Ayça Atabey, Judy Robertson and Elapeth Marwell. Thanks to Kevin Mcphee, Gregory Metcalfe and Kay Tisdall for their help.



# A draft AI curriculum framework for Scotland

We are seeking feedback from educators, AI experts, policymakers and other stakeholders to help us develop an updated version. If you would like to give feedback, please complete this form:

<https://edin.ac/4ksoz1>

# Teach AI Literacy

## A Guide for Teachers

work-in-progress



Free download of our published books



What do you think?

# AI Teachers-in-Residence



Adam Llewelyn  
Modern Studies, Falkirk



Ewen Glen  
RMPS & Digital, Edinburgh



Anonymous  
Biology/Science, Edinburgh



Matthew Mackie  
Computing, Perth & Kinross



Kevin McPhee  
ASN, Edinburgh



Louis Girvan  
Music, Dumfries & Galloway

# Learning about AI

A selection of **fun, low-tech, accessible activities** for **any Secondary teacher** introducing concepts in artificial intelligence

- ▶ Different types of AI systems and how they work
- ▶ Critical thinking skills
- ▶ Ethics, bias and sustainability issues



**TRAILS.scot/resource**



KATE.FARRELL  
@ED.AC.UK



JASMEEN.KANWAL  
@ED.AC.UK



ANTONIA.SEWELL  
@ED.AC.UK

# An AI sustainability board game!

Run a data centre without running out of power or water

‘Choose Your Own Discussion’ follow up activity



Choose your own discussion...

How much power does an AI server need?

Swimming pools heated by servers? Really?!

Do we need to use so much data

Where does the data come from?

Where should we put data centres?

Should we use AI?

Do AI servers really need that much water?

Who owns the data?

Is nuclear power safe?

Should governments restrict the use of AI?

Do undersea data centres exist?

How much data do AI systems need?

Is Atlantis real???

Where can we get the power for AI and data centres?

Why can't we use sea water?

Who owns the data?

Who is the 'creator' of a work generated by AI?

Is it the original authors, artists and creatives of the training data? Is it the developers of the AI systems? Is it the people writing the AI prompts?

Has your data been used for training AI systems?

Have I Been Trained website for searching popular AI training datasets

Scientific American article on personal data in training AI

12 min video on who owns AI art



How much data do AI systems need?

Where does the data come from?

Should we use AI?

← Back to the questions



Swimming pools heated by servers???



Yes! Octopus Energy have been trialing server cooling equipment that heats up the water in swimming pools in the UK.



BBC article on heating pools



See servers heating UK pools (3 min)



BBC Click: servers heating Danish homes (4 min)

Paris data centres heating the Olympic pool and growing fruit! (10 min)



Do undersea data centres exist?

Do AI servers really need that much water?

Why can't we use sea water?

← Back to the questions

# Digital Education and AI Thematic Hub



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