

The Scaffolded AI Literacy (SAIL) Framework for Education

Preparing learners at all levels to engage constructively with Artificial Intelligence



prepared by:
Kathryn MacCallum
David Parsons
Mahsa Mohaghegh

This report introduces an Artificial Intelligence (AI) literacy framework developed by a research team from The University of Canterbury, academyEX, and AUT.

The Scaffolded AI Literacy (SAIL) framework was developed from a Delphi Study of 17 experts in AI from Aotearoa New Zealand and overseas, with representatives from both education and industry, and cultural experts.

The framework has four levels of capability. Three define AI literacy, with an additional level that indicates what further capabilities come beyond AI literacy.

1. Know and Understand AI
2. Use and Apply AI
3. Evaluate and Create AI
4. + Beyond AI Literacy

These levels are not age and stage based. Rather, they provide a scaffolded pathway through levels of competency for all learners.

At each level, there are six categories of AI literacy

1. The Impacts of AI
2. What AI Is and How It Works
3. Cognitive Skills
4. Applied Skills
5. Social, Cultural, and Ethical Issues
6. Risks and Mitigations

In addition to detailing the SAIL framework, this report provides illustrative examples of learning activities that can be applied at the three main levels of AI literacy, taking account of different learner audiences.

The report also includes information about an online tool that has been developed to help educators evaluate or design course materials that address level 1 of the framework.

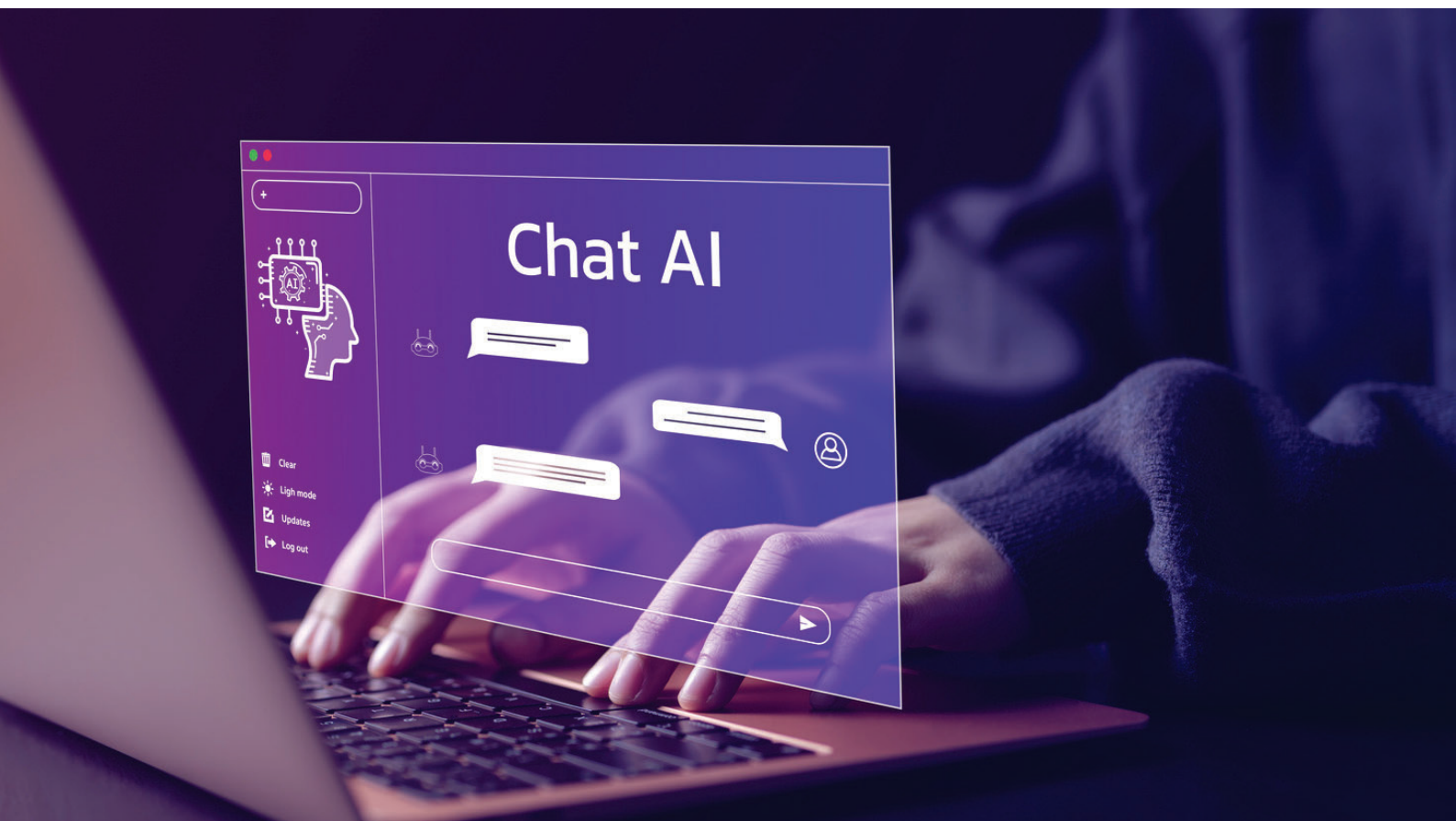


Introduction

With the rapid adoption of Generative Artificial Intelligence (GenAI) tools across many areas of life, the concept of AI Literacy - the sets of skills and competencies necessary for everyone to engage constructively with Artificial intelligence (AI) - is becoming a key focus in education and beyond.

UNESCO (2022) states that everyone should achieve AI literacy, including knowledge, understanding, skills, and value. The World Economic Forum in their 2022 report “Without universal AI literacy, AI will fail us” (WEF, 2022) has promoted the need to foster universal AI literacy and asserts that each of us (students, educators, non-profits, governments, parents, and businesses) needs to become literate about AI, to know when it is being used, and be able to evaluate its benefits and limitations in our lives. As AI continues to permeate society, it becomes increasingly essential for individuals to possess a foundational understanding of AI concepts, functionalities, and implications. AI literacy equips people with the skills to critically engage with AI systems, fostering informed decision-making and ethical awareness.

This report described the Scaffolded AI Literacy (SAIL) framework, intended to support equitable, accessible, and effective education in the age of AI. Using this framework can empower individuals across all demographics to navigate and contribute to an AI-driven world, ensuring they are not only passive consumers but also active participants in shaping the future of technology.



The Scaffolded AI Literacy (SAIL) Framework for Education

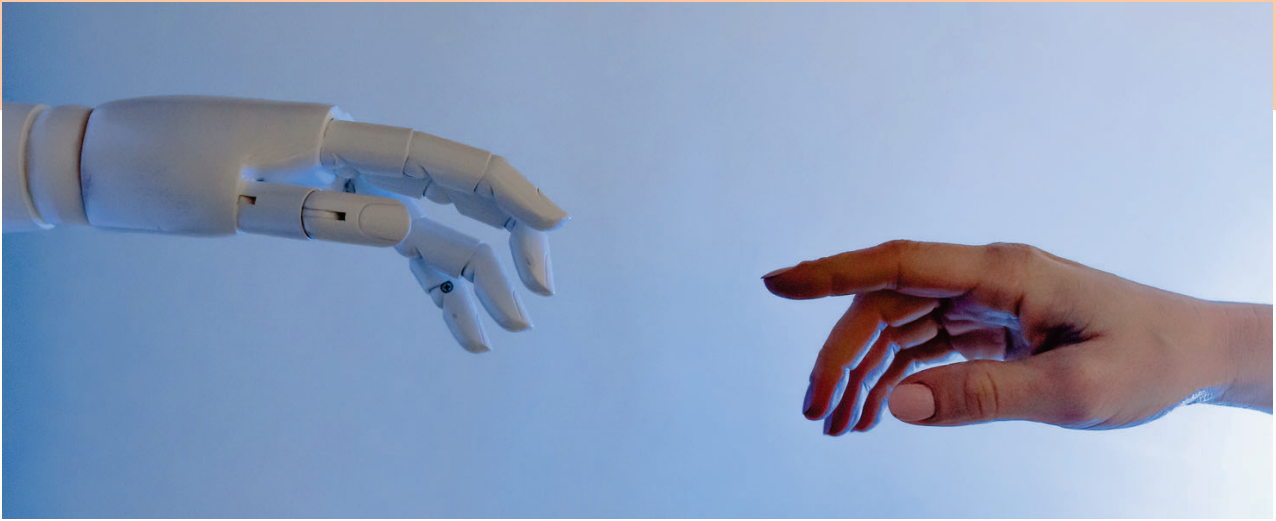


AI Literacy

AI literacy in education has become a rising concern across the education sector. As AI technologies become increasingly ubiquitous, educators and learners alike must understand the fundamental principles of how these systems work, their potential biases and limitations, and the ethical considerations surrounding their use (Faruqe et al., 2022). Without this critical understanding, learners may struggle to effectively and responsibly leverage AI in their studies and future careers. Developing learners' AI literacy should, therefore, be a key priority for all areas of education, from primary to tertiary education.

Emerging from previous work about the role of AI in education, AI literacy was first discussed around 2016 when Konishi conceptualised it as being able to recognise tasks that can be performed by AI, and learning and investing in the human strengths that it cannot replace. In contrast, Kandlhofer et al. (2016) took a more technical view, emphasising the techniques and concepts behind AI products and services. Since then, many others have suggested further definitions of AI literacy. One source that is commonly referred to is Long and Magerko's (2020) five AI literacy themes, which are based on other literature and linked to a set of competencies and design considerations. However, in the domain of AI literacy research, although many different perspectives have been explored, only a few have addressed the design of AI literacy frameworks, suggesting a need for further research.

The Scaffolded AI Literacy (SAIL) Framework for Education



The Need for an AI Literacy Framework

The first step towards AI Literacy is to identify what knowledge, skills, awareness, and understanding are necessary to use, benefit from, and create with, AI tools. This, however, is not enough to help develop the necessary skills and competencies. These concepts of AI literacy need to be organised into a suitable framework that provides a guide for learning and development. The purpose of an AI literacy framework is, therefore, to provide a structured approach to understanding and engaging with AI technologies.

The SAIL framework serves as a guide for educators, policymakers, and learners, outlining the key competencies and knowledge areas necessary to navigate the complexities of AI. It encompasses fundamental concepts such as machine learning, data privacy, and algorithmic bias, as well as cognitive skills like critical thinking and ethical reasoning. By integrating these essential components, the framework aims to foster a comprehensive understanding of AI, enabling individuals to responsibly and effectively apply AI tools in various contexts. It also seeks to democratise access to AI in education, ensuring that all learners, regardless of background, have the opportunity to become literate in AI. Ultimately, the AI literacy framework is designed to prepare individuals for a future where AI is ubiquitous, empowering them to leverage AI for personal, professional, and societal benefit.

The Delphi Study Design Process

The SAIL framework was developed through a comprehensive Delphi study, a research survey technique that collects data from domain experts to achieve consensus concerning real-world knowledge. This process involved a panel of 17 AI experts from both education (n=11) and industry (n=5); one expert bridged both domains, and cultural expertise was an essential component. The process involved three rounds of development and evaluation to determine the elements of the framework.

ROUND 1

Brainstorming key concepts, skills and understandings that would be relevant to four levels of AI literacy:

- Level 1: Informed – Initial awareness and foundational knowledge.
- Level 2: Empowered – Exploring ideas and reflecting.
- Level 3: Engaged – Implementing and embedding concepts and tools.
- Level 4: Active participant – Creating and applying AI in transformational ways.



ROUND 2

Refining initial concepts, skills, and understandings to sit under the following categories and subcategories:

1. Concepts
 - The Impacts of AI
 - What AI Is, and How It Works
2. Application and Technical
 - Cognitive Skills
 - Applied Skills
3. Issues, Challenges, and Opportunities
 - Challenges and Opportunities
 - Social and Ethical Issues

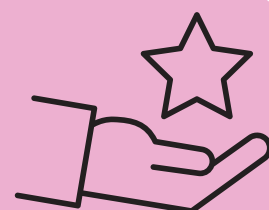


ROUND 3

The final round consolidated our framework, focusing on finding a consensus around the different points under each level and category.

Some of the terminology was changed to better express the concepts of the framework.

The next section explores the outcome of this final round.



The SAIL Framework Contains

3 Domains

of AI literacy

- AI Concepts
- Application of AI and Technical Skills
- AI Digital Citizenship

These are divided into

6 Categories

of AI literacy

- The Impacts of AI
- What AI Is and How It Works
- Cognitive Skills
- Applied Skills
- Social, Cultural, and Ethical Issues
- Risks and Mitigations

And there are

4 Levels

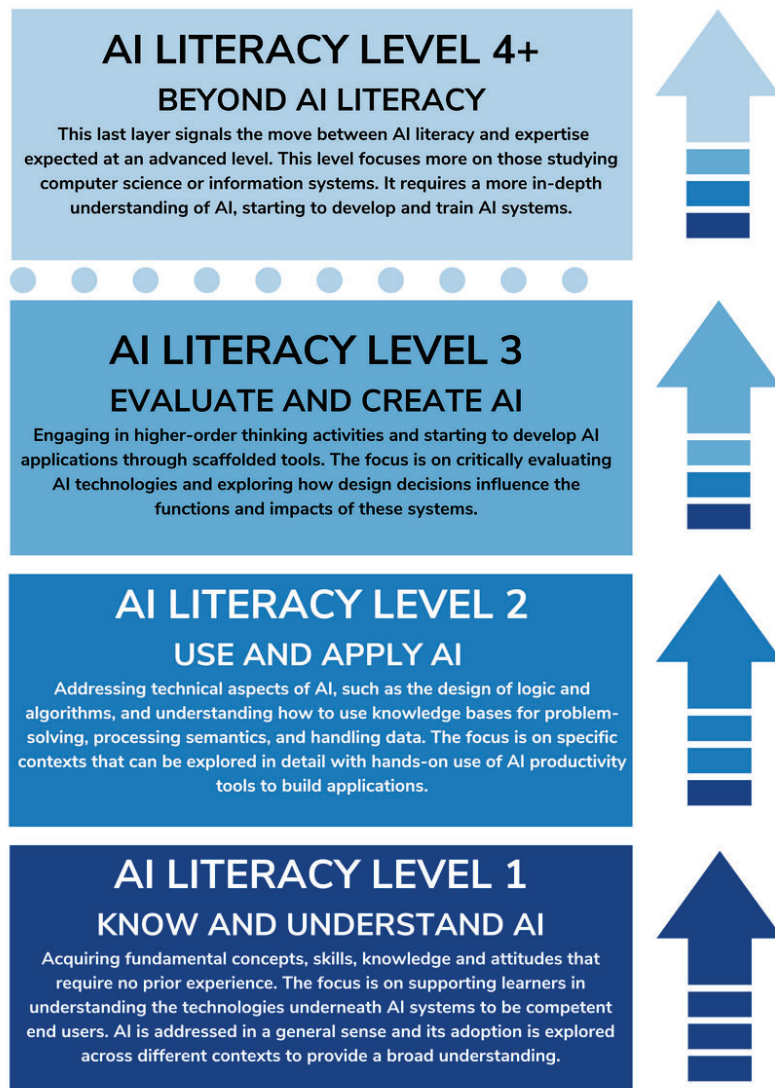
of capability. Three of these are part of the core literacy framework, with level 4+ going beyond literacy to specialist expertise.

1. Know and Understand AI
2. Use and Apply AI
3. Evaluate and Create AI
- 4.+ Beyond AI Literacy

The Four Levels of the SAIL Framework

From Know and Understand to Beyond AI Literacy







The figure below shows the four capability levels of the framework. These levels show the levels a learner would move through to build their AI literacy, with the final stage (Level 4+) representing the move towards specialist AI fluency, where learners move from literacy to deeper engagement - to the knowledge needed for those moving into AI fields of research and practice. It is also important to highlight that this framework was developed to be age agnostic. While the higher levels (3 and 4) would be more suited to older learners, different levels can be taught across different sectors (early years and beyond) with teaching adapted to suit different age levels and contexts.



The Scaffolded AI Literacy (SAIL) Framework for Education

The Categories of the Framework







The six categories of the framework are divided into three domains of AI literacy: AI concepts, application of AI and technical skills, and AI digital citizenship. These six categories together ensure that there is an appropriate mix of knowledge, skills, and critical thinking. Each category is represented in each level with the learner developing further related capabilities in each domain as they progress up the levels.

<h4>AI Concepts</h4> <p>Understanding the nature of AI and how it impacts on people in their everyday lives</p>	<h4>Application of AI & Technical Skills</h4> <p>Knowing how AI tools can be applied to useful tasks</p>	<h4>AI Digital Citizenship</h4> <p>Being aware of the issues, risks and their mitigations associated with AI</p>
 <h4>The Impacts of AI</h4> <p>Exploring AI's societal impacts by identifying human-AI interactions, understanding ethical use, assessing AI adoption and potential harms, and demonstrating data literacy and interdisciplinary applications.</p>	 <h4>Cognitive Skills</h4> <p>Developing cognitive skills by assessing AI's implications, evaluating tool suitability, understanding its impact on work and creativity, and demonstrating computational thinking and AI model-building expertise.</p>	 <h4>Social, Cultural, & Ethical Issues</h4> <p>Exploring social and ethical issues of AI by assessing societal benefits, identifying ethical implications, discussing cultural impacts, and applying principles-based approaches to equity, inclusivity, and policy development.</p>
 <h4>What AI Is & How It Works</h4> <p>Mastering AI fundamentals by defining key terms, comparing technologies, understanding data use, explaining human language interaction, and exploring advanced concepts like deep learning and quantum computing.</p>	 <h4>Applied Skills</h4> <p>Enhancing applied skills by selecting and using appropriate AI tools to collaborate, communicate, solve problems, and perform tasks in specific contexts such as learning and research.</p>	 <h4>Risks & Mitigations</h4> <p>Addressing the challenges of AI by identifying and mitigating risks, promoting responsible use, ensuring inclusivity, and applying moral frameworks to assess AI's societal value and future directions.</p>

The Scaffolded AI Literacy (SAIL) Framework for Education

Level 1 - Know and Understand AI

The first level of the framework provides the foundational level of AI literacy for everyone. How and when these literacies might be developed will vary across learners and contexts and may be developed in different sequences and at different depths. For example, educators working with older learners may be able to explore these same competencies using different approaches than those working with younger learners. This concept is explored in the subsequent examples of applying AI tools in learning contexts.

AI Concepts	Application of AI & Technical Skills	AI Digital Citizenship
 <h4>The Impacts of AI</h4> <ul style="list-style-type: none"> Identify when people are using AI Describe how AI is impacting society Explain how AI relates to other technologies Give examples of how AI has impacted different sectors 	 <h4>Cognitive Skills</h4> <ul style="list-style-type: none"> Evaluate the role of data within AI systems and the implications data has on the training of AI models Identify the useful features of AI technologies when applied in specific contexts Evaluate when the use, or non-use, of AI is suitable for different tasks Assess the implications of using AI for a specific purpose or context 	 <h4>Social, Cultural, & Ethical Issues</h4> <ul style="list-style-type: none"> Assess the potential benefits to society of the use of AI Identify the ethical implications of AI (e.g., bias, fairness, transparency, accessibility, and accountability) Explain the relationships between AI, data, and cultural contexts and values
 <h4>What AI Is & How It Works</h4> <ul style="list-style-type: none"> Define common terms in AI (e.g., machine learning, large language models, neural networks) Identify different types of AI Compare and contrast the main features of AI technologies Identify different ways that AI is being used within different applications and contexts Explain how data is used in different AI systems Explain how users can interact with AI systems, including natural language 	 <h4>Applied Skills</h4> <ul style="list-style-type: none"> Select and apply suitable AI tools to perform specific tasks (e.g., collaborate, communicate, solve problems) Apply AI tools in specific contexts to achieve personal, learning or work-based goals Evaluate the suitability and outcomes of using a range of AI tools across a range of tasks 	 <h4>Risks & Mitigations</h4> <ul style="list-style-type: none"> Identify risks presented by AI systems (e.g., security, personal data, privacy, fraud, and cyber threats) Identify ways to mitigate the risks presented by AI systems Demonstrate responsible and safe behaviours toward AI and the threats it poses through misuse Discuss the impact of AI on cultural diversity and ways of addressing cultural bias in AI systems

The Scaffolded AI Literacy (SAIL) Framework for Education

Applied AI Example for Level 1

Google's Quick Draw
(<https://quickdraw.withgoogle.com/>)



Can a neural network learn to recognize doodling?

Help teach it by adding your drawings to the [world's largest doodling data set](#), shared publicly to help with machine learning research.

Let's Draw!

Quick, Draw! provides real-time feedback as you draw. It is a fun and interactive way to introduce students to AI concepts. It uses a neural network to recognise drawings in real time, providing an engaging experience for learners. Students can see how good the neural network is at recognising their drawings. It also makes its data set publicly available, meaning that other researchers can use the data to train their own neural networks.

The following are some example concepts that could be covered using this tool:



Young Children

Young children can engage with the tool by drawing simple objects and seeing if the AI can recognise them. They can discuss how the AI 'learns' from millions of drawings to identify new ones, and understand that AI uses patterns in data to make decisions and recognise objects.

Older students

Older students can explore the app's dataset and discuss the importance of diverse data in training AI and the bias that can occur. They can also explore issues like what happens if the dataset lacks variety in styles or cultures and how this could be designed to avoid these limitations.



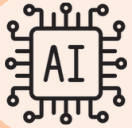
Adult Learners

Adult learners can use the tool to get a hands on example of how neural networks function. It could be used to help the learners think about the implications of using AI in various contexts, such as education, healthcare, and more and explore the deeper ethical issues of design in more depth.



The Scaffolded AI Literacy (SAIL) Framework for Education

Mapping the Example to Level 1 of the Framework



Identify different types of AI

Learners can see the actual data that has been input into the system and even help improve the data set by flagging drawings that are not correct, therefore improving the system.

This hands-on example of a neural network helps explain how AI can be used to recognise patterns and interpret user inputs. It can introduce key terms like dataset, bias, training data and Natural Language Processing.



Explain how users can interact with AI systems

Students can explore how different datasets impact AI performance and discuss the importance of data quality and diversity.

Explain how data is used in different AI systems



The tool can help introduce the different ways AI can accept input—in this case, via drawings.



Identify the useful features of AI technologies

Discussions can be held on the ethical implications of AI, including privacy concerns and potential misuse.

Evaluate the role of data within AI systems



Students can assess how Quick, Draw!'s technology can be used in various contexts, such as education and entertainment.

Identify the ethical implications of AI



Relevant Readings:

- Fernandez-Fernandez, R., et al. (2019). [Quick, stat!: A statistical analysis of the quick, draw! dataset.](#) arXiv preprint arXiv:1907.06417.
- Su, J., & Yang, W. (2023). [Artificial Intelligence \(AI\) literacy in early childhood education: an intervention study in Hong Kong.](#) Interactive Learning Environments

Sample Resource:

A slide set using Quick, Draw! to introduce young children to basic concepts of AI and introduce simple ideas about data and the issues around bias. It could be adapted for different ages.







Slide Link



The Scaffolded AI Literacy (SAIL) Framework for Education

Level 2 - Use and Apply AI

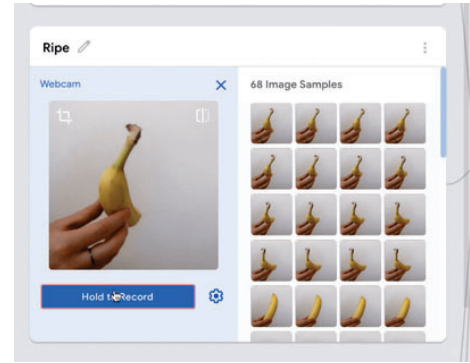
The second level of the framework provides a more active approach to AI literacy. Building on the foundational skills of level 1, it provides the learner with a pathway to become directly involved in the use and application of AI tools and engage more critically in the wider issues around AI technologies.

AI Concepts	Application of AI & Technical Skills	AI Digital Citizenship
 <h4>The Impacts of AI</h4> <ul style="list-style-type: none"> • Discuss the role of people in the development, deployment, and ethical use of AI • Demonstrate an understanding of AI's role in a specific situation • Explain the factors involved in AI adoption, including how AI is used and the potential harms 	 <h4>Cognitive Skills</h4> <ul style="list-style-type: none"> • Explain how AI will change how people work and interact in different tasks and situations • Discuss how AI could help people make smarter decisions and improve their understanding • Discuss how AI can be used for creative purposes • Determine which AI methods would be best suited to different problems and/or industry needs • Discuss issues related to the understandability of AI, such as AI transparency and explainable AI 	 <h4>Social, Cultural, & Ethical Issues</h4> <ul style="list-style-type: none"> • Understand how bias occurs in AI systems • Discuss the social impacts of AI, including its effects on societal norms and cultural biases • Give examples of AI ethics issues in various areas where AI is used • Explore the impact of AI on the future of work and implications for creative industries • Explore the impact of AI on Indigenous cultures and disadvantaged groups • Discuss the impact of AI on governance and policy, utilising a principles-based approach
 <h4>What AI Is & How It Works</h4> <ul style="list-style-type: none"> • Understand how AI algorithms work and how they are used in AI tools and applications • Apply key terms to explain how AI models are trained and the different steps involved • Explain how data is used in AI systems and identify different sources of data used to train various AI models 	 <h4>Applied Skills</h4> <ul style="list-style-type: none"> • Apply AI tools in different fields of study • Use AI tools to create basic AI applications • Apply structured and statistical methods to solve problems effectively • Assess how human-centered design principles impact the development of AI projects • Explain the different machine learning approaches that can be used (e.g., unsupervised, supervised and reinforcement learning), the role of data in these approaches, and their application to real-world problems 	 <h4>Risks & Mitigations</h4> <ul style="list-style-type: none"> • Assess the risks associated with data use in AI systems, including issues related to data collection, accuracy, relevance, storage, security, privacy, and potential misuse. • Identify and implement strategies to protect personal rights and privacy when interacting with AI tools, including understanding consent, privacy settings, and data-sharing policies. • Advocate for AI applications to be designed to be inclusive and accessible by considering diverse user needs and avoiding decisions that disadvantage or burden specific groups. • Apply ethical frameworks or moral principles to evaluate the impact of AI on individuals and society, determining what is just, fair, and beneficial.

The Scaffolded AI Literacy (SAIL) Framework for Education

Applied AI Example for Level 2

Google's Teachable Machine
(<https://teachablemachine.withgoogle.com/>)



Google's Teachable Machine is a user-friendly platform that allows individuals to train machine learning models without any prior coding knowledge. By allowing learners to create image, sound, and pose detection models through a simple, interactive interface, Teachable Machine provides a practical introduction to machine learning concepts. This hands-on experience helps demystify AI, making it accessible and engaging.



Young Children

Supported by the teacher, young children can be guided in designing simple activities to train models to recognise different objects or their own drawings. This can help children understand the basics of categorisation and pattern recognition in a fun way.

Older students

Older children can explore the mechanics of AI and machine learning, through the integration of basic coding and more sophisticated projects and concepts. The versatility of the platform allows for the integration of many different projects suitable for older students to explore AI concepts.



Adult Learners

The platform provides an accessible way to teach the basics of ML classification in a way that would be relevant to adult learners. Though hands on activities it provides a scaffolded way to learn about supervised learning and explain concepts of bias without students needing to be able to program, so it would be good for a wider range of learners that don't necessarily have programming skills. Data models can also be exported to create more advanced projects suitable for scaffolding into higher levels.



The Scaffolded AI Literacy (SAIL) Framework for Education



Understand how bias occurs in AI systems

Educators can use the outcomes from Teachable Machine projects as case studies for classroom debates on the broader social impacts of AI. This encourages critical thinking and ethical reasoning.



Discuss the impact of AI on governance and policy

By creating prototypes of AI applications, students gain practical experience in the AI development lifecycle, from data collection to model training and evaluation.



Assess how human centred design principles impact AI development

Educators can emphasise the critical role of data in each machine learning approach, discussing how different types of data (labeled, unlabeled, reward signals) drive the learning process.

Mapping the Example to Level 2 of the Framework

Teachable Machine allows users to create their own datasets, which can then be used to train models. By intentionally or unintentionally including biased data, users can observe how the model's performance is affected, highlighting the importance of diverse and representative data.

Discuss the Social Impacts of AI



Facilitators can introduce ethical guidelines and principles (such as those proposed by UNESCO, 2021) and have learners assess their Teachable Machine projects against these standards.

Use AI tools to create basic AI applications



Projects can include discussions on privacy, consent, and fairness, evaluating how human-centered (HC) design principles influence ethical AI development.

Explain the different machine learning approaches



Relevant Readings:

- Dwivedi, U., Elsayed-Ali, S., Bonsignore, E., & Kacorri, H. (2024). [Exploring AI Problem Formulation with Children via Teachable Machines](#). CHI '24
- Carney, M. (2019). [Using Teachable Machine in the d.school classroom](#). Medium.
- Payne, B. H. (2019). [An ethics of artificial intelligence curriculum for middle school students](#). MIT Media Lab.

Sample Resource:

A set of lessons created by MIT to teach middle school students about AI ethics, to help them become more conscientious consumers and future designers of AI. Examples include how Teachable Machines can be used to teach students about supervised machine learning. While targeted at middle school, the resources can be adapted for any age.

Resource Link



The Scaffolded AI Literacy (SAIL) Framework for Education

Level 3 - Evaluate and Create AI

This level of the framework provides the highest level of knowledge skill, and competency within the scope of AI literacy.

AI Concepts	Application of AI & Technical Skills	AI Digital Citizenship
 <h4>The Impacts of AI</h4> <ul style="list-style-type: none"> • Debate the future role of AI in education and work • Demonstrate data literacy through knowledge of data privacy, management, and governance in AI • Demonstrate an understanding of AI's interdisciplinary role in various fields such as biology, literature, climate science, etc. • Understand data exploration, cleaning, feature extraction, and model testing techniques 	 <h4>Cognitive Skills</h4> <ul style="list-style-type: none"> • Demonstrate computational thinking skills relevant to AI • Analyse the potentials and limitations of AI in business or organisational decision-making • Determine the usefulness of a given AI technology to meet a requirement or perform a task • Understand the steps involved in AI model building, including training, testing, validation, and deployment 	 <h4>Social, Cultural, & Ethical Issues</h4> <ul style="list-style-type: none"> • Evaluate ethical issues related to the design and implementation of AI models and systems (e.g., honesty, intellectual property, and potential harm) • Identify how AI design decisions can affect different social and cultural groups, and analyze the implications for social justice • Take a principles-based approach when addressing ethical and other issues related to AI, considering fundamental values and testing these principles in practice • Critically analyse how to develop AI systems that mitigate social and ethical issues (e.g., fairness, transparency, bias, job displacement)
 <h4>What AI Is & How It Works</h4> <ul style="list-style-type: none"> • Describe key deep learning concepts such as neural networks and backpropagation, and explain their importance in training AI models • Demonstrate an understanding of how AI systems decompose complex, how algorithms are developed, and how large datasets are used to train AI models • Differentiate between various AI systems, such as machine learning and probabilistic models, and describe their unique characteristics and applications 	 <h4>Applied Skills</h4> <ul style="list-style-type: none"> • Evaluate, select and implement creative approaches to the application of AI across contexts • Explain how data sets and training sets are transformed into AI models • Process and manage data for AI applications using appropriate tools • Develop AI projects using appropriate tools, scripts, and libraries • Be familiar with deep learning frameworks and their general principles • Effectively present and communicate data using visualisations 	 <h4>Risks & Mitigations</h4> <ul style="list-style-type: none"> • Discuss the state-of-the-art in AI and its future directions, understanding the benefits and potential risks • Apply strategies to keep users safe and protect their rights when using AI systems • Explain strategies for ensuring the accuracy and reliability of AI products • Consider the impact of bias in training data and the importance of diverse and inclusive datasets • Recognise the importance of privacy, security, and ethical considerations in data collection, analysis, and management • Explain the implications of AI in cybersecurity and the potential misuse of AI technologies • Demonstrate a critical mindset when utilising AI tools, question assumptions, and develop deeper understanding

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Applied AI Example for Level 3

Machine Learning for Kids
(<https://machinelearningforkids.co.uk/>)

Machine Learning for Kids is a platform that allows students to create and train their own machine learning models through a user-friendly interface. It provides hands-on experience with various types of AI projects, helping learners understand core concepts of machine learning.



Young Children

As the focus of the platform is to teach machine learning concepts using programming this may only be relevant for children in upper primary, who have some programming skills. However a range of projects could be used for younger children, but integrated in a more structured manner than would be needed for older learners.

Older students

As the platform includes examples that use scripting languages (Python) this provides more challenging options for older students. More complex projects such as creating chatbots or games provide opportunities for diversity, exploring a range of machine learning models, experimenting with various datasets, and discussing important topics like data bias and the ethical implications of AI.



Adult Learners

Although the platform is designed for children, the activities are still valid for adult learners. As they include block-based approaches they can be used by learners who not yet proficient with programming. Adapting these examples to address broader and more discursive topics will help them be more applicable to older learners. They can be used to develop critical understandings of the potential applications and limitations of AI in real-world contexts.

The Scaffolded AI Literacy (SAIL) Framework for Education



Develop AI projects using appropriate tools

Students create multiple versions of a model using Machine Learning for Kids, intentionally introducing various biases or limitations. They then test these models' performance under different conditions to understand the importance of diverse, representative training data.



Demonstrate an understanding of AI's interdisciplinary role

Learners explore potential misuse of their AI models created on Machine Learning for Kids and develop strategies to ensure responsible use. They critically analyse their projects, question assumptions, and discuss future AI developments based on their hands-on experience with the platform.



Evaluate, select, and implement creative approaches to the application of AI

Students evaluate the ethical implications of their Machine Learning for Kids projects, considering issues like fairness, transparency, and potential biases. They assess how their AI models might impact different social and cultural groups and propose strategies to address ethical concerns.

Relevant Readings:

- Fahrudin, T. M. (2020). [An Introduction To Machine Learning Games And Its Application For Kids In Fun Project](#). IJCONSIST
- Sunarya, P. A. (2022). [Machine learning and artificial intelligence as educational games](#). International Transactions on Artificial Intelligence,
- Pacheco, et al. (2023) [Machine Learning Tool for Kids: A Contribution to Teaching Computational Thinking in Schools](#).

Mapping the Example to Level 3 of the Framework

Students use Machine Learning for Kids to create a complex project that combines multiple AI models (e.g., image recognition and text classification) to solve a multifaceted problem. They could design an interactive story where the plot changes based on both visual input and text responses.

Understand the steps involved in AI model building



Learners use Machine Learning for Kids to create a project that addresses a real-world issue by combining AI with another subject area. For instance, they might develop an environmental monitoring tool that uses image recognition to identify and classify pollutants.

Explain the implications of the potential misuse of AI technologies



Learners use the platform to create and implement creative AI projects across various contexts. They develop AI applications using appropriate tools within Machine Learning for Kids, effectively presenting their projects and communicating results through data visualisations.

Critically analyse how to develop AI systems that mitigate social and ethical issues



Sample Resource:

Machine Learning for Kids includes a huge range of projects that can be adapted into the classroom. These resources include downloadable step-by-step guides, with explanations and colour screenshots for students to follow.







Resource Link



The Scaffolded AI Literacy (SAIL) Framework for Education

Level 4+ - Beyond AI Literacy

Level 4+ suggests what comes beyond literacy. Level 4+ signals the move beyond literacy and towards a deeper engagement with AI. These capabilities would be what would be expected of learners that are specialising in research or practice with a focus on AI.

AI Concepts	Application of AI & Technical Skills	AI Digital Citizenship
 <h4>The Impacts of AI</h4> <ul style="list-style-type: none"> • Explain the impact of advanced concepts like quantum computing and neuromorphic computing on AI • Demonstrate an understanding of the state-of-the-art in AI and its future directions, addressing the benefits and potential risks • Explore the implications of potential future AI technologies 	 <h4>Cognitive Skills</h4> <ul style="list-style-type: none"> • Engage in AI research and potential future directions, analysing how these may be applied in projects • Research into themes and approaches in the rapidly evolving field of AI and engage in discussions and hypothesis generation • Identify value in successful AI applications, plan and map end-to-end processes from data acquisition to model construction, evaluation, implementation, and life cycle management 	 <h4>Social, Cultural & Ethical Issues</h4> <ul style="list-style-type: none"> • Analyse the potential future directions of AI, their societal implications, and the importance of ethical guidelines in shaping these directions • Contribute to the development of policies and guidelines on the ethical and safe use of AI • Apply ethical considerations to AI projects, such as transparency, explainability, and fairness • Explain the importance of continual learning and reflection in ethical, societal, and technological aspects due to the rapidly evolving field of AI
 <h4>What AI Is & How It Works</h4> <ul style="list-style-type: none"> • Demonstrate an in-depth understanding and application of advanced AI models, including generative models, reinforcement learning, transfer learning, adversarial networks, and self-supervised learning • Demonstrate the ability to learn new AI concepts, tools, and techniques independently, recognizing the importance of continual learning in the rapidly evolving field of AI 	 <h4>Applied Skills</h4> <ul style="list-style-type: none"> • Create AI case studies or projects with measures or hypotheses, recording and analysing the results, and reporting on the findings • Design and implement AI strategies in business or organisational contexts, understanding the regulatory and policy environment, and taking a leadership role • Develop AI applications that serve specific purposes in practical settings, leveraging advanced programming and AI techniques • Design, implement, fine-tune, and troubleshoot complex AI models, using suitable frameworks • Manage projects and collaborate effectively with other groups, leveraging relevant coding and software knowledge to implement ideas 	 <h4>Risks & Mitigations</h4> <ul style="list-style-type: none"> • Explain the implementation of safeguards to mitigate possible psychological harm caused by AI systems, considering the levels of protection offered by different types of AI in terms of privacy and security • Demonstrate how AI systems can be deliberately biased and raise awareness of the ethical implications • Identify and evaluate potential risks associated with AI implementation, including machine-human interaction, intellectual property protection, societal impacts, and misuse of AI • Demonstrate the development and implementation of inclusive AI systems that respect diverse social and cultural contexts

The Three Domains Across the Four Literacy Levels

AI Concepts

Understanding the nature of AI and how it impacts on people in their everyday lives

The Impacts of AI

Exploring AI's societal impacts by identifying human-AI interactions, understanding ethical use, assessing AI adoption and potential harms, and demonstrating data literacy and interdisciplinary applications.

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4+
<ul style="list-style-type: none"> Identify when people are using AI Describe how AI is impacting society Explain how AI relates to other technologies Give examples of how AI has impacted different sectors 	<ul style="list-style-type: none"> Discuss the role of people in the development, deployment, and ethical use of AI Demonstrate an understanding of AI's role in a specific situation Explain the factors involved in AI adoption, including how AI is used and the potential harms 	<ul style="list-style-type: none"> Debate the future role of AI in education and work Demonstrate data literacy through knowledge of data privacy, management, and governance in AI Demonstrate an understanding of AI's interdisciplinary role in various fields such as biology, literature, climate science, etc. Understand data exploration, cleaning, feature extraction, and model testing techniques 	<ul style="list-style-type: none"> Explain the impact of advanced concepts like quantum computing and neuromorphic computing in AI Explore the implications of future AI systems (e.g., quantum computing, parallel processing, neuromorphic computing) Demonstrate an understanding of the state-of-the-art in AI and its future directions, addressing the benefits and potential risks

What AI Is & How It Works

Mastering AI fundamentals by defining key terms, comparing technologies, understanding data use, explaining human language interaction, and exploring advanced concepts like deep learning and quantum computing.

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4+
<ul style="list-style-type: none"> Define common terms in AI (e.g. machine learning, large language models, neural networks) Identify different types of AI Compare and contrast the main features of AI technologies Identify different ways that AI is being used within different applications and contexts Explain how data is used in different AI systems Explain how users can interact with AI systems, including natural language 	<ul style="list-style-type: none"> Understand how AI algorithms work and how they are used in AI tools and applications Apply key terms to explain how AI models are trained and the different steps involved Explain how data is used in AI systems and identify different sources of data used to train various AI models 	<ul style="list-style-type: none"> Describe key deep learning concepts such as neural networks and backpropagation, and explain their importance in training AI models Demonstrate an understanding of how AI systems decompose complex, how algorithms are developed, and how large datasets are used to train AI models Differentiate between various AI systems, such as machine learning and probabilistic models, and describe their unique characteristics and applications 	<ul style="list-style-type: none"> Demonstrate an in-depth understanding and application of advanced AI models, including generative models, reinforcement learning, transfer learning, adversarial networks, and self-supervised learning Demonstrate the ability to learn new AI concepts, tools, and techniques independently, recognizing the importance of continual learning in the rapidly evolving field of AI

Application of AI & Technical Skills

Knowing how AI tools can be applied to useful tasks.

Cognitive Skills

Developing cognitive skills by assessing AI's implications, evaluating tool suitability, understanding its impact on work and creativity, and demonstrating computational thinking and AI model-building expertise.

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4+
<ul style="list-style-type: none"> Evaluate the role of data within AI systems and the implications data has on the training of AI models Identify the useful features of AI technologies when applied in specific contexts Evaluate when the use, or non-use, of AI is suitable for different tasks Assess the implications of using AI for a specific purpose or context 	<ul style="list-style-type: none"> Explain how AI will change how people work and interact in different tasks and situations Discuss how AI could help people make smarter decisions and improve their understanding Discuss how AI can be used for creative purposes Determine which AI methods would be best suited to different problems and/or industry needs Discuss issues related to the understandability of AI, such as AI transparency and explainable AI 	<ul style="list-style-type: none"> Demonstrate computational thinking skills relevant to AI Analyse the potentials and limitations of AI in business or organisational decision-making Determine how data sets and training sets are transformed into AI models Process and manage data for AI applications using appropriate tools Develop AI projects using appropriate tools, scripts, and libraries Be familiar with deep learning frameworks and their general principles Effectively present and communicate data using visualisations 	<ul style="list-style-type: none"> Engage in AI research and potential future directions, analysing how these may be applied in projects Research into themes and approaches in the rapidly evolving field of AI and engage in discussions and hypothesis generation Identify value in successful AI applications, plan and map end-to-end processes from data acquisition to model construction, evaluation, implementation, and life cycle management

Applied Skills

Enhancing applied skills by selecting and using appropriate AI tools to collaborate, communicate, solve problems, and perform tasks in specific contexts such as learning and research.

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4+
<ul style="list-style-type: none"> Select and apply suitable AI tools to perform specific tasks (e.g., collaborate, communicate, solve problems) Apply AI tools in specific contexts to achieve personal, learning or work-based goals Evaluate the suitability and outcomes of using a range of AI tools across a range of tasks 	<ul style="list-style-type: none"> Apply AI tools in different fields of study Use AI tools to create basic AI applications Apply structured and statistical methods to solve problems effectively Assess how human-centered design principles impact the development of AI projects Explain the different machine learning approaches that can be used (e.g., unsupervised, supervised and reinforcement learning), the role of data in these approaches, and their application to real-world problems 	<ul style="list-style-type: none"> Evaluate, select and implement creative approaches to the application of AI across contexts Explain how data sets and training sets are transformed into AI models Process and manage data for AI applications using appropriate tools Develop AI projects using appropriate tools, scripts, and libraries Be familiar with deep learning frameworks and their general principles Effectively present and communicate data using visualisations 	<ul style="list-style-type: none"> Create AI case studies or projects with measures or hypotheses, recording and analysing the results, and reporting on the findings Design and implement AI strategies in business or organisational contexts, understanding the regulatory and policy environment, and taking a leadership role Develop AI applications that serve specific purposes in practical settings, leveraging advanced programming and AI techniques Design, implement, fine-tune, and troubleshoot complex AI models, using suitable frameworks Manage projects and collaborate effectively with other groups, leveraging relevant coding and software knowledge to implement ideas

AI Digital Citizenship

Being aware of the issues and risks associated with AI and their mitigations

Social, Cultural, & Ethical Issues

Exploring social and ethical issues of AI by assessing societal benefits, identifying ethical implications, discussing cultural impacts, and applying principles-based approaches to equity, inclusivity, and policy development.

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4+
<ul style="list-style-type: none"> Assess the potential benefits to society of the use of AI Identify ethical implications of AI (e.g., bias, fairness, transparency, accessibility, and accountability) Explain the relationships between AI, data, and cultural contexts and values 	<ul style="list-style-type: none"> Understand how bias occurs in AI systems Discuss the social impacts of AI, including its effects on societal norms and cultural biases Give examples of AI ethics issues in various areas where AI is used Explore the impact of AI on the future of work and implications for creative industries Explore the impact of AI on Indigenous cultures and disadvantaged groups Discuss the impact of AI on governance and policy, utilising a principles-based approach 	<ul style="list-style-type: none"> Evaluate ethical issues related to the design and implementation of AI models and systems (e.g., honesty, intellectual property, and potential harm) Recognise the impact of AI design decisions on social and cultural groups and consider implications for equity and inclusivity Take a principles-based approach when addressing ethical and other issues related to AI, considering fundamental values and testing these principles in practice Critically analyse how to develop AI systems that mitigate social and ethical issues (e.g., fairness, transparency, bias, job displacement) 	<ul style="list-style-type: none"> Analyse the potential future directions of AI, their societal implications, and the importance of ethical guidelines in shaping these directions Contribute to the development of policies and guidelines on the ethical and safe use of AI Apply ethical considerations to AI projects, such as transparency, explainability, and fairness Explain the importance of continual learning and reflection in ethical, societal, and technological aspects due to the rapidly evolving field of AI

Risks & Mitigations

Addressing the challenges of AI by identifying and mitigating risks, promoting responsible use, ensuring inclusivity, and applying moral frameworks to assess AI's societal value and future directions.

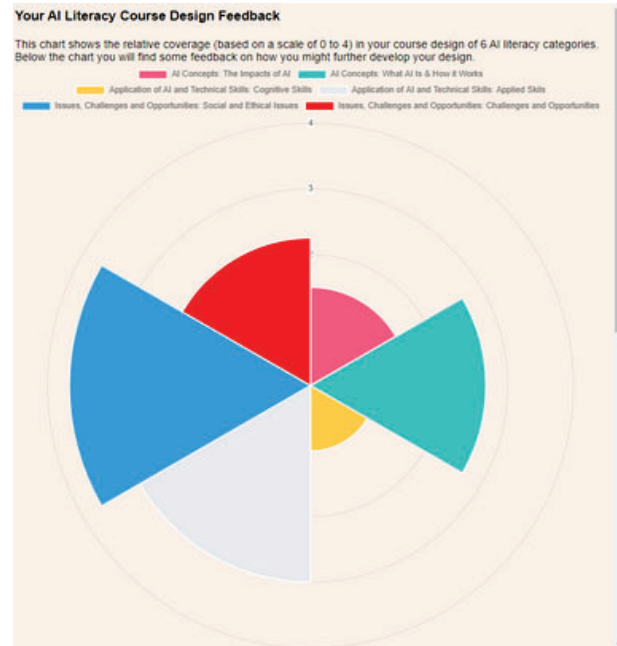
LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4+
<ul style="list-style-type: none"> Identify risks presented by AI systems (e.g., security, personal data, privacy, fraud, and cyber threats) Identify ways to mitigate the risks presented by AI systems Demonstrate responsible and safe behaviours toward AI and the threats it poses through misuse Discuss the impact of AI on cultural diversity and ways of addressing cultural bias in AI systems 	<ul style="list-style-type: none"> Assess the risks associated with data use in AI systems, including issues related to data collection, accuracy, relevance, storage, security, privacy, and potential misuse Identify and implement strategies to protect personal rights and privacy when interacting with AI tools, including understanding consent, privacy settings, and data-sharing policies Advocate for AI applications to be designed to be inclusive and accessible by considering diverse user needs and avoiding decisions that disadvantage or burden specific groups Apply ethical frameworks or moral principles to evaluate the impact of AI on individuals and society, determining what is just, fair, and beneficial 	<ul style="list-style-type: none"> Discuss the state-of-the-art in AI and its future directions, understanding the benefits and potential risks Apply strategies to keep users safe and protect their rights when using AI systems Explain strategies for ensuring the accuracy and reliability of AI products Consider the impact of bias in training data and the importance of diverse and inclusive datasets Recognise the importance of privacy, security, and ethical considerations in data collection, analysis, and management Explain the implications of AI in cybersecurity and the potential misuse of AI technologies Demonstrate a critical mindset when utilising AI tools, question assumptions, and develop deeper understanding 	<ul style="list-style-type: none"> Explain the implementation of safeguards to mitigate possible psychological harm caused by AI systems, considering the levels of protection offered by different types of AI in terms of privacy and security Demonstrate how AI systems can be deliberately biased and raise awareness of the ethical implications Identify and evaluate potential risks associated with AI implementation, including machine-human interaction, intellectual property protection, societal impacts, and misuse of AI Demonstrate the development and implementation of inclusive AI systems that respect diverse social and cultural contexts



The Scaffolded AI Literacy (SAIL) Framework for Education

The AI Literacy Analyser

To help educators assess the levels of AI literacy covered in their courses, we have developed the AI Literacy Analyser tool, which runs in the browser and gives feedback on the coverage of the competencies and categories of the framework at level 1 - “know and understand AI” - since this includes all the foundational components of AI literacy that are important to all learners.



The scores for each AI literacy category are as follows:

1. Issues, Challenges and Opportunities: Social and Ethical Issues with a score of 3.67
2. Application of AI and Technical Skills: Applied Skills with a score of 3.00
3. AI Concepts: What AI Is & How it Works with a score of 2.67
4. Issues, Challenges and Opportunities: Challenges and Opportunities with a score of 2.25
5. AI Concepts: The Impacts of AI with a score of 1.50
6. Application of AI and Technical Skills: Cognitive Skills with a score of 1.00

Please keep a record of these values so you can refer to them later

The AI Literacy component most evident in your course design is Issues, Challenges and Opportunities: Social and Ethical Issues with a score of 3.67

The AI Literacy components least evident in your course design are Application of AI and Technical Skills: Cognitive Skills with a score of 1.00, and AI Concepts: The Impacts of AI with a score of 1.50

You might consider including further aspects of **AI Concepts: The Impacts of AI** in your course design by:

- Helping learners to identify when people are using AI
- Helping learners to explore how AI is impacting society
- Facilitating discussions about the place of AI in the broader context of technological change
- Giving learners the opportunity to evaluate case studies of how AI has impacted different sectors

You might consider including further aspects of **Application of AI and Technical Skills: Cognitive Skills** in your course design by:

- Giving learners the opportunity to evaluate the role of data within AI systems and the implications data has on training of AI models
- Helping learners to identify the affordances of AI technologies for different contexts
- Debating the suitability for the use (or non-use) of AI for different contexts.
- Discussing the implications of using AI for a specific purpose or in a specific context.

If you want to save a text summary of your feedback, you can click on the button below.

[Download Summary as a Text File](#)

If you want to save a summary of your feedback as a CSV (spreadsheet) file, you can click on the button below.

[Download Summary as a CSV File](#)

The tool asks a series of questions and then generates a radar chart of the coverage of each of the six categories.

From this, it provides some advice about how to incorporate more aspects of AI literacy into the course.

It also has options to download:

- A text file of the advice shown on screen for later reference
- A spreadsheet that contains the user’s input data and the generated totals for further analysis



The tool can be accessed at:
<https://davidparsons.ac.nz/AIanalyser.html> or by scanning the QR code.

Next steps

The next steps for the framework are to gain ongoing feedback from the relevant communities and create comprehensive support materials for educators that will help them develop AI literacy in themselves and their students.

AI Literacy is an evolving area of knowledge and understanding, and as AI technologies and applications evolve, the AI literacy framework will also need to respond to these changes.

Our research into this area will continue as we evaluate the use of the framework in practice and develop further resources to help educators to embrace AI literacy.

Further Information

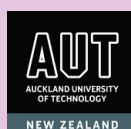
If you would like further information, or to be involved in future phases of this research, please contact Associate Professor Kathryn MacCallum via email:

kathryn.maccallum@canterbury.ac.nz

To quote this report we suggest:

MacCallum, K., Parsons, D., & Mohaghegh, M. (2024). An AI Literacy Framework for Education. He Rourou.

With thanks to the members of the Delphi panel who provided their invaluable insights and arguments during the creation of the framework.



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