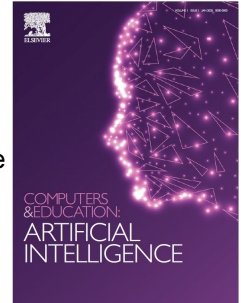


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The Scaffolded AI Literacy (SAIL) Framework: Results of a Delphi Study for Equitable AI Literacy Framework Design in Education

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## Article title

The Scaffolded AI Literacy (SAIL) Framework: Results of a Delphi Study for Equitable AI Literacy Framework Design in Education

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## Declaration of Interest statement

No interests to declare

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# The Scaffolded AI Literacy (SAIL) Framework: Results of a Delphi Study for Equitable AI Literacy Framework Design in Education

## Abstract

Developments in AI technologies and their increasing use in education have prompted ongoing interest in the development of generally applicable AI literacy frameworks to ensure equity of access to knowledge, skills, and understanding. Researchers have investigated the components of AI literacy, how they can be structured, and how they can be developed in educators and learners. Despite much work in this area, and the opportunities and challenges presented by generative AI technologies, most recent frameworks have been confined to those that simply aggregate older ideas from the literature or those that focus on non-generalisable contexts. Few existing frameworks provide novel perspectives on generic approaches to AI literacy that also support equitable, scaffolded competency development for all learners, regardless of context. In contrast, this article reports on a Delphi study that led to the creation of the Scaffolded AI Literacy (SAIL) framework, which is broadly applicable across contexts but also accessible enough to be easily assimilated into the curriculum. Unlike many other frameworks, it provides a scaffolded pathway through competency levels that can be applied across all ages and stages of education and helps to address second- and third-level digital divides. This article details how the Delphi study unfolded, the key decisions that were made during the process, the resulting framework, and how it may contribute to equitable access to AI literacies.

## Keywords

Artificial Intelligence, AI Literacy, Digital Divide, Equity, Framework, Scaffolding

## 1. Introduction

### 1.1 The need for AI Literacy

As AI technologies continue to become pervasive, understanding their fundamental principles has transitioned from being a specialised skill to a critical competency for all learners. This shift necessitates a comprehensive approach to AI literacy that goes beyond technical knowledge. Education systems worldwide are now grappling with the disruptive effects of AI systems, raising questions about the nature of knowledge, learning, and authentic assessment, as well as the risks that existing digital divides will be made worse by AI technologies. As a result, 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). Finding accessible and equitable ways to develop learners' AI literacy should, therefore, be a key priority in all sectors of education.

## 1.2 Defining AI literacy

The concept of AI literacy began to emerge in literature in 2016 when Konishi (2016) conceptualised it as the ability to recognise tasks that can be performed by AI and learning and investing in the human strengths that it cannot replace. Kandlhofer et al. (2016) took a more technical view, emphasising the techniques and concepts behind AI products and services, while Burgsteiner et al. (2016) focused on the role of AI literacy in High School Science education. These initial diverse interpretations laid the foundation for the many subsequent definitions of AI literacy that had different conceptual approaches, within a growing awareness that AI literacy is an interdisciplinary theme (Fadel et al., 2024). Fulkerson et al. (2017) applied the cognitive, behavioural, affective, and metacognitive learning domains, while Long and Magerko (2020) proposed five AI literacy themes, based on a review of the literature and linked to a set of competencies and design considerations. The themes were: what is AI?, what can AI do?, how does AI work?, what should AI do?, and how do we perceive AI? Talagala (2021) outlined the 'four C's' of AI literacy as concepts, context, capability, and creativity. Cui and Wheatcroft (2021) stated that AI literacy could be understood as skills and technical abilities, applications and practical considerations, and transformative thinking, experiences, and considerations. Miao and Shiohira (2024) suggested a human-centred mindset, ethics of AI, AI techniques and applications, and AI system design. These are just a few examples of many. To add further complexity to the piece, AI literacies are often proposed within specific contexts such as elementary school (Kim et al., 2021) or university (Southworth et al., 2023), or linked to other skills and literacies such as computer programming (Vazhayil et al., 2019) or data literacy (Olari & Romeike, 2021). It would be fair to say that definitions of AI literacy are many and varied, and some may reinforce digital divides based on access to tools or social or cultural biases. In this article, we take a broad definition of AI literacy that aims to capture not just the immediate knowledge and skills needed to use AI, but also the wider issues and contexts within which AI has impacts.

*AI literacy is the ability to understand the nature, opportunities, and challenges of AI technologies, to use and create with them wisely, effectively, safely, and responsibly, with respect for the rights and values of others.*

It is also important to make clear that when referring to AI literacy and the framework described in this article, this was not confined only to generative AI but to all forms of AI, including what we might consider traditional forms of machine learning that continue to provide valuable applications and services. We also view AI literacy as distinct from the broader range of digital literacies required to thrive in an increasingly digital society. While it draws upon and is underpinned by other digital literacies and skills, such as computational thinking, our focus in this paper is to identify the specific literacies most relevant to AI. In doing so, we aim to support people to become critically informed and actively engaged users of AI technologies.

### 1.3 Addressing equity through AI literacy

Equity in education has long been tied to questions of digital access and participation, and AI adds a new dimension to this challenge. AI literacy is not simply about learning technical concepts; it also requires learners to engage critically with the social, cultural, and ethical implications of AI. In this sense, AI literacy becomes inseparable from equity, because it determines who can participate meaningfully in societies increasingly shaped by algorithmic systems (Hollands et al., 2024). While many digital equity discussions focus on access to technologies, equally important are ethical considerations, including the consequences of use (Rogers et al., 2018). Therefore, AI adds further layers to the equity implications of technology, such as the potential biases in AI systems that may disadvantage certain groups (Hollands et al., 2024).

Recent research has established clear connections between AI literacy and bias awareness in educational contexts. For example, Chinta et al. (2024) provide a foundational framework identifying three primary forms of bias that AI literacy directly addresses: data-related, algorithmic, and user-interaction bias. This emphasises how AI literacy education helps learners recognise these biases and develop strategies to mitigate them. Similarly, Baker and Hawn (2022) suggest that algorithmic bias in education can disproportionately impact learners from marginalised communities, but that AI literacy can support educators and students to identify and address these inequities. Further, a study investigating algorithmic bias in student progress monitoring found that educators with higher AI literacy were significantly more effective at identifying and mitigating biased outcomes (Boateng & Boateng, 2024).

A useful lens for conceptualising the relationship between AI literacy and equity is the three-level digital divide (van Deursen & van Dijk, 2014). The first-level divide concerns access to technologies and infrastructure. Without reliable connectivity, devices, or supportive environments, learners cannot engage in even basic AI literacy activities. Yet, equity challenges extend beyond this. The second-level divide addresses skills and competencies. This level accounts for the uneven capacity of learners and educators to make effective and meaningful use of AI tools. This level highlights the importance of pedagogical support, teacher training, and structured opportunities to practise AI-related skills. The third-level divide concerns outcomes, focusing on who benefits most from technology use. Here, inequities emerge when AI exacerbates existing social, cultural, or economic disparities, privileging some groups while marginalising others.

Understanding AI literacy through this three-level framework makes it clear that equity requires more than closing the gap in device and infrastructure provision. It requires ensuring that learners develop the skills to use AI effectively and critically, and that the benefits of AI are distributed fairly, rather than reinforcing existing inequalities. In this way, AI literacy can be framed as a central mechanism for addressing structural barriers in education - linking access, capability, and outcomes to broader questions of social justice (Hollands et al., 2024).

Therefore, AI literacy offers a way to address these barriers by framing them not simply as matters of technical provision but as issues of justice and participation. By emphasising equitable access to knowledge, skills, and critical understanding, AI literacy initiatives can

mitigate the risks of exclusion, empower teachers to deliver effective pedagogy, and create pathways for learners who might otherwise be left behind.

### 1.3 AI literacy frameworks in education

Although identifying concepts of AI literacy is useful, it does not, on its own, help to structure and evaluate the development of AI literacy in educators and learners. For this, AI literacy frameworks are required. An AI literacy framework can take many forms, but its main objective is to provide an organised way of thinking about how someone might scaffold their learning about AI. A framework aimed at education should, therefore, provide a structured approach to teaching and learning about AI, supported by a set of guidelines about the knowledge, skills and critical perspectives needed for learners to engage effectively with AI technologies.

From a learning theory perspective, the concept of scaffolding is loosely based on Vygotsky's zone of proximal development (Verenikina, 2008). The role of scaffolded frameworks is to guide learners to evolve from initial supported stages of learning, which may include some elements of direct instruction, to become fully autonomous. The logical progressions through a scaffolded framework provide the necessary focus on critical concepts and logical sequence that underpin the ability of scaffolding to drive learning forward for all learners (Blackburn, 2024).

Scaffolded learning is also supported by activity theory, in which the scaffolding contains inherent cultural knowledge (in this case, the knowledge, tendencies and skills required for AI literacy) that learners interpret as 'signs' from their own perspectives (Beland, 2017). This interpretation emphasises the way that learners individually internalise the cultural knowledge in the framework.

While a scaffolded framework cannot, on its own, provide scaffolded learning, it nevertheless provides a pedagogical structure within which educators can integrate the necessary activities and opportunities to progress.

### 1.4 Frameworks across contexts

Within the broader literature about AI literacy, a subset of work has addressed AI literacy frameworks in a range of different contexts. While some of these frameworks are generic, many others provide analyses of AI literacy in specific contexts and/or levels of learning. While context-dependent frameworks can be useful in their areas of focus, confining a framework to a specific learning context limits its broader usage. An AI literacy framework would ideally be applicable across multiple learning contexts and provide scaffolded pathways for learners at all levels of learning and across all contexts to develop knowledge, skills, and critical perspectives about AI. This article outlines the creation of such a framework that is designed to offer some unique advantages that justify its adoption by educators at all levels and across all subject areas. In this article, we, therefore, present a new framework developed to address the gaps in the current literature and articulate what skills and competencies learners need in this evolving digital landscape.

The remainder of this article is structured as follows. The next section provides a review of recent literature addressing AI literacy frameworks in education in the age of generative AI

(post 2022) and why the framework described in this paper provides new contributions in the context of this work. This is followed by the aims of the development project and why a Delphi study was chosen as the methodology. The next section details the Delphi study process and explains how the final framework evolved from the study, outlining its key features (the full framework is included in Appendix A). The article continues with a reflective summary of how scaffolded AI literacy relates to equity, before discussing some conclusions, limitations, and future work.

## 2. Related Frameworks

The landscape of research into AI literacy and associated frameworks is complex and multifaceted, but there are several core aspects of published frameworks that can be used to compare them and identify in what contexts they may or may not be useful. To provide this comparison, we reviewed recent articles that proposed AI literacy frameworks for education to identify their characteristics. Given the major impact of generative AI tools that started to become widely used in 2022, it was important to focus on recent work, given that there are literacies appropriate to generative AI that may not have come to the fore in early studies in the field and would therefore form an addendum to earlier work. Therefore, the articles included in this review section are those published in 2023 and 2024. 13 frameworks published in the academic literature are considered from this period, alongside the UNESCO AI competency frameworks for students and teachers.

### 2.1 Framework contexts

Notably, there has been a continuing focus on the development of AI literacy frameworks in specific learning contexts. Of the 13 articles reviewed, two were from early years education (Luo et al., 2024; Su et al., 2024), one from primary (Mott et al., 2023), two from secondary (Ng et al., 2023; Kong et al., 2024), three from K12 (Chiu et al., 2024; Mills et al., 2024; Touretzky et al., 2023), three from higher education (Tenório & Romeike, 2023; Pretorius & de Caux, 2024; Biagini et al., 2024), and one for 'novices' (Laupichler et al., 2023). Only one academic paper adopted a multidimensional or holistic approach (Allen & Kendeou, 2024), though it should be noted that the secondary school framework by Ng et al. (2023) was based on the more generic TRACK model that was developed from a literature review (Ng et al., 2021). The UNESCO frameworks (Miao & Cukurova, 2024; Miao & Shiohira, 2024) also take a holistic approach but differentiate between what literacies teachers need and what is needed of learners and include a wider focus than just the competencies required.

### 2.2. Framework sources

The sources of these frameworks are also worth considering. Many of the frameworks are purely theoretical, based on literature reviews rather than any additional sources or empirical data. However, there are some based on more empirical approaches, for example, two studies that applied grounded theory (Luo et al., 2024; Pretorius & de Caux, 2024), with the latter study including autoethnography. In several cases, experts were used at some level to inform the design of these studies, involving expert interviews (Tenório & Romeike, 2023), expert consultation (Miao & Cukurova, 2024; Miao & Shiohira, 2024), professional association member contributions (Touretzky et al., 2023), and a Delphi study (Laupichler et al., 2023), while Chiu et al. (2024) employed co-design with teachers, and Mott et al. (2023)

ran a games-based pilot. Some of the literature-based studies also followed up with further work, including testing the frameworks in schools (Ng et al., 2023; Kong et al., 2024) and following up with expert interviews (Biagini et al., 2024).

### 2.3 Scaffolded progression in frameworks

Most of the frameworks reviewed for this study contain no explicit descriptions of scaffolded progression. This is unsurprising, given that these were primarily literature reviews, so generalised across different approaches, or focused on specific contexts where AI literacy was applied to an individual stage of learning. There are, however, some frameworks that do include some concept of scaffolded progression. Mott et al. (2023) briefly mention students using such a progression in one activity, but do not provide details. Ng et al. (2023) suggest that an AI literacy framework should include the three levels of 'know and understand AI', 'use and apply AI', and 'evaluate and create AI', but also conflate the latter two layers and provide little detail about how this progression might be defined and structured. These three levels are similar to the 'understand, apply, create' progression included in the UNESCO framework for students, which also includes details on what is expected in these levels (Miao & Shiohira, 2024), while the teacher framework instead proposes 'acquire, deepen, create' (Miao & Cukurova, 2024). The framework proposed by Mills et al. (2024) does not propose any details on scaffolded progression, but the authors do recommend that AI literacy skills should be integrated cumulatively throughout school grades. This is addressed by Touretzky et al. (2023), who provide some indicative ideas about what might be expected across four grade bands (K-2, 3-5, 6-8, and 9-12). Another factor to consider is that frameworks often include dimensions of AI literacy that may also imply stages. For example, Pretorius and Cahusac de Caux (2024) identify several AI literacy themes, of which the 'foundational' theme provides the first stage from which others can be developed, but these do not constitute a scaffolded progression.

### 2.4 Frameworks comparison

Our overview of recent frameworks suggests that many of them have sources that are either retrospective literature views (e.g., Campanozzi et al., 2023; Ng et al., 2021; Olari & Romeike, 2021) or are based on rather narrow expert groups (e.g., Biagini et al., 2024) or contextualised experiments (e.g., Burgsteiner et al., 2016; Kong et al., 2024). Frameworks are, more often than not, developed for a specific educational level or context (e.g., Tenório & Romeike, 2023; Vazhayil et al., 2019), and few provide a scaffolded progression through levels of competence. The two UNESCO frameworks (Miao & Cukurova, 2024; Miao & Shiohira, 2024) come the closest to meeting these criteria, but further challenges in these frameworks are the division into separate AI literacies for teachers and students, and the sheer scale of many of the student competencies, which are very broad in scale, and then aligned to quite complex sets of curricular goals. There is a danger in such ambitious frameworks that many learners will be left behind, given the complexity and level of understanding educators need to apply and implement. In addition, separating teachers' and students' literacy seems to reinforce that AI literacy needs are different, and it is less clear how they overlap or build on each other. The challenge in separating teacher and student literacy is that this can conflate the difference between literacy and pedagogy. So, while it is agreed that teachers need additional competencies to use AI to teach, what is less clear when reviewing these frameworks is how this differs from student (general) literacies.

While the frameworks discussed above may be valuable in a range of different contexts to which they align, they leave some key aspects unresolved. To address these gaps, a universal AI literacy framework must:

- Be adaptable to diverse educational contexts and age groups.
- Provide clear progression from foundational to advanced competencies.
- Balance technical, ethical, societal, and cultural dimensions of AI literacy.

We propose that the framework presented here occupies a unique space in the broader landscape of AI literacy frameworks, based on its origins in a systematic Delphi study, its structure of progression through scaffolded levels of competency, and its balanced approach. While not all frameworks contain explicit stages of scaffolding, those that do have features in common, typically based around steps such as 'understand', 'apply', 'evaluate' and/or 'create'. The SAIL framework also shares similar characteristics; however, it is also distinct in that, even at each level, including from a foundational level, all these steps are expected. We maintain that to be a critical user of AI, we need to be able to demonstrate a broad understanding of AI. Therefore, in this framework, we explored the notion that all learners need to understand the concepts of AI, develop basic cognitive and technical skills, and evaluate the critical influence of AI; however, the depth of these concepts differs as the learner progresses through the different levels.

The framework also offers a different perspective in its effort to specify the boundary between AI literacy and what comes after that, by outlining what might be expected of those specialising in developing and deploying AI systems. This approach helps to clarify what comprises AI literacy for all learners, and what additional AI knowledge and capabilities are needed by those who wish to go further.

We contend that this AI literacy framework is inclusive of multiple perspectives, including social, ethical, and cultural, and lays the foundation for AI literacy as a core capability for all learners, from novice to expert (educators and students alike).

### 3. Methodology

The chosen methodology for this study was the Delphi technique, based on its ability to gather systematic and unbiased data from a wide range of expert sources. This method ensures systematic input while minimising biases associated with face-to-face interactions. Although rarely used in the reviewed AI literacy articles, the Delphi technique has been frequently used in an educational context and is particularly suited to curriculum-related activities (Green, 2014). Our study of the literature around AI literacy frameworks revealed that the use of expert panels was a method that avoided the generalised recycling of framework concepts based on literature reviews or the limited focus of contextual studies. Not all these panels used a Delphi approach, so it was not always possible to know the demographics and expertise of these groups, nor how the consultation was organised. Of the previous studies we investigated, only Laupichler et al.'s Delphi study (2023) provided full details of their process. However, some form of expert consultation appeared in several other studies, at various points in the research process. Biagini et al. (2024) conducted open-ended expert interviews with five specialists in the fields of AI and educational

assessment to help them create an AI literacy questionnaire. Tenório and Romeike (2023) interviewed 17 professionals with roles related to AI, most of whom were academics. In Miao and Cukurova (2024), a group of five international experts was consulted, while the related UNESCO publication by Miao and Shiohira, (2024) lists the names of twelve experts who were involved in the peer review process. Touretzky et al. (2023) utilised a working group of 16 teachers and 9 others with relevant expertise, along with an advisory board of up to 12 members.

### 3.1 Characteristics of the Delphi Technique

The Delphi Technique was designed to overcome individual biases by gaining the intuitive insights of experts as systematically as possible. It was intended to avoid the difficulties of face-to-face committees, where many interpersonal factors can disrupt effective consensus forming (Pelletier, 1972) by replacing them with a sequence of individual interrogations (Helmer, 1972). The technique has three features: (1) the opinions of the Delphi panel are gathered anonymously, (2) interaction is managed by a systematic set of iterations, with carefully controlled feedback between rounds, and (3) the opinion of the group is an appropriate aggregate of individual opinions in the final round (Dalkey & Rourke, 1971). Although the basic concepts of the Delphi approach have remained largely consistent over time, details may vary, including the number of rounds, methods of question delivery and response collection, and criteria for judging 'consensus' (Barrett & Heale, 2020). While technology has impacted the communication channels used for these studies, and offers new ways of analysing the data such as sentiment analysis (Beiderbeck et al., 2021), the method remains fundamentally consistent.

### 3.2 Preparing the Delphi study

The initial stages of the Delphi study took place at the beginning of 2023, when the researchers defined the overall goal and scope of the study based on a review of the literature addressing AI literacy concepts and frameworks. It is not essential to conduct a literature view in the initial stages of a Delphi study, since the process can begin simply with a set of open questions. The role of the literature review in Okoli and Pawlowski's (2004) systematic approach to Delphi studies is seen primarily as a means to identify panel participants rather than to inform the study. However, Delphi studies based on an initial literature review, enabling more structured interactions (Hsu & Sandford, 2007), typically require fewer rounds than those based on open questions (Furtado et al., 2024). While some researchers have performed a systematic literature review as part of the Delphi process, this is relatively unusual and is not an expected component of the method (Fathullah et al, 2023). The exploratory literature review outlined above was sufficient to provide the structured framing for the first set of interactions with the Delphi panel. One key idea that emerged from this review was the limitations of AI literacy frameworks that had no explicit concept of progression. This makes it hard to clearly identify where AI literacy begins (what are its fundamentals?) and where its ceiling lies (what comes beyond literacy?), a question that was important to this study, which regarded AI literacy as separate from expert AI knowledge. As a result, we proposed a multi-level framework to structure the questions for the Delphi panel. Initial ideas for who would be invited to the panel were also discussed, deciding to focus mostly on experts the researchers were already aware of, either personally or by reputation,

with a view to extending the initial list of potential experts in practice based on how many agreed to participate and snowball sampling further experts. We also aimed to include experts from diverse fields, with a particular focus on indigenous perspectives. From this preparatory work, an ethics application was developed that was approved by the institutional ethics committee at the end of March 2023. The approval was based on an assumption that the Delphi study would involve at least two iterations and a maximum of five. After ethics approval was given, the Delphi panel was recruited, and the initial round of questions was sent out.

A total of 83 experts were invited, with 17 completing all three rounds. Participants included educators, industry professionals, and cultural experts, ensuring diverse perspectives. The majority of these were already known to the authors as being recognised in their fields. Invitations to participate were also shared through various professional channels. Because the study was focused on considering how AI literacy might be integrated into the curriculum, our experts came from both education and industry.

Three rounds of surveys were conducted:

- Round 1: Experts identified key competencies and provided feedback on an initial maturity model.
- Round 2: Competencies were refined based on feedback, with participants ranking their relevance and importance.
- Round 3: The final framework structure and competencies were validated.

## 4. Results

This section describes the three rounds of the Delphi study, including what materials were provided to the panel in each round, and how the responses were analysed and integrated into the evolving framework.

### 4.1 Delphi study round 1

Round 1 took place between May and July 2023. The information provided to panel members explained that we were asking them to identify the capabilities a person needs to utilise AI technologies effectively and ethically in education and society. We also asked them to specifically consider the knowledge, skills and understandings that were required at each of the four levels of a proposed maturity model that was presented as follows:

Level 1: Informed - initial awareness / foundational knowledge.

Level 2: Empowered - exploring ideas, reflecting.

Level 3: Engaged - implementing and embedding concepts and tools.

Level 4: Active participant - creating/applying AI in transformational ways.

The survey sent to the panel comprised three sections.

1. General questions about what components of knowledge, skills, and understanding should be at each level of the proposed maturity model
2. Questions asking for feedback on the proposed maturity model itself
3. Demographic information

The survey was extensive, containing 15 detailed questions on the various aspects of the model. A total of 83 people opened the survey, but the majority of these did not complete it. Being designed for an expert audience, the survey was demanding to respond to in detail, requiring extensive knowledge of AI, and it appears likely that many of those who viewed the survey did not feel able to effectively complete it. Most of those who did complete the survey had been directly invited as recognised experts in AI. Only 17 respondents fully completed the first round of the Delphi survey, but the detail and expertise that was provided meant that the rich data provided a firm foundation for proposing some initial findings to be fed back into the next round of the Delphi study. 11 of the respondents came from education, five from industry, and one respondent had both education and industry roles.

The respondents from the education sector held roles that either taught AI, including tertiary educator (n=4, professor to lecturer) and high school or primary teacher/principal (n=3), or those that supported these teaching roles - lab technician, learning support, or designer (n=4). The years of teaching were diverse, with an even split between those who had taught up to 10 years (n=8) and those who had taught for 11 years or more (n=7).

Those in the industry group came from a diverse mix of experts, including a Senior Quality Editor, Senior Principal Data Scientist, Special AI Projects Lead, and founders of businesses that use AI as part of their work (n=3). Of these, one specialised in Indigenous culture and AI ethics and another in privacy, cybersecurity, and online safety.

Of the experts, most (n=12) had up to 5 years of experience in AI, while one educator had 11-20 years. Two respondents had 21-30 years of experience (one from academia and the other representing both education and industry), and one industry respondent had over 30 years of experience in the field of AI. The experts covered a wide range of AI expertise, including AI ethics, building of AI systems, probabilistic models, and general and specialist teaching of AI concepts.

As this study was based in Aotearoa New Zealand, there were many local experts (n=11) in the study, but also several contributors from other countries (Australia, Canada, South Africa, the UK, and the USA). The study may, therefore, be characterised as one that deliberately focuses on New Zealand education to be as relevant as possible to the authors and their networks, while also considering the views of non-educators and those from other countries to ensure a broad understanding is attained. The focus on New Zealand also has significant implications for the grounding of Indigenous views, where the country is recognised for its international leadership in bicultural education and Indigenous data sovereignty (Kukutai & Taylor, 2016).

While the Māori perspectives that informed this work are rooted in the New Zealand context, many of the concerns raised, such as data sovereignty, cultural misrecognition, and equitable participation in AI futures, are shared by Indigenous communities globally. For instance, First Nations in Canada (Oguamanam, 2020), Aboriginal peoples in Australia (Barrowcliffe et al., 2025), and Native American communities in the USA (Maitra, 2020) have all articulated similar concerns about how digital and AI technologies can both marginalise and empower their communities. Issues such as algorithmic bias, exclusion of Indigenous languages, and control over data are not unique to Māori and Pacific peoples but reflect a wider international discourse around Indigenous rights in digital and AI governance.

Given sensitivities around ethnicity, the study did not record ethnic origin, unless this was self-identified. However, through deliberate recruitment of participants and expert networks, the study ensured that diverse perspectives were included, with a particular emphasis on incorporating Indigenous voices. Importantly, these perspectives are not only relevant regionally but also resonate with broader international debates, reinforcing the applicability of the framework beyond New Zealand.

## 4.2 Analysis of results from round 1

The results from the first round provided a large amount of data in each of the three focus areas of the original survey questions (knowledge, skills, and understanding) across the four suggested levels. The expert responses were coded using thematic analysis, identifying repeated ideas by constant comparison, clustering these into themes and then positioning these under the three constructs taken from the original survey questions. Within 'knowledge', two broad themes were identified: The concepts of AI and applications of AI knowledge. Skills were gathered under the theme of technical skills for AI, while understandings comprised ethical and societal issues, alongside developing critical awareness and transdisciplinary thinking in relation to AI. Themes were partly defined in ways that would support a reasonably consistent number of statements in each theme for the next round of the study.

Each of the individual contributions from the Delphi panel was put into the emerging framework based on the five themes. The researchers limited their editing of these ideas to the removal of clear duplicates to reduce unnecessary overhead for the panel in round 2. In these cases, the original wording of the combined suggestions was kept as intact as possible. The number of statements in each theme after the removal of duplicates is shown in Table 1.

Table 1: AI literacy themes that emerged from round 1 of the study

Theme	No. of Statements
The concepts of AI	26
Applications of AI knowledge	29
Technical skills for AI	23
Understanding of the ethical and societal issues related to AI	26
Developing a broader understanding, required for critical awareness and transdisciplinary thinking in relation to AI	14

## 4.3 Delphi study round 2

The analysis of the results for the first round and the creation of a draft framework from that data took several months, with the second round taking place between December 2023 and January 2024. In this round, the experts were asked to review each of the suggested items in each theme as identified from the data in the first round. Before responding to the second-

round survey, they were asked to review a document that summarised the overall model created from the data from the first round, showing all the proposed competency statements in each of the five themes across all four levels. That was to ensure that the panel were aware of the overall content of the material to be evaluated before starting the survey.

When completing the survey, if they regarded items as relevant to the level they had been placed in, they were asked to rank them in order of importance. In addition, the experts were asked to:

- Indicate any items that they considered relevant but not at the correct level
- Indicate any items that they did not consider relevant to AI literacy
- Identify any new items that they believed were missing from the relevant level

#### 4.4 Analysis of results from round 2

At the conclusion of the second round, the resulting feedback was analysed within the five emerging categories of concepts, application, technical, ethics, and transdisciplinary skills. Individual ranking data from panel members was used to provide aggregate values for each idea and a summary ranking from the panel as a whole. In addition, we took note of comments regarding the relevance or relative level of some ideas and the items that were missing across the proposed framework.

Having ranked and filtered the data from round two, we began a process of rationalisation. In general, based on these rankings, the items that were the highest rated remained in the framework. Items that were rated as low were individually discussed with the research team, and then the decision was made on whether they would remain in the framework. Items that were noted by the panel as being at the wrong level, not relevant, or suggested to be added were also discussed on an individual level within the team to decide if they would be moved, removed, or added. Additional and moved items were labelled as such so that in the next round, the experts could do a final round of validation.

As an outcome of this evaluation and finalisation of the feedback, the researchers developed a series of diagrams to help clarify and conceptualise the resulting framework. The first set showed each level and the categories within them. A further set showed each category across all levels. This made it possible to cross-reference content between categories and progression in terms of level. We then reviewed for logic gaps and appropriateness of progressions between items to evaluate how well concepts built on each other as they progressed up the levels. If any changes were suggested, these were made but noted to be shared with the experts for feedback. One of the main outcomes of this process was the decision to remove items that were more related to general digital skills over those that were more AI-focused. For example, in level 2, we decided to remove coding skills, as while these were relevant to AI literacy, they are overarching digital literacy skills and not specifically for AI literacy.

This process also helped us refine the levels, conceptualising them as:

- Level 1: Know and Understand AI - acquiring fundamental concepts, skills, knowledge, and attitudes that require no prior experience.
- Level 2: Use and Apply AI - understanding of how to use AI in specific contexts with hands-on use of AI productivity tools to build applications.

- Level 3: Evaluate and Create AI - engaging in higher-order thinking activities and developing AI using more sophisticated tools.
- Level 4: Transform and Develop AI - developing systems, exploring and guiding future development.

As before, these four levels remained age-agnostic, but based on feedback from the panel, we acknowledged that the higher levels would only be introduced at appropriate ages and stages. Indeed, Level 4 later became separated from the other three levels after the third round. However, we maintained that Level 1 concepts were appropriate (indeed, essential) to all age groups, though educators would adapt the delivery to suit the context.

After much discussion of the Delphi panel feedback and exploring several different options for restructuring the suggested five categories to respond to that feedback, we reorganised the framework into a set of three domains and six categories that we believed accurately reflected the material prioritised, critiqued, and suggested by the panel. These were:

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

In assembling the material into these domains and categories, and taking account of levels, we endeavoured to be as consistent as possible with the use of language and be logical about defining material in each level, such that progression between levels was evident.

#### 4.5 Delphi study round 3

The third and final round of the study took place between February and May 2024. In this round, the panel were asked to respond to the revised six-category framework and its competencies. At this stage of the process, it was assumed that the overall framework structure was already agreed upon, so the focus here was on the details of the domains, categories, and competencies, addressing clarity, wording, relationships between items, and any missing focus areas.

#### 4.6 Analysis of results from round 3

In their feedback, the panel members agreed that the structure of domains and categories was appropriate, though it was evident that within the new structure, changes were needed in how the different competencies were allocated. Some changes were also made in areas such as competencies related to data and risk, with various modifications and enhancements suggested by the panel. These suggestions were all incorporated into the evolving framework. Because the feedback from the panel from round three focused on relatively minor edits to the framework, with generally positive feedback about the content

and structure, it was decided that there was no need for further rounds of consultation with the expert panel, but that the framework was ready for wider visibility and feedback.

#### 4.7 Further feedback and review

After using the results of the three-round Delphi study to create an initial AI literacy framework, we opened the draft for review to a wider audience by presenting it through communities of practice and other opportunities to present the work, inviting feedback both directly and through an online feedback form. Through this process of presenting the framework, we could reflect further on its structure and content. As a result, some further changes were made, including that 'Level 4 - Transform and Develop AI' was removed from the definition of AI literacy and renamed 'Level 4+ - Beyond AI Literacy'. This was based on feedback that it is important to know the boundaries of AI literacy and where knowledge, skills, and understanding move into the expert domain. It also became evident that the 'Issues, Challenges, and Opportunities' domain and its categories and competencies were not very clearly defined. As a result, it was renamed 'AI Digital Citizenship' to give it a broader focus, and its two categories were renamed 'Social, Cultural, and Ethical Issues' and 'Risks and Mitigations', which allowed the competencies to be rearranged into more coherent groups. Also, during this stage, much of the wording was simplified and made more consistent to make the framework more accessible. This was the basis for the first publicly released version of the framework, which was shared as a report so that it could be used in practice and further feedback could be gathered from users (MacCallum et al., 2024).

Following the publication of that report, further refinements have been added to the framework. These are principally a renaming of the four levels and a restructuring to ensure that each row of the framework addresses a specific key idea, providing a clear scaffolded pathway across the levels. Part of this process resulted in rephrasing, moving, and adding competencies, based on the experiences of applying the framework in practice. In renaming the levels, we sought to indicate that Level 1 included practical engagement with AI tools, and that Level 2 was not only about applying AI but also integrating it into a range of activities and contexts. Further, to clarify that Level 4+ was outside the scope of literacy and defined what comes beyond it, the level number was removed, and its original title restored. The levels of the framework were therefore renamed: "Level 1 - Understand and Explore AI", "Level 2 - Apply and Integrate AI", "Level 3 - Evaluate and Create AI", and "AI++ - Transform and Develop AI (Beyond AI Literacy)".

## 5. The Scaffolded AI Literacy (SAIL) Framework

This section provides some summary details about the final version of this framework, which we named the Scaffolded AI Literacy (SAIL) framework, developed from the Delphi Study. Further details can be found in Appendix A.

### 5.1 SAIL framework levels

Figure 1 shows the four (three plus one) levels of the framework. These levels show the stages a learner would move through to build their AI literacy, with the final stage (AI++) representing the move beyond AI literacy, where learners progress to deeper engagement,

addressing the capabilities for those moving into AI fields of research and practice. It is also important to remember that this framework was developed to be age agnostic. While the higher levels (3 and above) 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.

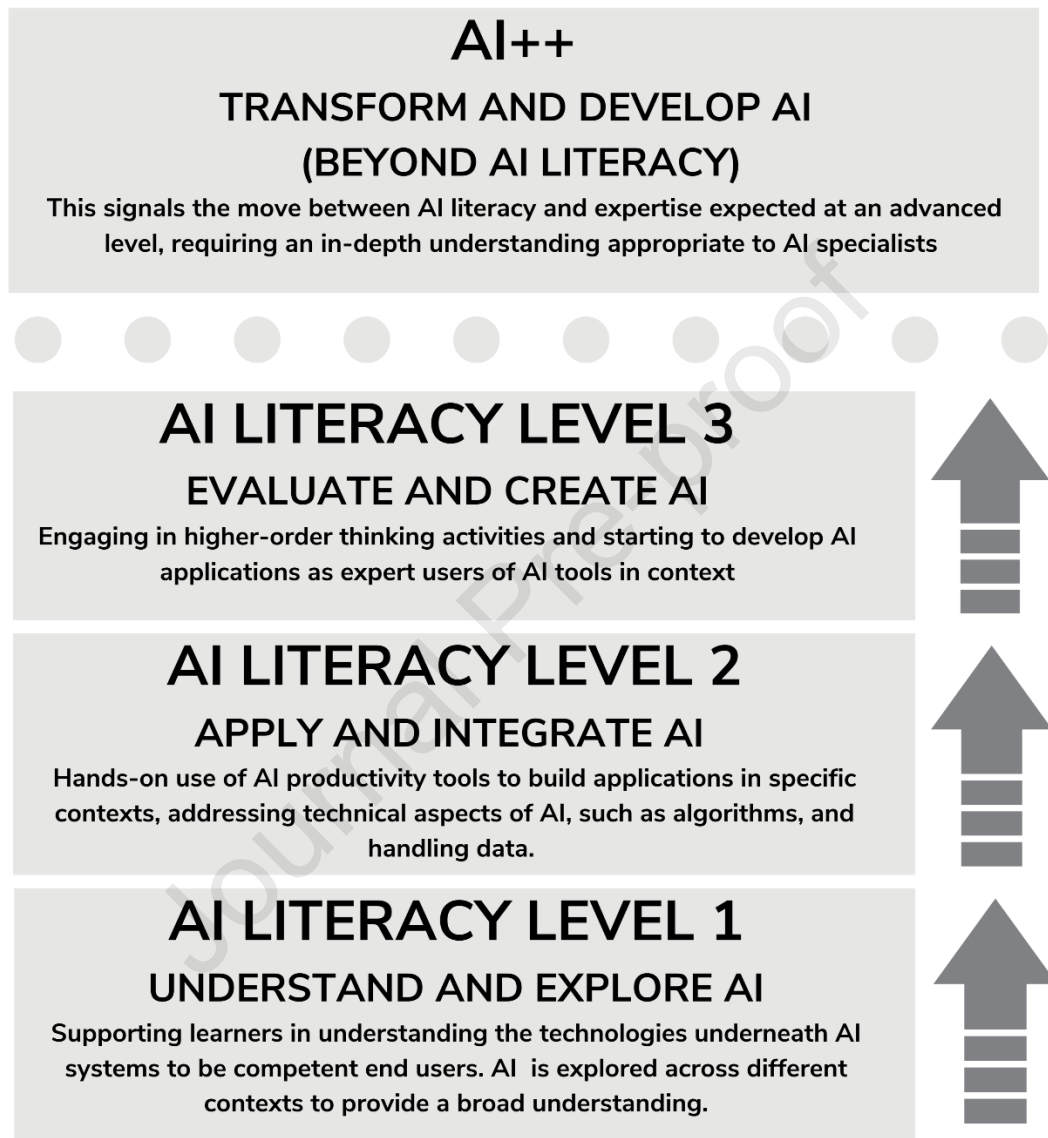


Figure 1: The four (three plus one) levels defined in the SAIL framework

## 5.2 SAIL framework domains and categories

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”. The six categories together ensure that there is an appropriate mix of knowledge, skills, and critical thinking. Figure 2 shows the domains and categories, with brief descriptions of each.

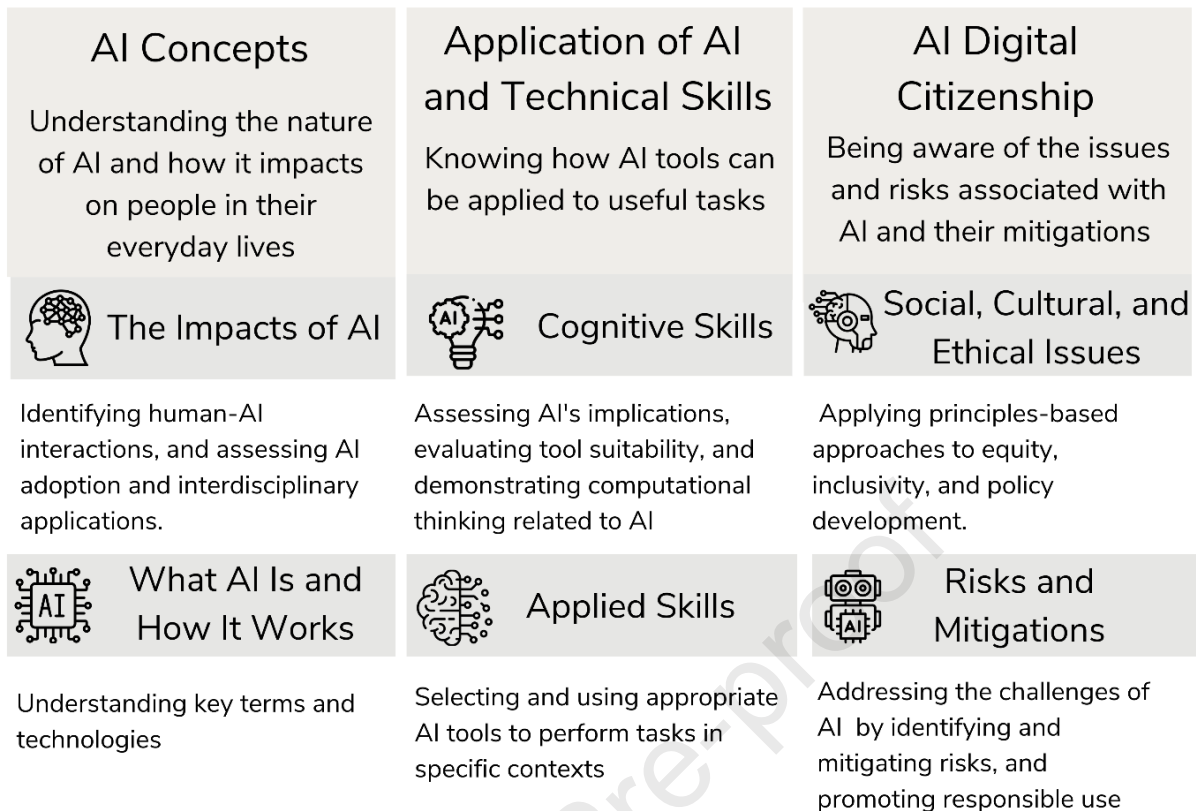


Figure 2: The domains and categories of the SAIL framework

In the complete framework, each category is represented in each level, with the learner developing further related competencies in each domain as they progress through the levels. Each competency is mapped across the four levels of the framework using a set of key ideas to make it easy to follow how a given competency can be developed in stages. Figure 3 shows the key ideas that apply across all levels in each category. The competencies themselves are detailed in Appendix A.

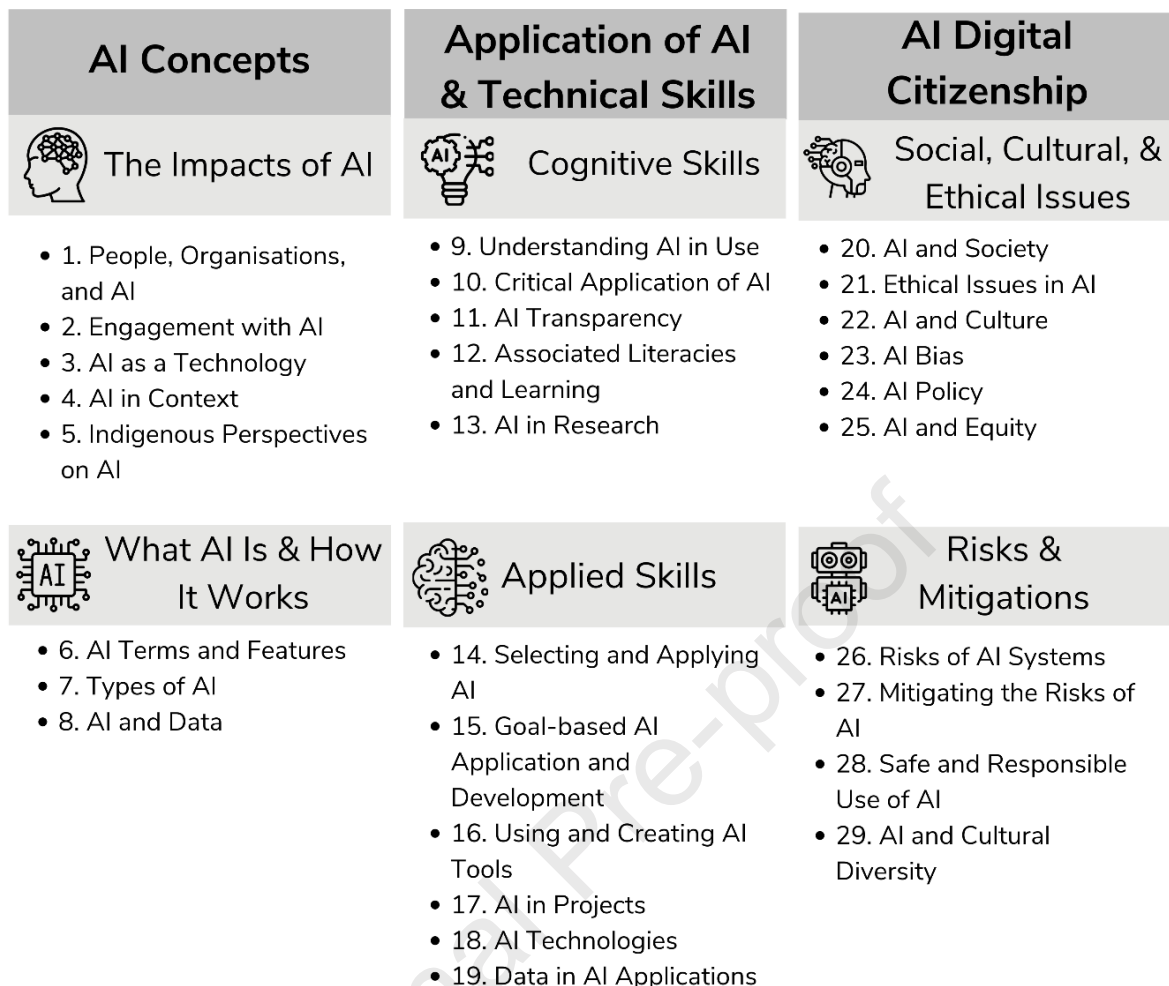


Figure 3: The key ideas in each category, within which the competencies are defined at each level

### 5.3 Competency scaffolding

As an indicative example of how different competencies are scaffolded through the levels of the framework, one component of the category “What AI Is and How It Works” relates to learners’ understanding of the terminology and technology of AI. At Level 1 (“Understand and Explore”), related to the key idea of “AI Terms and Features”, there is the following competency, which addresses a basic understanding of important terms.

**Define and recognise common AI terms and features.**

At Level 2 (‘Apply and Integrate’), the following related competency is outlined, which ensures that learners have insight into some of the mechanics of the tools they are applying (the depth to which the competency is developed will depend on age, stage, and context).

**Apply terms to explain how AI models are trained, including steps such as input, training, and outputs.**

At Level 3 ('Evaluate and Create'), the following competency is addressed, which ensures that learners have a critical understanding not only of the terminology and technology but of their implications when evaluating and creating AI systems.

**Evaluate how deep learning and other architectures shape model capabilities and limitations**

For experts at AI++ (Transform and Develop AI - Beyond AI Literacy), a comprehensive knowledge of how AI models work is expected through this competency.

**Demonstrate mastery of advanced AI concepts and apply them to novel or domain-specific systems.**

This example illustrates the approach of the scaffolded framework. The full set of competencies and their progressions is provided in Appendix A.

## 6. How Scaffolded AI Literacy Relates to Equity

### 6.1 Digital divides and AI literacy

When discussing AI literacy through the lens of the digital divide, it is important to recognise that the notion of a "divide" no longer refers exclusively to differences in physical access to technology and connectivity (first-level digital divide) (Kitsara, 2022). Access remains a necessary foundation, as without sufficient infrastructure, devices, and connectivity, learners are excluded from even the most basic forms of AI literacy. The SAIL framework cannot directly solve these infrastructural issues, but its design ensures some inclusivity - many of the foundational competencies can be taught with low-tech analogies and contextually relevant activities. Focusing on building AI literacy even in contexts with limited access prevents the divide between those who "have" and those who "have not" from widening (Cao et al., 2025).

While access matters, addressing only the first-level divide is insufficient. The second-level digital divide highlights disparities in the skills and competencies needed to make meaningful use of technology (van Deursen & van Dijk, 2014). Here, equity is often undermined not just by the absence of technology but also by uneven teacher capacity to integrate AI meaningfully into learning. Therefore, as a whole, the framework is designed to address Level 2 digital divides, focused on addressing skills needed to utilise digital technology. However, the framework also includes aspects that help broaden notions of equity. By embedding the construct *AI and Equity* (key idea #25) explicitly into the framework, learners at Level 1 are asked to recognise that AI can create unequal impacts across groups, while Level 2 competencies explore how AI access and use vary across socio-economic, cultural, and geographic contexts. These early stages provide a foundation for teachers and learners alike to develop critical awareness of inequities and begin addressing them in practice.

At the third Level, equity becomes a matter of critically evaluating AI systems for fairness, accessibility, and inclusion. This aligns closely with the third-level digital divide, which concerns who benefits most from technology adoption and to what extent. Finally, at Level

AI++, learners are expected to lead AI initiatives that promote equity, social justice, and inclusive design. This ensures that AI literacy is not only about technical competence, but also about enabling learners and educators to actively shape fairer and more just AI futures.

This framework, therefore, does not just conceptualise AI literacy as an equity concept (something everyone needs) but also a concept we need to explicitly understand (that AI technologies can impact and, if not considered, widen inequity). Thereby, by offering a scaffolded progression, the SAIL framework creates a roadmap for both learners and teachers. For educators in particular, the framework provides a structure for professional development: building confidence in foundational concepts, moving toward applied skills, and ultimately cultivating the ability to guide students in critical and ethical engagement with AI. Taken together, this mapping across the three levels of the digital divide, reinforced by explicit equity competencies, makes visible how the SAIL framework operationalises equity - by ensuring that learners are not only included in access, but also supported in skills development and empowered to achieve equitable outcomes.

## 6.2 Cultural and social equity

An awareness of context includes consideration of the relevant cultural contexts where the learning is situated. This study was initiated in New Zealand and therefore recognises the importance of indigenous knowledge, which is central to that country's bi-cultural commitments and leadership in Indigenous data sovereignty (Kukutai & Taylor, 2016). However, as mentioned before, these concerns are not unique to the New Zealand setting. AI impacts are not equal across all sectors and can adversely impact Indigenous and marginalised voices (Maitra, 2020). The SAIL framework, therefore, draws from local contexts while also addressing themes that resonate across global Indigenous and equity discourses.

To operationalise these perspectives, the SAIL framework embeds explicit competencies across multiple domains and levels; these sit not just in the digital citizenship space but also more broadly in the understanding of the concepts of AI. For example, in Concepts of AI, the concept of Indigenous perspectives of AI (key idea #5) are explored. In this framework, learners begin at Level 1 by recognising Indigenous knowledge, worldviews, and values in relation to technology, progressing at Level AI++ to co-developing AI initiatives in partnership with Indigenous communities, embedding cultural principles into governance and design. Similarly, in the *Social, Cultural, and Ethical Issues* domain, early competencies introduce AI's relationship with culture and values, while more advanced stages involve analysing structural inequities (e.g., racism, sexism, class bias) and ultimately leading to inclusive AI development that respects diverse cultural values (key idea # 22, AI and Culture). Finally, in the *Risks and Mitigations* domain, learners move from recognising risks of cultural bias and impacts on minority cultures to advocating for inclusive AI applications and designing safeguards that respect cultural protocols and Indigenous collective rights (key idea # 29, AI and Cultural Diversity).

By structuring these competencies across levels, the framework ensures that cultural and Indigenous perspectives are not treated as add-ons but as integral to AI literacy at every stage. However, across all competencies, these concepts can support a wider understanding of the impacts of AI on culture, marginalised groups, and Indigenous peoples.

For example, at foundational levels, this may involve using culturally relevant examples, low-tech analogies, and accessible language to make AI concepts approachable for diverse learners. As learners progress, these broader equity concerns deepen to include an understanding of data sovereignty, bias, and algorithmic fairness, ensuring that students critically evaluate how AI systems can perpetuate or disrupt inequities. At the highest levels, learners are positioned not only to critique but also to co-create AI systems in ways that embed cultural principles and prioritise inclusive governance.

This developmental approach matters because AI technologies risk amplifying inequities when certain groups disproportionately benefit while others are marginalised or harmed (Kitsara, 2020). By embedding Indigenous and cultural considerations across all domains and levels, the SAIL framework helps reduce outcome disparities, supports cultural survival and self-determination, and empowers diverse communities worldwide to shape AI responsibly. In this way, the framework contributes both to local priorities in New Zealand and to international debates about equity and inclusion in AI. By ensuring that learners critically evaluate AI's societal impacts and co-create equitable solutions, the framework hopes to reduce outcome disparities and empower diverse communities to shape AI in ways that serve the public good.

## 7. Conclusion, Limitations, and Future Work

The development of this framework was to address what AI literacy looked like in a wide and encompassing manner. As already identified, one point of difference is that many other existing frameworks are primarily from literature reviews and anecdotal insights rather than systematic expert consensus-building. By contrast, the SAIL framework leveraged a Delphi study to consolidate expert perspectives on AI competencies, ensuring that the proposed layers - from "Understand and Explore AI" through to "Transform and Develop AI (Beyond AI Literacy)" - reflect a robust, iterative consensus (Laupichler et al., 2023). Although the Delphi approach itself has rarely been used in AI literacy research, studies employing it show that it can better capture a wide range of expert inputs, minimise bias, and clarify the rationale behind the learning design (e.g., Townsend et al., 2016).

Unlike some frameworks that create distinct "tracks" for teachers and students or focus on either technical competence or ethical considerations, risking a fragmented approach (Mott et al., 2023; Biagini et al., 2024), the SAIL framework consolidates these strands to emphasise scaffolded progression for all roles, thereby addressing core cognitive, applied, and ethical dimensions of AI literacy in one coherent structure. In doing so, it aims to mitigate the complexity that can arise when separate, disjointed guidelines must be reconciled (Miao & Shiohira, 2024). This coherence, coupled with a tiered design, offers a potentially more accessible and equitable pathway for diverse learners to become AI-literate. The SAIL framework, in particular, through its inclusion of Indigenous voice, aims to acknowledge the cultural and Indigenous impact of using AI and emphasises the importance of equity for everyone.

We see this inclusion of Indigenous voice as a distinctive contribution of this study. While the framework is not intended to function as an Indigenous-specific framework, the inclusion of Indigenous experts ensures that considerations of Indigenous knowledge, values, sovereignty, and equity are embedded within the broader consensus. This positions the

SAIL Framework as one of the few AI literacy models that explicitly incorporates Indigenous voices as part of mainstream AI literacy development rather than treating them as separate or peripheral concerns.

The SAIL framework provides educators with a practical tool for integrating AI literacy into curricula. Its scaffolded design ensures accessibility for learners with varying levels of prior experience. 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 apply AI tools responsibly and effectively in various contexts. It also seeks to democratise access to AI in education, ensuring that all learners, regardless of background, can 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.

## 7.2 Limitations of this study

Although the Delphi-based approach provided systematic, iterative input from a panel of recognised experts, there are inherent tensions and limitations in this design. Delphi studies are strong in promoting open debate and leveraging expert input. However, they also include participants who are, to some extent, both selected and self-selecting, so they may not be truly representative. Also, as AI is an evolving and wide field, the role of an expert in AI is contentious. Therefore, while we have tried to draw expertise from both professional and academic contexts, it is acknowledged that the experts in this study may have different perspectives from other experts. In addition, the size ( $n=17$ ) and composition of the expert group can limit generalisability. While industry experts were included, their proportion was relatively low compared to educators, which may constrain the ability to fully capture sectoral and workforce needs. Similarly, although participants came from several countries, the absence of experts from across different sectors, such as Asian contexts, is a limitation, given the distinctive emphasis on teaching and examination-oriented approaches to AI literacy as a universal concept. While Delphi studies are known for enabling in-depth consensus among specialists (Beiderbeck et al., 2021), these factors mean that the relatively small and geographically skewed panel in this study may not fully reflect the heterogeneity of international contexts. A larger and more globally representative panel, with stronger industry and international and Asia-Pacific participation, may have produced different outcomes. However, as we have already noted, the selective focus also has its strengths, particularly in grounding Indigenous perspectives and ensuring the framework's educational relevance, which we do not view as a key weakness of the design.

Another limitation of the study is that at each point of the Delphi process, various compromises must be made between the large volume and range of expert suggestions and the need for the researchers to blend and summarise material so that it can be presented coherently for the next round of expert input. It is possible that in this process, important ideas may be lost. Seeking to be both concise and widely applicable means that certain nuances or domain-specific competencies may be "flattened" or subsumed under broader categories. While the high-level structure helps ensure accessibility, it may not fully capture specialised needs, such as data-intensive skills required by advanced computing students or more granular ethical concerns that vary across cultures (Pretorius & de Caux, 2024).

A further tension involves the boundary between AI literacy and AI fluency (Laupichler et al., 2023). Levels 1, 2, and 3 target a broad audience, but “Beyond AI Literacy” ventures into expert territory, raising questions about how best to delineate what “everyone should know” versus what “specialists need.” This can lead to ambiguity in the extent to which general expertise coexists and crosses over to specialisation.

Finally, rapid evolutions in AI mean that any fixed framework risks partial obsolescence if it is not updated regularly (Allen & Kendeou, 2024). While the iterative Delphi process captured expert consensus at a point in time, new technological breakthroughs, such as emerging generative AI models, could demand ongoing revisions. Consequently, maintaining the currency of each competency level is an enduring challenge, underscoring the need for future revalidation or additional Delphi rounds (Ng et al., 2023).

### 7.3 Future work

Now that the initial version of the framework has been developed, the focus of work has moved on to creating teaching materials that can be used at different levels of the framework. In this task, we are maintaining a focus on equity in terms of issues such as the choice of AI tools for classroom activities, suggesting accessible tools with acceptable privacy policies, and ensuring that there are appropriate activities for students to explore social, ethical, and cultural issues, with opportunities to engage in practical activities to raise awareness about equity and strategies to address it when using AI. It is also important that we co-create these resources with diverse participants, including communities from the Indigenous and neurodiverse sectors. Finally, we also see that ongoing refinement of the framework may be necessary to reflect newly emerging literacies. Regularly reviewing the framework while applying it across a range of learning contexts will ensure that it meets its aim of providing access to AI literacy across the field of education.

AI literacy is a rapidly evolving field, and new frameworks continue to emerge. The brief review included in the introduction was not intended to systematically examine the broader landscape of AI literacy frameworks. Rather, its purpose was to contextualise the study and to illustrate how our focus - using a Delphi method and adopting a scaffolded, developmental framing - was distinctive at the time the Delphi was conducted. As the field continues to expand, additional frameworks will undoubtedly be developed, many of which may offer complementary perspectives to the SAIL Framework. A valuable direction for future work will be to examine how these emerging frameworks align with, extend, or diverge from our consensus-based model, and to consider opportunities for integrating insights across these approaches.

### Ethics statement

The study was approved by the academyEX ethics panel on March 30th 2023, for a period of three years, with ID: aex.staff.2023.02. Informed consent was obtained from all participants, and their privacy rights were strictly observed.

### Open data statement

Under the requirements of ethical approval, data cannot be publicly shared to protect the anonymity of the participants.

## Conflict of Interest statement

There is no potential conflict of interest in this study.

## References

- Allen, L. K., & Kendeou, P. (2024). ED-AI Lit: An Interdisciplinary framework for AI literacy in education. *Policy Insights from the Behavioral and Brain Sciences*, 11(1), 3-10. <https://doi.org/10.1177/23727322231220339>
- Baker, R.S., & Hawn, A. (2022). Algorithmic Bias in Education. *International Journal of Artificial Intelligence in Education* 32, 1052–1092. <https://doi.org/10.1007/s40593-021-00285-9>
- Bansal, N., & Choudhary, H. (2024). Fostering digital equity: evaluating impact of digital literacy training on internet outcomes in rural marginalised communities in India. *International Journal of Lifelong Education*, 43(5), 473–493. <https://doi.org/10.1080/02601370.2024.2347327>
- Barrett, D., & Heale, R. (2020). What are Delphi studies? *Evidence-based nursing*, 23(3), 68-69. <https://doi.org/10.1136/ebnurs-2020-103303>
- Barrowcliffe, R., Hutchinson, B., Abdilla, A., Acres, L., Beetson, B., Bell, A., Benton, P., Bligh, B., Bowen, R., Burton, N., Carlson, B., Cawthorne, R., Cook, B., Farrell, A., Fay, D., Fejo, J., Fewster, J., Gray, N., Hackman, D., ... Wright, S. (2025). Envisioning Aboriginal and Torres Strait Islander AI Futures Communique: March 2025. *Journal of Global Indigeneity*, 9(1). <https://doi.org/10.54760/001c.133656>
- Beiderbeck, D., Frevel, N., von der Gracht, H., Schmidt, S., & Schweitzer, V. (2021). Preparing, conducting, and analyzing Delphi surveys: Cross-disciplinary practices, new directions, and advancements. *Methods X*, 8(101401). <https://doi.org/10.1016/j.mex.2021.101401>
- Belland, B.R. (2017). *Instructional Scaffolding in STEM Education : Strategies and Efficacy Evidence*. Springer. <https://doi.org/10.1007/978-3-319-02565-0>
- Biagini, G., Cuomo, S., & Ranieri, M. (2024). Assessing AI Literacy: a framework-based approach. In *Proceedings of the Italian Symposium on Digital Education 2024 "Teaching & Learning. Inclusion and Wellbeing for the Data Society"*. <https://www.researchgate.net/publication/384625476>
- Blackburn, B.R. (2024). *Scaffolding for Success: Helping Learners Meet Rigorous Expectations Across the Curriculum*. Routledge. <https://doi.org/10.4324/9781003506560>
- Boateng, O., & Boateng, B. (2025). Algorithmic bias in educational systems: Examining the impact of AI-driven decision making in modern education. *World Journal of Advanced Research and Reviews*, 25(1). <https://doi.org/10.30574/wjarr.2025.25.1.0253>

- Burgsteiner, H., Kandlhofer, M., & Steinbauer, G. (2016). IRobot: Teaching the Basics of Artificial Intelligence in High Schools. *Proceedings of the AAAI Conference on Artificial Intelligence*, 30(1). <https://doi.org/10.1609/aaai.v30i1.9864>
- Campanozzi, L. L., Gibelli, F., Bailo, P., Nittari, G., Sirignano, A., & Ricci, G. (2023). The role of digital literacy in achieving health equity in the third millennium society: A literature review. *Frontiers in Public Health*, 11, 1109323. <https://doi.org/10.3389/fpubh.2023.1109323>
- Cao, H. J., Choi, K., Park, C., & Lee, H. R. (2025, April). AI Literacy for Underserved Students: Leveraging Cultural Capital from Underserved Communities for AI Education Research. In *Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems* (pp. 1-15). <https://doi.org/10.1145/3706598.3713173>
- Chinta, S. V., Wang, Z., Yin, Z., Hoang, N., Gonzalez, M., Quy, T. L., & Zhang, W. (2024). FairAIED: Navigating Fairness, Bias, and Ethics in Educational AI Applications. *ArXiv*. <https://arxiv.org/abs/2407.18745>
- Chiu, T. K., Ahmad, Z., Ismailov, M., & Sanusi, I. T. (2024). What are artificial intelligence literacy and competency? A comprehensive framework to support them. *Computers and Education Open*, 6, 100171. <https://doi.org/10.1016/j.caeo.2024.100171>
- Cui, V., & Wheatcroft, L. (2021). *AI Literacy – the role of primary education*. Birmingham City University. <https://www.bcu.ac.uk/education-and-social-work/research/news-and-events/cspace-conference-2021/blog/ai-literacy-the-role-primary-education>
- Ertl, B., & Helling, K. (2011). Promoting gender equality in digital literacy. *Journal of educational computing research*, 45(4), 477-503. <https://psycnet.apa.org/doi/10.2190/EC.45.4.f>
- Fadel, C., Taylor, R., & Black, A. (2024). *Interdisciplinary Themes: Embedding Contemporary Contexts within Content*. Center for Curriculum Redesign. <https://curriculumredesign.org/wp-content/uploads/Interdisciplinary-Themes.pdf>
- Faruqe, F., Watkins, R., & Medsker, L. (2022). Competency Model Approach to AI Literacy: Research-Based Path From Initial Framework to Model. *Advances in Artificial Intelligence and Machine Learning*, 02(04), 580–587. <https://doi.org/10.54364/AAIML.2022.1140>
- Fathullah, M. A., Subbarao, A., & Muthaiyah, S. (2023). Methodological Investigation: Traditional and Systematic Reviews as Preliminary Findings for Delphi Technique. *International Journal of Qualitative Methods*, 22. <https://doi.org/10.1177/16094069231190747>
- Fulkerson, D., Ariew, S., Jacobson, T., & University of South Florida, Sarasota. (2017). Revisiting Metacognition and Metaliteracy in the ACRL Framework. *CommInfoLit*, 11(1), 21. <https://doi.org/10.15760/comminfolit.2017.11.1.45>
- Furtado, L., Coelho, F., Pina, S., Ganito, C., Araújo, B., & Ferrito, C. (2024). Delphi Technique on Nursing Competence Studies: A Scoping Review. *Healthcare*, 12(17), 1757. <https://doi.org/10.3390/healthcare12171757>

- Green, R. A. (2014). The Delphi Technique in Educational Research. *Sage Open*, 4(2). <https://doi.org/10.1177/2158244014529773>
- Helmer, O. (1972). Analysis of the future: The Delphi method. In K. McGovern & P. Browning (Eds.), *Mental Retardation and the Future*. Rehabilitation Research and Training Center in Mental Retardation Monograph No. 5. University of Oregon.
- Hollands, F. M., DiPaola, D., Breazeal, C., & Ali, S. (2024, December). AI Mastery May Not Be For Everyone, But AI Literacy Should Be. In Proceedings of the 2024 ACM Virtual Global Computing Education Conference V.1 (pp. 60-66). <https://doi.org/10.1145/3649165.3690117>
- Hsu, C. & Sandford, B. A., (2007). The Delphi Technique: Making Sense of Consensus. *Practical Assessment, Research, and Evaluation* 12(1), 10. <https://doi.org/10.7275/pdz9-th90>
- Kandlhofer, M., Steinbauer, G., Hirschmugl-Gaisch, S., & Huber, P. (2016). Artificial intelligence and computer science in education: From kindergarten to university | IEEE Conference Publication | IEEE Xplore. IEEE Frontiers in Education Conference. <https://ieeexplore.ieee.org/abstract/document/7757570>
- Khan, M.S., Umer, H. & Faruqe, F. (2024), Artificial intelligence for low income countries. *Humanities and Social Sciences Communications* 11(1422). <https://doi.org/10.1057/s41599-024-03947-w>
- Kim, S., Jang, Y., Kim, W., Choi, S., Jung, H., Kim, S., & Kim, H. (2021). Why and What to Teach: AI Curriculum for Elementary School. Proceedings of the AAAI Conference on Artificial Intelligence, 35(17), Article 17. <https://doi.org/10.1609/aaai.v35i17.17833>
- Kitsara, I. (2022). Artificial Intelligence and the Digital Divide: From an Innovation Perspective. In A. Bounfour (Ed.), *Platforms and Artificial Intelligence: The Next Generation of Competences* (pp. 245-265). Springer. [https://doi.org/10.1007/978-3-030-90192-9\\_12](https://doi.org/10.1007/978-3-030-90192-9_12)
- Kong, S. C., Cheung, M. Y. W., & Tsang, O. (2024). Developing an artificial intelligence literacy framework: Evaluation of a literacy course for senior secondary students using a project-based learning approach. *Computers and Education: Artificial Intelligence*, 6, 100214. <https://doi.org/10.1016/j.caeai.2024.100214>
- Konishi, Y. (2016, January). What is Needed for AI Literacy?. Research Institute of Economy, Trade and Industry. [https://www.rieti.go.jp/en/columns/s16\\_0014.htm](https://www.rieti.go.jp/en/columns/s16_0014.htm)
- Kukutai, T., & Taylor, J. (2016). Data sovereignty for indigenous peoples: current practice and future needs. In *Indigenous data sovereignty: Toward an agenda*. ANU Press. 1-22. <https://library.oapen.org/bitstream/handle/20.500.12657/31875/624262.pdf>
- Laupichler, M. C., Aster, A., & Raupach, T. (2023). Delphi study for the development and preliminary validation of an item set for the assessment of non-experts' AI literacy. *Computers and Education: Artificial Intelligence*, 4, 100126. <https://doi.org/10.1016/j.caeai.2023.100126>

- Long, D., & Magerko, B. (2020, April). What is AI literacy? Competencies and design considerations. In *Proceedings of the 2020 CHI conference on human factors in computing systems* (pp. 1-16). <https://doi.org/10.1145/3313831.3376727>
- Luo, W., He, H., Gao, M., & Li, H. (2024). Safety, Identity, Attitude, Cognition, and Capability: The 'SIACC' Framework of Early Childhood AI Literacy. *Education Sciences*, 14(8), 871. <https://doi.org/10.3390/educsci14080871>
- MacCallum, K., Parsons, D., & Mohaghegh, M. (2024). The Scaffolded AI Literacy (SAIL) Framework for Education: Preparing learners at all levels to engage constructively with Artificial Intelligence. *He Rourou*, 1(1), 23. <https://doi.org/10.54474/herourou.v1i1.10835>
- Maitra, S. (2020, February). Artificial intelligence and indigenous perspectives: Protecting and empowering intelligent human beings. In *Proceedings of the AAAI/ACM Conference on AI, Ethics, and Society* (pp. 320-326). <https://doi.org/10.1145/3375627.3375845>
- Miao, F., & Cukurova, M. (2024). AI competency framework for teachers. *UNESCO*. <https://doi.org/10.54675/ZJTE2084>
- Miao, F., & Shiohira, K.. (2024). AI competency framework for students. *UNESCO*. <https://doi.org/10.54675/JKJB9835>
- Mills, K., Ruiz, P., Lee, K., Coenraad, M., Fusco, J., Roschelle, J. & Weisgrau, J. (2024, May). *AI Literacy: A Framework to Understand, Evaluate, and Use Emerging Technology*. <https://doi.org/10.51388/20.500.12265/218>
- Mott, B., Gupta, A., Glazewski, K., Ottenbreit-Leftwich, A., Hmelo-Silver, C., Scribner, A., Lee, S., & Lester, J. (2023, June). Fostering Upper Elementary AI Education: Iteratively Refining a Use-Modify-Create Scaffolding Progression for AI Planning. In *Proceedings of the 2023 Conference on Innovation and Technology in Computer Science Education* (Vol. 2, p. 647). <https://doi.org/10.1145/3587103.3594170>
- Ng, D. T. K., Leung, J. K. L., Chu, S. K. W., & Qiao, M. S. (2021). Conceptualizing AI literacy: An exploratory review. *Computers and Education: Artificial Intelligence*, 2, 100041. <https://doi.org/10.1016/j.caeai.2021.100041>
- Ng, D. T. K., Wu, W., Leung, J. K. L., Chiu, T. K. F., & Chu, S. K. W. (2024). Design and validation of the AI literacy questionnaire: The affective, behavioural, cognitive and ethical approach. *British Journal of Educational Technology*, 55(3), 1082-1104. <https://doi.org/10.1111/bjet.13411>
- Oguamanam, C. (2020). Indigenous peoples, data sovereignty, and self-determination: Current realities and imperatives. *The African Journal of Information and Communication*, 26, 1-20. <https://doi.org/10.23962/10539/30360>
- Okoli, C., & Pawlowski, S. D. (2004). The Delphi method as a research tool: an example, design considerations and applications. *Information & Management*, 42(1), 15–29. <https://doi.org/10.1016/j.im.2003.11.002>

Olari, V., & Romeike, R. (2021). Addressing AI and Data Literacy in Teacher Education: A Review of Existing Educational Frameworks. *The 16th Workshop in Primary and Secondary Computing Education*, 1–2. <https://doi.org/10.1145/3481312.3481351>

Pelletier, A. J. (1972). *The Delphi technique: a review of the literature* (Master's thesis). Kansas State University.

Pretorius, L., & Cahusac de Caux, B. (2024). *The AI Literacy Framework for Higher Education: A Grounded Theory Exploration of the Foundational, Social, Conceptual, Ethical, and Affective Domains of AI Literacy*. Monash University Repository. <https://doi.org/10.26180/25965178.v4>

Rogers, T., Smythe, S., Darvin, R., & Anderson, J. (2018). Introduction to Equity and Digital Literacies: Access, Ethics, and Engagements. *Language and Literacy*, 20(3), 1-8. <https://doi.org/10.20360/langandlit29405>

Rourke, D. (1971). Experimental Assessment of Delphi Procedures with Group Value Judgments. *Advanced Research Projects Agency*.

Su, J., & Yang, W. (2024). Artificial intelligence and robotics for young children: Redeveloping the five big ideas framework. *ECNU Review of Education*, 7(3), 685-698. <https://doi.org/10.1177/20965311231218013>

Talagala, N. (2021, April 4). The Four Cs of AI Literacy: Building the Workforce of the Future. *Forbes*. <https://www.forbes.com/sites/nishatalagala/2021/04/04/the-four-cs-of-ai-literacy-building-the-workforce-of-the-future/>

Tenório, K., & Romeike, R. (2023, November). AI Competencies for non-computer science students in undergraduate education: Towards a competency framework. In *Proceedings of the 23rd Koli Calling International Conference on Computing Education Research* (pp. 1-12). <https://doi.org/10.1145/3631802.3631829>

Townsend, L., Hofer, A. R., Lin Hanick, S., & Brunetti, K. (2016). Identifying threshold concepts for information literacy: A Delphi study. *Communications in Information Literacy*, 10(1), 23-49.

Touretzky, D., Gardner-McCune, C., & Seehorn, D. (2023). Machine learning and the five big ideas in AI. *International Journal of Artificial Intelligence in Education*, 33(2), 233-266. <https://doi.org/10.1007/s40593-022-00314-1>

van Deursen, A. J. A. M., & van Dijk, J. A. G. M. (2014). The Digital Divide Shifts to Differences in Usage. *New Media & Society*, 16(3), 507–526. <https://doi.org/10.1177/1461444813487959>

Vazhayil, A., Shetty, R., Bhavani, R. R., & Akshay, N. (2019). Focusing on Teacher Education to Introduce AI in Schools: Perspectives and Illustrative Findings. 2019 IEEE Tenth International Conference on Technology for Education (T4E), 71–77. <https://doi.org/10.1109/T4E.2019.00021>

Verenikina, I. (2008). Scaffolding and learning: its role in nurturing new learners, in Kell, P, Vialle, W, Konza, D and Vogl, G (eds), *Learning and the learner: exploring learning for new times*. University of Wollongong.

## Appendix A: The SAIL Framework

### AI Literacy Level 1 - Understand and Explore AI

Acquiring fundamental concepts, skills, knowledge and attitudes that require no prior experience. The focus is on supporting learners in understanding the technologies underneath AI systems to be competent end users. AI is addressed in a general sense and its adoption is explored across different contexts to provide a broad understanding.

#### Concepts

##### The Impacts of AI

1. People, Organisations, and AI
  - Recognise critical issues in the relationship between people and AI (bias, hallucinations, uncritical use).
2. Engagement with AI
  - Identify how people are using AI in daily life; give examples of sector impacts.
3. AI as a Technology
  - Explain basic concepts of AI and distinguish AI from other technologies.
4. AI in Context
  - Give examples of how AI has impacted different sectors.
5. Indigenous Perspectives on AI
  - Recognise Indigenous knowledge, worldviews and values in relation to technology.

##### What AI Is and How It Works

6. AI Terms and Features
  - Define and recognise common AI terms and features.
7. Types of AI
  - Identify what is, and is not, AI; describe basic categories (rule-based vs. machine learning, generative vs. discriminative).
8. AI and Data
  - Explain the role of data in AI systems, using simple examples.

### Application of AI and Technical Skills

#### Cognitive Skills

9. Understanding AI in Use
  - Identify features of AI and describe their applications and interactions
10. Critical Application of AI
  - Recognise situations where using AI may or may not be appropriate.
11. AI Transparency
  - Demonstrate awareness of AI inaccuracies and simple checking strategies.
12. Associated Literacies and Learning

- Integrate AI literacy into broader digital literacies, considering how equity issues in AI literacy can be supported (recognising differences in access to technology, skills, and learning opportunities).

### 13. AI in Research

- Apply and evaluate how AI can support simple research practices (such as literature reviews).

## Applied Skills

### 14. Selecting and Applying AI

- Select and apply simple AI tools for specific tasks.

### 15. Goal-based AI Application and Development

- Apply AI tools to achieve personal, learning, or work goals.

### 16. Using and Creating AI Tools

- Use AI tools to support simple tasks and reflect on their outputs

### 17. AI in Projects

- Recognise examples of AI projects and their purposes.

### 18. AI Technologies

- Recognise different AI technologies (ML, NLP, CV, etc.).

### 19. Data in AI Applications

- Recognise that AI systems depend on data and identify examples of data used in everyday AI applications.

## AI Digital Citizenship

### Social, Cultural, and Ethical Issues

#### 20. AI and Society

- Recognise potential benefits and challenges of AI in society.

#### 21. Ethical Issues in AI

- Identify common ethical concerns in AI (e.g., bias, fairness, and transparency).

#### 22. AI and Culture

- Explain AI's relationship with culture and values.

#### 23. AI Bias

- Explain how bias occurs in AI systems.

#### 24. AI Policy

- Recognise that AI requires governance and oversight.

#### 25. AI and Equity

- Recognise that AI can create unequal impacts for different groups.

## Risks and Mitigations

### 26. Risks of AI Systems

- Identify risks presented by AI systems (e.g., privacy, security, fraud, misuse).

### 27. Mitigating the Risks of AI

- Recognise and describe simple ways to mitigate risks presented by AI systems (e.g., safe passwords, privacy settings).

### 28. Safe and Responsible Use of AI

- Demonstrate responsible behaviours when using AI tools, recognising potential misuse.

### 29. AI and Cultural Diversity

- Discuss the impact of AI on cultural diversity and identify risks of cultural bias.

## AI Literacy Level 2 - Apply and Integrate AI

Addressing technical aspects of AI, such as the design of logic and algorithms, and understanding how to use knowledge bases for problem-solving, processing semantics, and handling data. The focus is on specific contexts that can be explored in detail with hands-on use of AI productivity tools to build applications.

### Concepts

#### The Impacts of AI

1. People, Organisations, and AI
  - Discuss how AI systems address the needs of people and organisations.
2. Engagement with AI
  - Discuss the opportunities and risks of AI adoption in specific contexts and how access to AI technologies impacts participation in education, work, and civic life.
3. AI as a Technology
  - Understand how algorithms work and how they are used in AI tools and applications.
4. AI in Context
  - Demonstrate an understanding of AI's role in a specific situation.
5. Indigenous Perspectives on AI
  - Describe how AI can support Indigenous aspirations in education, health, and cultural preservation.

#### What AI Is and How It Works

6. AI Terms and Features
  - Apply terms to explain how AI models are trained, including steps such as input, training, and outputs.
7. Types of AI
  - Compare the main features of different AI approaches.
8. AI and Data
  - Identify and discuss different data sources, including issues of quality, bias, and representativeness.

### Application of AI and Technical Skills

#### Cognitive Skills

9. AI in Use
  - Explain how AI influences tasks, work, and systems.
10. Critical Application of AI
  - Discuss how AI can support decision-making and problem-solving.
11. AI Transparency
  - Discuss transparency and explainability in AI, and why they matter.
12. Associated Literacies and Learning
  - Demonstrate computational thinking skills relevant to AI.
13. AI in Research
  - Explore and discuss AI research outputs and implications.

**Applied Skills**

14. Selecting and Applying AI
  - Determine which AI methods/tools best fit different problems or contexts.
15. Goal-based AI Application and Development
  - Apply AI tools across different fields of study or disciplines and create simple AI applications that promote equitable outcomes.
16. Using and Creating AI Tools
  - Use, adapt and/or combine AI tools to create basic applications.
17. AI in Projects
  - Contribute to simple AI projects using basic tools or datasets.
18. AI Technologies
  - Explain core machine learning approaches and their applications.
19. Data in AI Applications
  - Explain how datasets (including training and testing sets) are used and transformed to create AI models.

**AI Digital Citizenship****Social, Cultural, and Ethical Issues**

20. AI and Society
  - Explore the impact of AI on societal norms, work, creativity, and participation.
21. Ethical Issues in AI
  - Provide examples of ethical issues across AI use cases.
22. AI and Culture
  - Explore the impact of AI on Indigenous and disadvantaged groups.
23. AI Bias
  - Evaluate how data quality and sources shape bias in models.
24. AI Policy
  - Describe examples of AI policies/regulations in practice.
25. AI and Equity
  - Explore how AI access and use vary across socio-economic, cultural, and geographic contexts.

**Risks and Mitigations**

26. Risks of AI Systems
  - Assess risks related to data use in AI, including accuracy, relevance, storage, and potential misuse.
27. Mitigating the Risks of AI
  - Apply strategies to protect personal rights and privacy when interacting with AI (e.g., consent, data-sharing policies).
28. Safe and Responsible Use of AI
  - Apply ethical frameworks to evaluate AI's impact on individuals and society, considering fairness and justice.
29. AI and Cultural Diversity
  - Recognise how AI can affect minority cultures and apply principles of Indigenous data sovereignty.

## AI Literacy Level 3 - Evaluate and Create AI

Engaging in higher-order thinking activities and starting to develop AI applications through scaffolded tools. The focus is on critically evaluating AI technologies and exploring how design decisions influence the functions and impacts of these systems.

### Concepts

#### The Impacts of AI

1. People, Organisations, and AI
  - Discuss the role of people and organisations in the development and deployment of AI.
2. Engagement with AI
  - Evaluate current and potential uses/harms across disciplines; Analyse how global inequities shape who builds AI and who bears the risks.
3. AI as a Technology
  - Evaluate AI models, including fairness across populations; create design principles for AI in context.
4. AI in Context
  - Demonstrate an understanding of the role of AI across interdisciplinary fields.
5. Indigenous Perspectives on AI
  - Critically evaluate AI systems for alignment with Indigenous data sovereignty

#### What AI Is and How It Works

6. AI Terms and Features
  - Evaluate how deep learning and other architectures shape model capabilities and limitations.
7. Types of AI
  - Evaluate the strengths, limitations, and application contexts of different AI systems.
8. AI and Data
  - Evaluate how AI systems address problems, how their algorithms are developed, and how they learn patterns from large datasets.

### Application of AI and Technical Skills

#### Cognitive Skills

9. AI in Use
  - Evaluate how AI adoption may impact workers differently across industries, focusing on the benefits and mitigating limitations, supporting equity and redistribution of benefits.
10. Critical Application of AI
  - Evaluate the suitability and usefulness of AI technologies for tasks.
11. AI Transparency
  - Evaluate approaches to enhance transparency, explainability, and accountability in AI.
12. Associated Literacies and Learning
  - Demonstrate data literacy, including privacy, management, and governance.
13. AI in Research

- Learn and apply new AI concepts, tools, and techniques independently.

### **Applied Skills**

14. Selecting and Applying AI
  - Evaluate and implement creative approaches to AI applications across contexts.
15. Goal-based AI Application and Development
  - Develop AI projects using scripts, tools, and libraries.
16. Using and Creating AI Tools
  - Apply the steps in AI model development (training, testing, validation, deployment).
17. AI in Projects
  - Assess how human-centred design principles shape AI projects.
18. AI Technologies
  - Evaluate how algorithms and data underpin approaches to AI, and their suitability.
19. Data in AI Applications
  - Process and manage data for AI applications using appropriate tools (e.g., cleaning, preparation, validation).

## **AI Digital Citizenship**

### **Social, Cultural, and Ethical Issues**

20. AI and Society
  - Critically analyse approaches to mitigate societal/ethical risks.
21. Ethical Issues in AI
  - Evaluate ethical challenges in AI design and implementation.
22. AI and Culture
  - Analyse how AI design decisions may reinforce or disrupt structural inequities (e.g., racism, sexism, class bias).
23. AI Bias
  - Analyse the impacts of bias and propose strategies for diverse datasets.
24. AI Policy
  - Discuss the impact of AI on governance and policy, utilising a principles-based approach
25. AI and Equity
  - Critically evaluate AI systems for equity, fairness, and accessibility.

### **Risks and Mitigations**

26. Risks of AI Systems
  - Evaluate current risks of AI implementation, including human–AI interaction, intellectual property, and societal impacts.
27. Mitigating the Risks of AI
  - Implement strategies to enhance safety, security, and reliability of AI systems, ensuring ethical data collection and management.
28. Safe and Responsible Use of AI
  - Use a critical mindset to question assumptions and limitations of AI tools.
29. AI and Cultural Diversity
  - Advocate for inclusive AI applications by addressing diverse user needs and avoiding discriminatory impacts.

## Level AI++ - Transform and Develop AI (Beyond AI Literacy)

This last layer signals the move between AI literacy and expertise expected at an advanced level. This level focuses more on those specialising in AI. It requires a more in-depth understanding of AI, starting to develop and train AI systems.

### Concepts

#### The Impacts of AI

1. People, Organisations, and AI
  - Design and implement AI strategies to lead ethical governance and contribute to shaping AI policy/standards.
2. Engagement with AI
  - Explore implications of future AI technologies and state-of-the-art developments.
3. AI as a Technology
  - Analyse the impact of advanced computing concepts and future technical directions.
4. AI in Context
  - Demonstrate an understanding of the state-of-the-art in AI and its future directions, addressing the benefits and potential risks.
5. Indigenous Perspectives on AI
  - Co-develop AI initiatives in partnership with Indigenous communities, embedding relevant cultural principles in governance and design.

#### What AI Is and How It Works

6. AI Terms and Features
  - Demonstrate mastery of advanced AI concepts and apply them to novel or domain-specific systems.
7. Types of AI
  - Design or adapt AI solutions that leverage appropriate system types for specific domains or problems.
8. AI and Data
  - Apply advanced data practices (e.g., exploration, cleaning, feature extraction, model testing/validation) in the development or adaptation of AI systems.

### Application of AI and Technical Skills

#### Cognitive Skills

9. AI in Use
  - Design and evaluate end-to-end AI processes (from data to lifecycle management).
10. Critical Application of AI
  - Explore and critique emerging research directions in AI.
11. AI Transparency
  - Apply ethical considerations such as transparency, explainability, and fairness to AI practice/governance
12. Associated Literacies and Learning
  - Sustain continual learning in ethical, societal, and technological aspects of AI.
13. AI in Research

- Contribute to AI research through exploration, hypothesis generation, and scholarly engagement, ensuring knowledge creation respects cultural values.

### **Applied Skills**

#### 14. Selecting and Applying AI

- Design and deliver AI projects with measurable outcomes, analysing and reporting findings.

#### 15. Goal-based AI Application and Development

- Build real-world AI applications leveraging advanced programming and AI techniques.

#### 16. Using and Creating AI Tools

- Design, implement, fine-tune, and troubleshoot advanced AI models using frameworks.

#### 17. AI in Projects

- Manage and lead AI projects, collaborating with teams and applying coding/software expertise.

#### 18. AI Technologies

- Apply AI frameworks and principles to complex problem-solving.

#### 19. Data in AI Applications

- Design and implement data pipelines, including integration, feature engineering, and optimisation for AI systems.

## **AI Digital Citizenship**

### **Social, Cultural, and Ethical Issues**

#### 20. AI and Society

- Anticipate future AI directions and propose socially-conscious guidelines.

#### 21. Ethical Issues in AI

- Apply and test principles-based frameworks in practice.

#### 22. AI and Culture

- Lead inclusive AI development that respects cultural values.

#### 23. AI Bias

- Demonstrate and critique deliberate bias to raise ethical awareness.

#### 24. AI Policy

- Contribute to the development of policies and guidelines on the ethical and safe use of AI

#### 25. AI and Equity

- Lead AI initiatives that promote equity, social justice, and inclusive design.

### **Risks and Mitigations**

#### 26. Risks of AI Systems

- Anticipate and analyse future risks of AI (e.g., advanced cybersecurity threats, malicious use), balancing benefits against potential harms.

#### 27. Mitigating the Risks of AI

- Design and embed safeguards into AI systems to mitigate psychological, societal, and security risks across diverse contexts.

#### 28. Safe and Responsible Use of AI

- Demonstrate a safety-first, equitable and accessible approach in AI development, taking responsibility for system impacts and long-term consequences.

29. AI and Cultural Diversity

- Lead the design and implementation of inclusive AI systems that respect cultural diversity and social justice.

Journal Pre-proof

**Declaration of interests**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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