Learnovate

Artificial Intelligence, Planning and Preparation for Learning and Teaching in Primary and Special Schools

Dr Bilal Ahmad
Technology Lead
Helena Ledermann
K12 Pedagogy Researcher

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

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1. Executive Summary

The purpose of this report is to synthesise research drawn from both academic and grey literature on the application of artificial intelligence in curriculum development for primary schools, with a particular focus on preparation and planning. This synthesis aims to inform policy and practice and guide responsible implementation by examining legislations and frameworks, AI-based tools, illustrative case studies, and ethical alignment.

A critical theme emerged from analysis of the frameworks is the challenge of implementation in diverse school contexts like primary, bilingual and special education needs (Department of Education and Youth (DEY), 2025; Olurinola, 2025). AI-based tools for curriculum development are broadly classified into three categories: Instructional, Analytical and Administrative, with the former appearing to be the most widely available (Kwid et al., 2024). The evolution in teacher practices is not driven by such tools alone, but is shaped by agency, professional development and meaningful adoption (Blundell, Mukherjee, & Nykvist, 2025; Walter, 2024). The essential skills for teachers for ethical integration include AI transparency and explainability, critical analysis of AI, and culturally responsive and inclusive pedagogy (Tagare et al., 2025).

However, translating legal and technical mandates into the classroom remains difficult for teachers where guidance is generic, resources are uneven and limited professional development (DEY, 2025; pp.17-21, 24; Olurinola, 2025; Yim, 2024). In addition, the developing landscape of AI-based tools is a positive first step towards curriculum development and efficiency and reduction of workload, yet it should not be considered a replacement of teachers' expertise (Elkordy & McVey, 2025; Lusi et al., 2025; Nattawuttisit et al., 2025; Zagkotas, 2025). Initial evaluations have started to report time saving of up to 80% (Raskob et al., 2025) and opportunities for inclusion in classrooms. Furthermore, the synergy of AI with gamification is also reported to have the potential to enhance motivation, engagement and learning outcomes in students (Alenezi, 2023). Conversely, the reported ethical alignment of AI-based tools appears to be low, and their application to Irish language has not yet extended. Also, the studies on special purpose AI-based tools and evaluation

with primary school teachers in Ireland in this context appear to be scarce. This implies that AI in primary schools require context-sensitive frameworks for easier implementation, balanced development across tool types, professional development as a cornerstone of adoption and the embedding of ethical literacy throughout practice. Based on these implications, a few takeaways are outlined below:

- **Adapt frameworks to the context of schools:** This involves ensuring that the AI-tools align with curriculum principles, local contexts and specific needs of the students in primary schools.

- **Increase investment in under-represented AI tools (with a focus on Irish language):** Along with Instruction based tools, attention needs to be paid towards developing Analytical and Administrative special purpose AI-based tools for curriculum development harnessing innovative features like gamification. Moreover, from the perspective of Ireland, incorporating Irish language support in AI-based tools can help alleviate the risk of cultural preservation.

- **Use targeted models and frameworks:** It is suggested to use targeted models together with AI-based tools for maintaining pedagogical coherence and integrity of curriculum e.g. NextGen, ReKnow AI, TAG.

- **Evaluate ethical alignment of tools before adoption:** Utilise frameworks for evaluating ethical alignment of AI-based tools for curriculum development. Some recommended and tested frameworks are Independent Asynchronous Content Moderation Agent (IACMA) for safety, the Contextual Embedding Association Test (CEAT) for automated bias detection, and the Banks Four Levels of Integration of Multicultural Content model for evaluating Diversity, Equity and Inclusion in curriculum.

- **Prioritise professional development with embedded ethical competencies:** Policy and practice must prioritise teacher leadership, teacher agency, equity, and continuous learning, in order for AI to realise its potential in advancing inclusive, high-quality education, while safeguarding against fragmentation and unintended harm.

2. Introduction

Artificial intelligence (AI) is increasingly becoming an important part of modern education, particularly in curriculum development for primary and special school teachers. It offers promising solutions to support lesson planning, personalisation and pedagogical innovation. However, its adoption into everyday teaching practice raises critical questions around policy, effectiveness, real world impact and ethical alignment. This report explores this evolving role of AI in curriculum design and development with a particular focus on primary schools through answering the following research questions:

Key Research Question (RQ) - How is the use of AI impacting the evolution of primary and special school teachers' curriculum design practices, particularly preparation and planning for learning and teaching?

To answer this research question, we set out to explore the following four sub-research questions (SRQ).

SRQ1. What existing legislation, policy frameworks, and/or guidelines govern AI-based curriculum design in education, and how can these inform and support primary and special school teachers planning and practice?

Rationale : To highlight the key considerations required by government organisations when developing such applications.

SRQ2. What are some current open source and proprietary AI-based tools that support curriculum design for primary and special school teachers and what is their impact (positive or negative) on their teaching and learning practices?

Rationale : To review and classify the tools available and highlight what works best.

SRQ3. What are some success stories or case studies in the context of AI-supported preparation for learning and teaching for primary and special school teachers from which we can derive learnings and recommendations?

Rationale : To give a detailed outline of the key factors that can make such applications successful and impactful for teachers.

SRQ4. How is AI currently being used by primary and special school teachers in Ireland and internationally and to what extent does this align with ethical practices?

Rationale : To understand current AI applications broadly and identify their adoption of ethical guidelines, legislations and teachers adoption across Ireland and Europe.

Before answering these research questions, it is important to understand the context and existing landscape. The next section provides a background on current AI-based tools available for primary and special education, policy and legislative frameworks, motivations and the issue of long-term adoption of such tools.

3. Background

In Ireland, the education system is at a pivotal moment of digital transformation, where curriculum reform, teacher workload, and equitable access to high-quality learning are central priorities (Department of Enterprise, Tourism and Employment, 2024). Teachers face increasing demands in curriculum planning, differentiation, and adapting to diverse student needs, while also grappling with time constraints and resource challenges. In 2023, 90% of Irish primary school teachers (n=4,000) expressed that they are struggling with excessive workload (Irish National Teachers' Organisation (INTO) 2023). In this context, AI-powered tools have emerged as promising supports to enhance teachers' planning for learning and teaching, allowing for more efficient, tailored, and dynamic curriculum design. They can help reduce educational gaps and foster more inclusive classrooms.

AI has moved from being a specialist domain within computer science, over the past decade, to becoming a mainstream catalyst for transforming teaching, learning, and assessment practices (Zhai, X., et al. (2021). Educational systems globally face a defining challenge: How to embed AI ethically, pedagogically, and inclusively in both curriculum development and daily classroom practice? This challenge is particularly acute for teachers in primary and special education, where questions of technology adoption are inseparable from professional agency, digital equity, and the need to ensure learning continuity for all students (Yim, 2024; Yim & Su 2025).

Key legislative and policy frameworks governing AI-based curriculum design include the EU AI Act (2024) for risk-based regulation, the GDPR (2016) for data protection and child privacy, and the UNCRC (1989) for children's rights and agency. National policy guides such as Ireland's AI Guidelines for Schools (DEY, 2025) and the UK's Aila lesson planning assistant (Clark et al., 2025a), emphasise transparency, teacher oversight, and ethical alignment.

It is evident from the literature that AI can be beneficial for reducing teachers' workload, enabling innovative teaching methods and enhancing student outcomes (Ugras et al., 2024). One such example emerging from Ireland is a project named Diotima (Diotima, n.d.). Designed

to alleviate the cognitive load for teachers by creating tailored formative assessments and providing individualised feedback to learners, there are three pillars to the project:

1. Support for teaching practice and individualised active learning

2. Responsible AI[1]

3. Compliance with the EU AI Act and other regulations.

The literature also reports risks in using AI too such as diminished critical thinking and social consequences (Lamanauskas, 2025) and an over-reliance on AI-generated resources. It is important to address these concerns through targeted support and adoption of ethical guidelines, empowering teachers to review the outputs. This can help ensure AI enhances planning while sustaining professional judgement and creativity.

One potentially significant barrier at primary level is the absence of a common definition of AI literacy and effective teacher approaches, as well as ongoing uncertainty about how AI integrates into different subject areas. Arriving at a common understanding is essential for teachers' professional development because it empowers teachers to understand, evaluate, and use AI tools to enhance their instructional practice and student learning. AI literacy should be viewed as a core professional competency, not only strengthening technical skills but also deepening pedagogical strategies, critical thinking, and the ability to foster responsible student engagement with AI (OECD, 2025). In short, AI literacy is an educational priority.

Furthermore, Edtech Insiders[2] published a map of ~60 K-12[3] use cases for Generative AI and listed over 300 tools for education (EdTech Insiders, n.d.). They are grouped into six categories based on the use case. These are: Instruction Materials, Assessment and Feedback, Teacher

[1] Responsible AI is a framework for developing and deploying AI systems ethically, safely, and in alignment with human values and societal well-being

[2] 'Edtech Insiders' is a source for edtech information, providing expert analysis and industry news and considered a valuable source for the educational technology sector.

[3] K-12, an international term, is an abbreviation for the 13 years of education from kindergarten through the 12th grade; Irish equivalent of pre-school - end of secondary education: 3-18 years of age.

Practice Support, Teacher Professional Learning, Student Support and Social Tools. Despite the long list of tools, the influence of such tools on teachers' preparation and planning practices is, as yet, underexplored (Tan, X., et al., 2024). In addition, the inclusion of such sources introduces a potential element of bias, especially where findings reflect the interests of technology providers, but excluding them would preclude an adequate, up-to-date understanding of technological trends and implementation in education (UNESCO, 2025). Widely cited in the literature is the limited empirical evidence on how AI is transforming the day-to-day curriculum design process of teachers, especially those working with diverse learner needs (Boulhrir, T., et al., 2025; Tripathi, T., et al. (2025) and second language teaching (Shah, R., et al., 2025). Primary and special school teachers face unique challenges in adapting AI, including aligning the AI-based tools to pedagogical goals, ensuring inclusiveness and navigating ethical and legislative frameworks (Almusaed, et al. 2024a; McCoy, S., & Siedschlag, I. (2025).

Although there is growing interest in integrating AI into classroom practice, long-term empirical research on the specific contributions that AI can make to planning processes in primary education remains limited. International case studies indicate that AI may offer unique opportunities for primary teachers, such as the rapid generation of differentiated lesson materials, automated feedback, and personalising pathways for diverse learners (Blundell, Mukherjee & Nykvist, 2025; Clark et al., 2025a; Hoare & Smith-Ferguson, 2025, Nezhyva et al., 2024; Ugras et al., 2024; Walter, 2024). Additionally, psychological and pedagogical motivations play a key role. For example, student excitement, teacher engagement and perceived efficiency increase interest, while interaction quality, adaptability, and resource support enhance pedagogical value (Filiz, Kaya & Adiguzel, 2025). However, the real-world impact and feasibility of these approaches, attitudes and motivation depend on multiple factors, including teacher readiness, quality and nature of professional development (Blundell, Mukherjee & Nykvist, 2025; Hoare & Smith-Ferguson, 2025), institutional supports including funding, and enabling policy frameworks.

By analysing this complex landscape, it is evident that AI-based tools and related frameworks can support inclusive and innovative curriculum development, but their widespread adoption by primary and special school teachers is shaped by technical, ethical and pedagogical challenges (Almusaed et al., 2024b). Therefore, this report serves as a stepping stone to address this gap by examining legislation, tools, success stories and ethical practices nationally and internationally in the realm of AI-based curriculum design for primary and special school teachers.

4. Methodology

This research report adopted a structured literature review methodology designed to systematically identify, evaluate, and synthesise researched evidence related to the overarching key research question and its four sub research questions. The process combined initial database searching, seed study selection, and a snowballing methodology, where themes were extracted that aligned under the sub-research questions. Theme identification and extraction provided both rigour and transparency for capturing relevant insights.

A rigorous methodology was carried out to conduct this research covering both grey[4] and academic literature review. This is shown in Figure: 1 and described in this section. The first step of this literature review was Planning the Review. It helped to lay the foundation for structured and focused research. One key research question and four sub-research questions were defined based on an initial collaborative multi-stakeholder workshop. The key question served to define the overarching focus and purpose of the study, while the sub-questions break it down into manageable, specific components that collectively address different aspects necessary for a comprehensive answer. These questions were reviewed and critically examined to ensure they meet the intended objectives of this research and are comprehensive and feasible within the time-bound nature of the report. Revising these questions resulted in a shared understanding and an agreement on the final wording of the research questions, as outlined in Section 2 i.e. Introduction.

[4] Grey Literature (GL) is considered to be a kind of literature that has not been subject to quality control mechanisms (e.g., the peer reviewed process) before publication (Cranfield University Library).

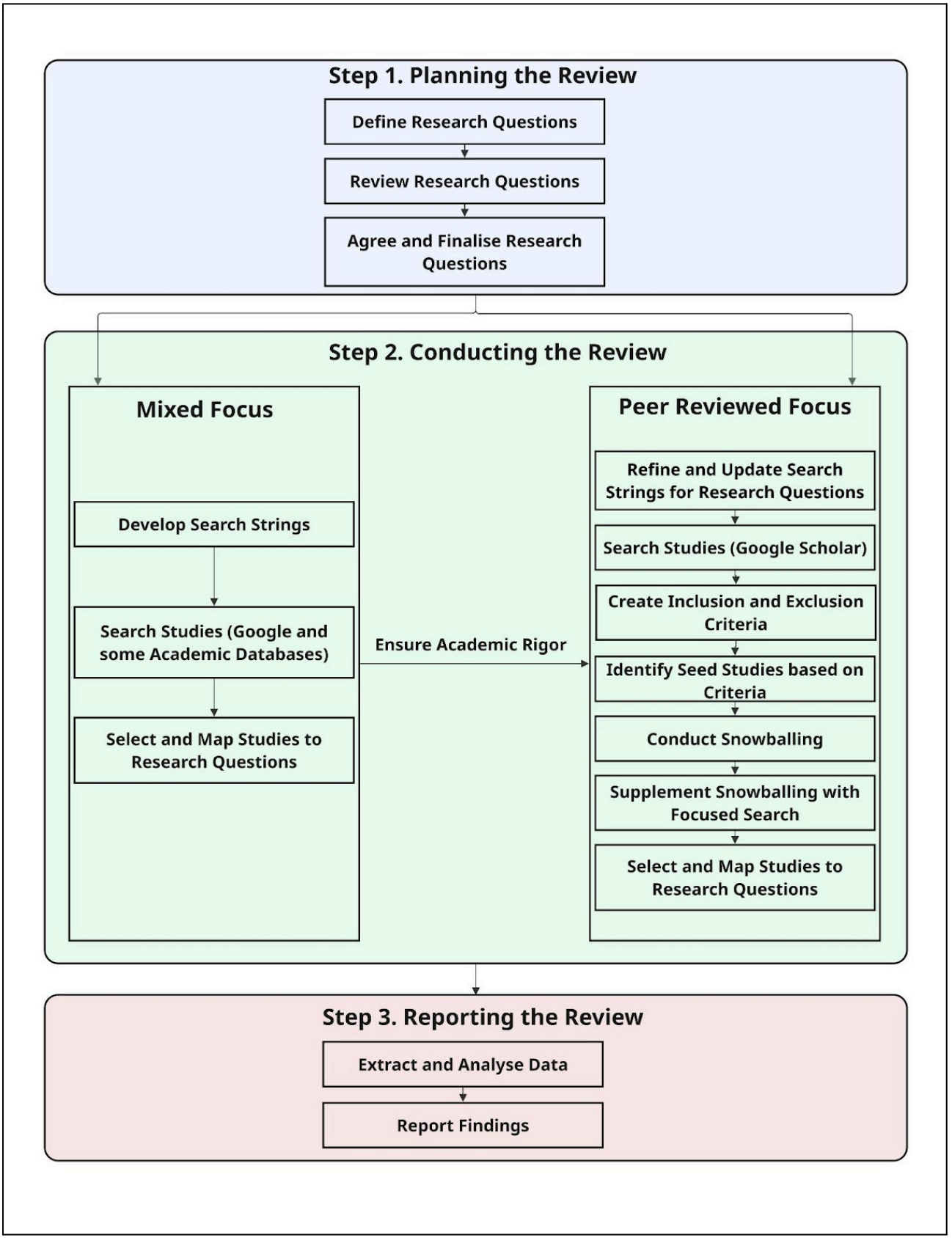


Figure: 1 Adapted Research Methodology for NCCA

The second step, Conducting the Review, was divided into two phases. In the first phase, the focus was mixed i.e. any relevant studies that can support answering the research questions were included regardless of whether they were peer-reviewed studies or grey literature. This included academic research papers from Google Scholar, Springer etc., case studies from Irish and international-context schools, policy documents such as EU ethical frameworks and AI-based tools and their reported case studies. Our key goal was to identify key features, best practices, challenges and any patterns that are making AI in primary schools impactful. The three steps during this phase were: developing the search strings (see Figure: 2 for example search string), searching for literature on Google and relevant academic databases as referenced earlier, and selecting and mapping those studies to the research questions. These searches identified a lot of interesting related studies; however, they were a mix of academic and grey literature, with the latter making up the majority. Therefore, to enhance and enrich the academic rigour of the review, a second phase called Peer Reviewed Focus was conducted to source peer-reviewed studies.

The second phase was primarily focused on collecting peer-reviewed literature targeting our research questions. Existing search strings were refined and updated, focusing on each of the four sub-research questions (example in Figure: 2 illustrates the search string used for research question 2) and the search was conducted on Google Scholar. Nonetheless, as a time-bound study, the research employed a focused methodology designed to capture key insights within the available timeframe. While this approach ensured timely findings, it also constrained the depth of data collection and triangulation.

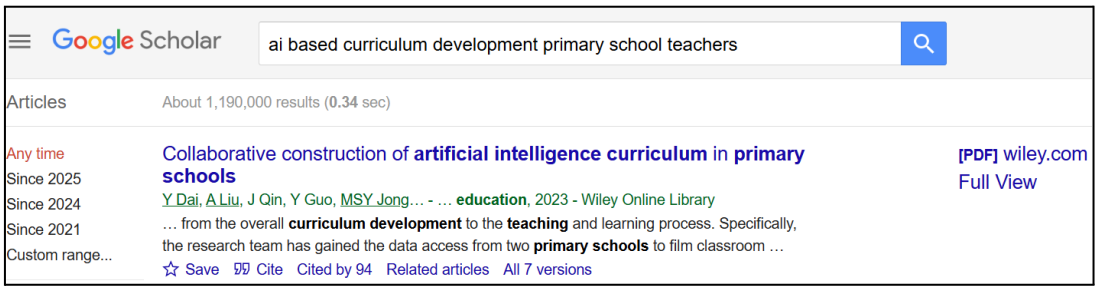


Figure: 2 Search String on Google Scholar

The reason to exclusively use Google Scholar for this academic literature search phase was its multidisciplinary focus and that it aggregates content from multiple academic databases (Springer, Science Direct, IEEE Xplore) and provides comprehensive coverage. A set of inclusion and exclusion criteria was created to select and reject research papers, as shown in Table: 1 for screening the studies.

Inclusion Criteria	**Exclusion Criteria**
Is the study targeted towards primary schools? Exceptions were made if the findings demonstrate relevance or applicability to primary school contexts.	Does the study fail to address the research question or align with overall objectives of the review?
Does the study focus on AI use and not general Edtech?	Is the publication an editorial, opinion piece, book chapter (unless readily available and highly relevant to the RQs)
Is the AI application used by teachers, not just students?	Is the study non peer reviewed, a news article or blog post?
Is it published between 2020-2025?	Is the study published before 2020?
Is it peer reviewed or a reliable preprint that demonstrates potential for eventual publication?	Is the study published in a language other than English?
Is the study indexed in reputable databases (Google Scholar, IEEE Xplore, Springer, Science Direct)?	Is the study about teaching students AI concepts rather than using AI for developing curriculum e.g. lesson plans, assessments?

Table 1: Inclusion and Exclusion Criteria

Applying the search strings[5] on Google Scholar helped to identify a set of 17 seed studies matching the inclusion and exclusion criteria. From these 17, a total of 4 highly relevant seed studies were identified; one for each sub-research question, as evident in Appendix A. A process of forward and backward snowballing (Wohlin, 2014) was conducted on these four

[5] A search string is a combination of keywords, phrases, and operators used to search databases and search engines for scholarly materials.

selected studies. Due to the time-bound nature of this report, as stipulated earlier, the snowballing process was limited to one seed study per sub-research question. It was expected that reviewing more than 600 studies, together with the use of snowball sampling, would be sufficient to reach data saturation; consequently, repeating the review process was deemed unnecessary. This resulted in a total of 628 studies, out of which 40 were selected. See Figure: 3 for breakdown of the process from start to end and Figure: 4 for an example search string during this phase. In some cases, literature that was provisionally included proved to be less focused on the desired aim of the research question. Therefore, only the most relevant studies remained in the accepted shortlist.

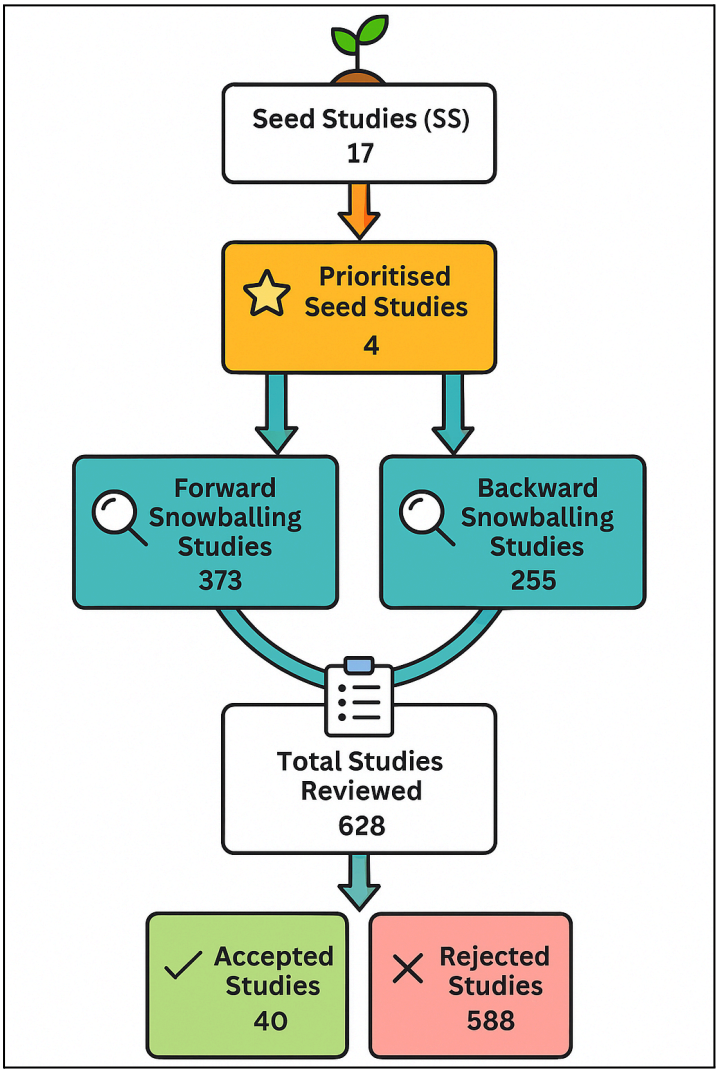


Figure: 3 Snowballing Study Selection Breakdown (Wohlin, 2014)

Further analysis uncovered that some of the questions were not directly answered though these selected studies in detail e.g. SRQ3, SRQ4. To address this, current studies were supplemented with additional focused research. Key words were used to search for studies addressing gaps in the earlier literature review, particularly for primary, bilingual, and special schools, as well as studies on ethical alignment. Additional case studies were only included if they focused on how teachers or schools use AI, not just on teaching students about AI or their attitudes. Five new case studies were added from this extra search. For SRQ3, two additional studies were included: Clark et al., (2025a) and Hoare & Smith-Ferguson, (2025). The relevance of these cases studies is without dispute, they matched the inclusion criteria and it is agreed their inclusion enhanced the answering of the specific question. Similarly, for SRQ4, three new studies were added: Clark et al., (2025a); Clark et al., (2025b); Peng et al., (2025). After this step, we had a set of 45 new studies to augment the findings from a peer-reviewed academic literature perspective. After that, the selected studies were then mapped against the sub-research questions.

The third step, Reporting the Review involved developing a data extraction framework. This helped to extract the data, including, but not limited to, name, type, reported impact and source, ethical guidelines, adoption etc. These extracted points were then synthesised to address the research questions, which helped to identify the patterns, gaps and insights across the reviewed literature. The final step was to report and present the findings, in a structured and coherent manner, targeting each of the research questions.

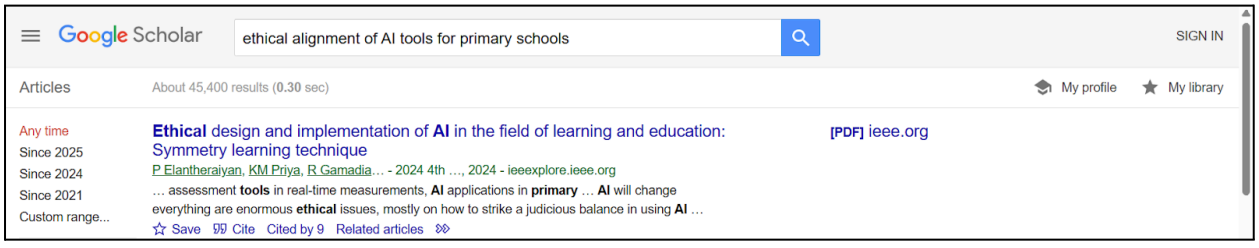


Figure: 4 Search String on Google Scholar

5. Current Legislations and Policy Frameworks

This is the first section addressing a sub-research question (SRQ).

SRQ1 asks: *What existing legislation, policy frameworks, and guidelines govern AI-based curriculum design in education, and how can these inform and support primary and special school teachers' planning and practice?*

In order to address this, the analysis draws from European and Irish governance structures, international competency frameworks, and evidence-based approaches to teacher professional development. The discussion begins by examining the concept and definition of AI literacy in the primary school context, followed by legislative foundations that govern AI guidance. The discussion then moves to look at the national policy context by looking at key European and Irish policy drivers. It concludes with an overview of international and national frameworks on AI in education that can inform and guide Ireland's future direction in refining its governance approach.

5.1 AI Literacy and Primary Schools

The growing use of AI across many fields has sparked ongoing debate about how AI literacy should be defined. AI literacy education, once limited to universities and secondary schools, is now expanding into primary education, as age-appropriate tools such as teachable machines, block-based programming, creativity tasks, and Generative AI become available. While several frameworks exist for older learners, like the *AI Literacy Framework* (Long & Magerko, 2020), *Five Big AI Ideas* (Touretzky et al., 2019), and others, they largely reflect higher-education or technical perspectives. Despite its prevalence, AI literacy education for young students is still in its infancy and lacks a clear definition for effective implementation (Yim & Su, 2025).

Initial attempts to define AI literacy have been reported in the development of different frameworks. Research has yet to establish what or how to teach AI literacy effectively for teachers and students in primary settings. Developing a dedicated, age-appropriate framework

is therefore essential to build foundational understanding, support equity, and prepare teachers and young learners for future digital demands (Han et al., 2024).

Yim's paper responds to calls for expanding AI literacy frameworks to reflect emerging technologies and social contexts (Yim, 2024). The paper initially reviewed 19 articles, identifying seventeen AI literacy frameworks, primarily from studies in Hong Kong, the United States, and Germany, with additional research from Austria, Italy, Ireland, and the United Kingdom. By analysing 17 existing frameworks across educational levels, it develops a new intelligence-based AI literacy framework tailored for primary education. The study notes the advocacy for a shift from traditional humanistic to post-humanistic approaches, introducing the concept of *AI thinking* to guide curriculum design, critical thinking and teaching practice. It represents the first comprehensive effort to conceptualise and define AI literacy specifically for young learners, as illustrated in Figure: 5 (Yim, 2024, p.12) below. It outlines six interrelated domains that collectively support young students' understanding and application of AI concepts. A strong focus on promoting equality and inclusiveness is evident by embedding AI thinking into literacy learning suited to children's cognitive development. It shifts focus from technical AI content toward accessibility for early learners in primary education. Building AI literacy at this foundational stage supports equitable access to technology and fosters ethical, responsible engagement from a young age (Yim, 2024).

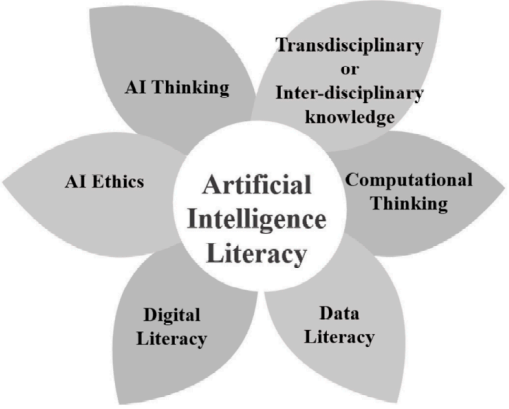


Figure: 5 An Intelligence-based AI Literacy Framework for young students (Yim, 2024, p.12)

The concept of *AI Thinking* considers the importance of the collaboration between "humans and AI and the introduction of human values and ethical and societal considerations in the design of AI technology" (Yim, 2024, p.13) is illustrated in Figure: 6, see below:

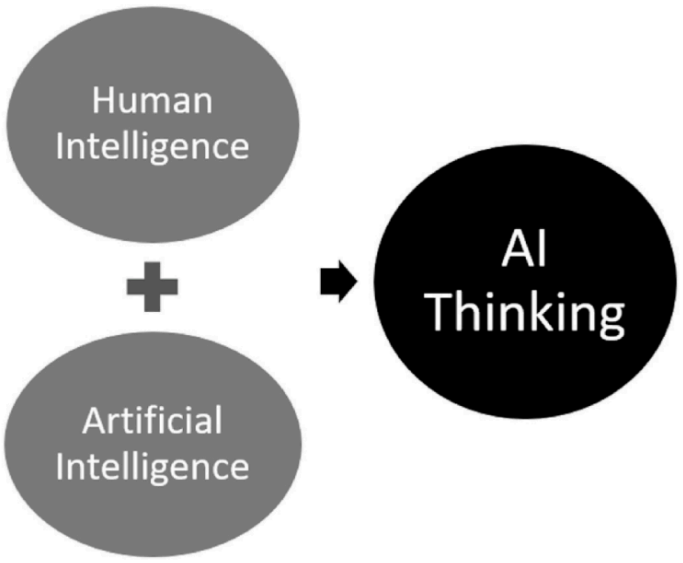


Figure: 6 Conceptual understanding of AI Thinking

The possibilities are wide, e.g. integrating AI literacy in education offers opportunities for interdisciplinary learning, critical thinking, workforce preparation, and personalised, innovative teaching. However, implementation faces major challenges as the literature suggests. These are referred to in various sections of this report. They include, for example, limited teacher education, unequal access to infrastructure, lack of clear curricular standards, and ethical and societal concerns. Ensuring responsible, inclusive, and equitable use of AI in education remains essential (Choi, 2025).

Moreover, recent literature consistently emphasises the importance of contextual adaptation in implementing AI literacy frameworks within education. Yim's systematic review (2024) illustrates that prevailing models often require modification to suit primary and special education environments, calling for flexible strategies that acknowledge variations between schools and the diverse learning needs of pupils. Similarly, Casal-Otero et al. (2023) highlight that effective AI integration depends on allowing educators to adapt frameworks to local

realities, underscoring the central role of teacher agency in the process. Complementing these findings is a more recent, non-peer reviewed paper by Olurinola, (2025). This paper deals with AI integration frameworks for low and middle-income countries and demonstrates the necessity of tailoring global models to resource availability, infrastructure conditions, and teacher capacity. It also advocates co-design approaches developed at the school or community level. While Oluinola's study is not peer reviewed, its value lies in the concise mapping of 43 studies on AI integration frameworks in education and highlights the ED-AI Lit framework (Allen & Kendeou, 2023) as a practical, teacher-centered tool for curriculum design, especially in lower-resource contexts. The six components of this Framework are: Knowledge, Evaluation, Collaboration, Contextualisation, Autonomy, and Ethics. Its relevance to the discussion deemed Oluinola's study worthy of inclusion. The main strengths of ED-AI Lit are its strong focus on ethics, contextual adaptation, and actionable guidance for teachers (covering "What, Why, How, and When" of AI use). This makes it useful for schools and educators seeking practical, equitable AI adoption. While Oluinola's mapping of studies n=43 is significant, its limitations may include less rigorous validation, and there may be gaps in addressing systemic barriers or providing evidence for impact beyond context-specific use.

In addition, the Department of Education and Youth's October 2025 Guidelines for Artificial Intelligence in Schools (DEY, 2025) emphasise adapting AI frameworks to local contexts. Rather than mandating uniform implementation, the guidance encourages schools and teachers to personalise AI planning and professional development, supporting differentiated approaches that reflect their unique realities. In line with these perspectives, the broader review of AI literacy in primary contexts recommends project-based, contextually responsive methodologies that reflect the unique needs and conditions of diverse school environments (Yim, 2024). This contextual adaptation ensures that implementation is impactful, relevant and equitable.

The following section maps the evolving policy landscape and examines the complex interplay between regulation and pedagogy. It synthesises scholarly literature, white papers and (where relevant) grey literature, to illustrate the point. It will show, for example, how European legal frameworks such as the EU Artificial Intelligence Act (2024) inform classroom-level initiatives

such as Oide Technology in Education's (Oide TiE, n.d.) digital tools for Irish schools. Notwithstanding the lack of findings in a special school context, the rationale underpinning this analysis is to identify key considerations for governmental and educational bodies striving to responsibly guide AI integration and find their applicability and relevance in Irish primary and special school settings. The findings in this context are applicable in all contexts with increased weight given to ethical consideration with more vulnerable communities in question. Later, a detailed analysis of ethical alignment and what can be learnt from existing works to ensure ethically aligned curriculum development tools is presented as part of sub-research question 4.

5.1.1 Global Shift Toward AI Literacy in Education

International perspectives on AI in education have evolved from isolated technological experimentation to coordinated policy efforts. Landmark documents such as UNESCO's 2024 AI Competency Frameworks for Teachers and Students (UNESCO, 2024a; 2024b) and the OECD - European Commission AI Literacy (AILit) Framework (OECD, 2025) now represent a global consensus around core principles: the centrality of human agency, ethics, and inclusivity as non-negotiables for responsible AI use. The AILit Framework aims to build a shared understanding of AI literacy and provide practical guidance for integrating it across subjects, echoing back to the interdisciplinary aspect of the 'Intelligence-based AI Literacy Framework for young students' illustrated in Figure: 7 (Yim & Su, 2025, p.12). As frequently reported in the literature review, few studies have examined AI literacy education in primary schools. Yim & Su's study provides evidence-based insights to define AI literacy, outline current teaching and assessment practices, and guide educators in implementing effective approaches. It also serves as a foundation for developing future frameworks, curricula, and assessment models in AI education for young learners.

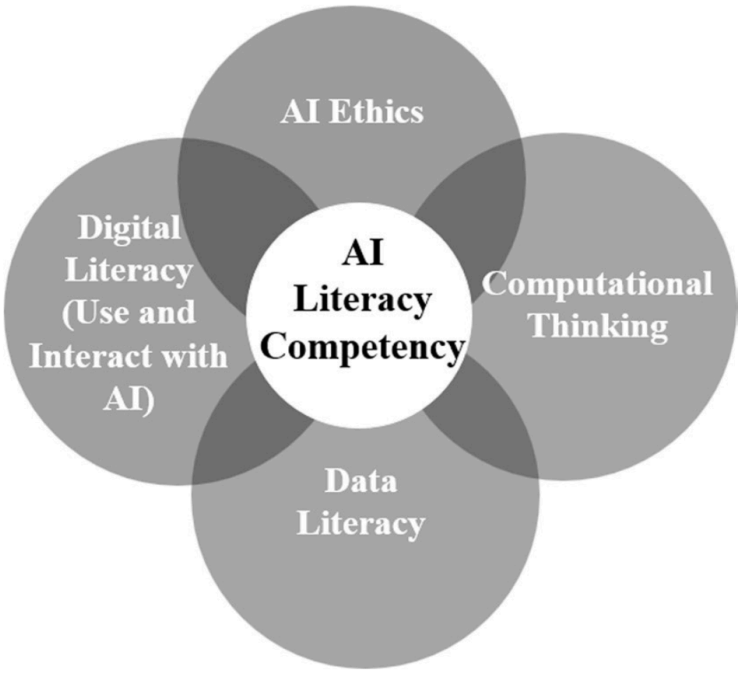


Figure: 7 The conceptual framework of AI Literacy competency in primary school settings

Based on 25 evidence-based studies from 2019 to early 2024, Yim & Su's study provides valuable insights into not only the understanding of AI literacy but how it is applied in primary education. It sheds light on effective pedagogy for policymakers and on tools and assessment for sustainable AI learning. Its goal is to empower learners to critically and ethically engage with AI, while supporting educators to overcome barriers such as unclear definitions of AI literacy and uncertainty about its role within the curriculum. Countries such as Australia, Canada, and Japan are now piloting AI literacy programmes that extend beyond technical know-how to include civic and ethical knowledge, signalling a more holistic approach and officially integrating these dimensions into their education systems (Chiu et al, 2024). Across these diverse contexts, a common direction has emerged: AI must function as a support to, not a substitute for, professional judgement and pedagogical creativity (DEY, 2025; UNESCO, 2024a; Olurinola, 2025; Chiu et al., 2024).

Empirical research affirms this policy orientation. Evidence from Yim (2024) and Chiu et al. (2024) demonstrates that many schools now embed AI literacy as a cross-curricular competence, integrating it into the wider learning environment rather than treating it as a standalone subject (Yim, 2024 ; Chiu et al., 2024). Findings from Choi et al. (2025) confirm that this approach is critical for developing students' higher-order skills in critical thinking, problem-solving, and ethical reasoning, skills that are now recognised as foundational to AI-infused education. These principles are now enshrined in many national strategies that define AI literacy as a core citizen competence on par with traditional literacy and numeracy.

5.1.2 European and Irish Policy Drivers

Within the European Union, the EU AI Act (2024) represents a landmark legislative milestone shaping educational AI. Its risk-based system classifies AI applications used for student profiling, personalised learning, or automated assessment as "high-risk", demanding transparency, accountability, and robust human oversight. Importantly, Article 4 of the Act introduces a legal obligation for AI literacy among all professionals deploying such technologies, thereby elevating digital competence from a pedagogical ambition to a matter of statutory compliance. This creates a direct mandate for teacher education and institutional responsibility.

Ireland's response stands out as coherent and joined-up. The Department of Education and Youth's *Digital Strategy for Schools to 2027* explicitly incorporates AI awareness and digital inclusion into overarching school improvement planning, linking technological advancement directly to curriculum renewal and inclusive practice. The corresponding strategy AI: Here for Good (Department of Enterprise, Tourism and Employment, 2024) affirms education as a strategic sphere where ethical innovation is prioritised. These policy directions are being operationalised via Oide Technology in Education's national capacity-building initiatives, such as the AI in Schools Hub and the widely accessed AI for Schools teacher education course (Oide, 2024; DEY, 2025).

Crucially, the Department of Education and Youth's 2025 Guidance on Artificial Intelligence in Schools provides a strategic framework for aligning practice with European regulatory requirements (DEY, 2025). Using a 4P Approach: Purpose, Planning, Policies, Practice - see Figure: 8 (DEY, 2025, p.20), the document gives schools autonomy to determine why and how AI should be used, under what ethical standards, and in what pedagogical contexts.

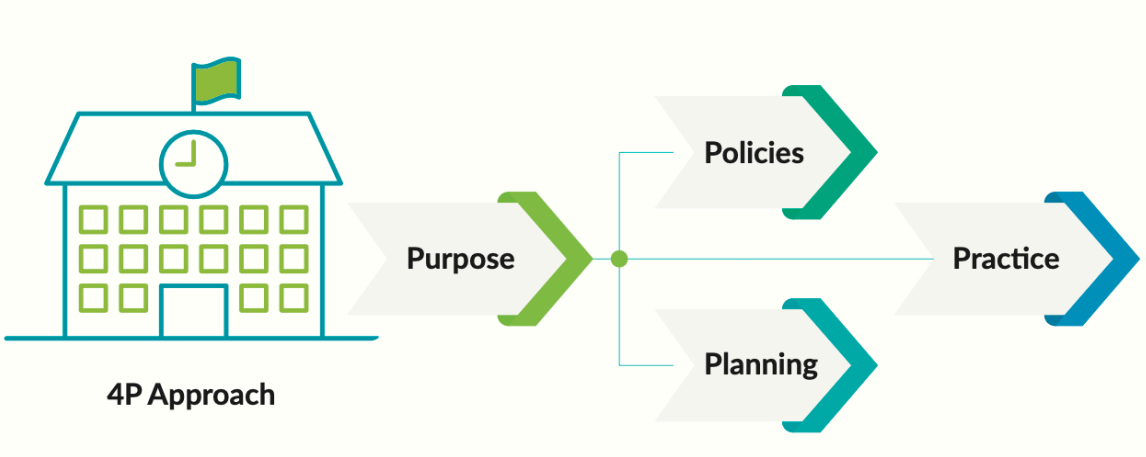


Figure: 8 The 4P Approach

The Guidance document's emphasis on teacher agency and Universal Design for Learning (UDL) helps ensure that AI adoption addresses the needs of diverse learners across mainstream and specialist settings. It also underscores its partnership with Oide Technology in Education (TiE) in supporting schools and teachers and signposts teachers to further publications as supplementary in professional support.

This new Guidance represents a significant step for Ireland. However, the practical implementation dimension remains underdeveloped. Schools would benefit from a clearer 'how-to' roadmap, including vetted AI tool guidance, structured professional learning, curriculum and assessment alignment, and targeted resourcing for inclusion and infrastructure. In short, the Guidelines articulate the principles effectively but provide limited operational direction for schools to translate these into consistent practice.

5.1.3 Oide Technology in Education

Oide's national role in professional development is pivotal to attaining the objectives set by both the EU and the Guidance on AI in Schools by the Department of Education and Youth. Professional learning communities, digital safety guidance, and collaborative practitioner research ensure that support is both progressive and context-responsive. The AI in Schools Hub provides curated examples of AI-enhanced teaching, guidance on data ethics, and resources for inclusive curricular planning (Oide TiE, n.d.). Such infrastructure enables teachers to weigh the opportunities and risks of AI within clearly defined legal and ethical boundaries, consistent with best practice worldwide (Yim, 2024).

Evaluations reveal that while Ireland's infrastructure and policy intent are robust, school-level implementation remains variable. Differences in readiness, staffing confidence, and available resources mean that national ambitions for AI integration are not yet uniformly met. The challenge for policy, therefore, is to balance system-level coherence with practical adaptability at the level of the school and classroom.

5.1.4 Synthesising Governance, Policy and Practice

This section of the report sits at the intersection of governance and professional practice. It synthesises statutory frameworks, policy findings, and contemporary empirical/desk-based literature so as to inform policymaking at government, agency, and school levels. By examining legislation (EU AI Act, GDPR), leading frameworks (Department Guidance, National AI Strategy, UNESCO/OECD), and institutional structures (Oide-led professional development), the report offers a holistic account of AI governance in education.

Synthesising the literature that emerged from this research, there is a refreshed understanding of the need for a holistic lens on AI literacy in primary education, integrating conceptual and practical knowledge, research strategies, and robust evaluation. It draws on recent syntheses in the field which underline not only the importance of technical skill acquisition, but of fostering critical data literacy, ethical reasoning, and student agency (Yim, 2024; Chiu et al., 2024). Project-based and inquiry-driven methodologies, rooted in constructivist paradigms are strongly

endorsed in the literature as effective for embedding these competencies, particularly for young and diverse learners (Olurinola, 2025; Yim & Su, 2025). The outcomes and evaluation domains reflect the multi-dimensional aims of leading frameworks such as the UNESCO's AI Competency Frameworks (2024), which stress both academic attainment and broader personal and social development (DEY, 2025). Research design focuses on constructivism and suggests the ARCS Model (Keller, 1987). Adapting Keller's ARCS model (Attention, Relevance, Confidence, Satisfaction) helps ensure that AI integration remains learner-centred, balancing cognitive engagement with ethical and motivational design. It is especially useful in evaluating AI tutoring systems, chatbots, and adaptive learning platforms - ensuring they motivate, not replace, authentic human learning processes (Yim & Su, 2024). Yim & Su's systematic review identifies the ARCS model as one of the dominant instructional design models used in studies of AI literacy in primary education, highlighting its role in assessing and building student motivation within AI-focused learning interventions.

The focus on primary and special school contexts recognises these as the vital testing ground for equitable AI adoption, where learner diversity and differentiation must remain central. It is relevant to note that no study/paper that emerged from the literature during the snowballing phase, reflected the context of special schools in particular. Targeted searches were applied subsequently but the results did not place the focus on teachers using AI for the benefit of planning curriculum content. However, learnings can be taken from the studies examined and applied in these school contexts nonetheless. For example, frameworks such as the 4Ps and EU AI Act guidance can be equally applicable for such contexts (DEY, 2025).

Each subsequent section will address, in turn, the legislative frameworks, policy examples, and pedagogical strategies that underpin robust, inclusive, and responsible AI-based curriculum design in Ireland, Europe and further afield.

5.2 Legislative Foundations Governing AI in Education

The regulatory landscape for artificial intelligence (AI) within education is grounded in European legal frameworks that prioritise safety, accountability, and human agency. These legislative pillars underpin national policies and institutional strategies, establishing the compliance environment within which educators must plan and deliver AI-enhanced curricula. Three primary legal frameworks shape this environment: the European Union Artificial Intelligence Act (2024), the General Data Protection Regulation (GDPR, 2016), and the United Nations Convention on the Rights of the Child (UNCRC, 1989). Collectively, they delineate the lawful, ethical, and rights-based boundaries for AI deployment in teaching and learning contexts.

5.2.1 The European Union Artificial Intelligence Act (2024)

The EU AI Act, adopted in 2024 and entering phased implementation between 2024 and 2026, represents the first binding legislative framework globally to regulate AI from a risk-management perspective. The Act introduces a tiered risk classification system, from minimal to prohibited, based on potential impacts on fundamental rights and public safety. AI systems used in education, particularly those implicated in student profiling, assessment automation, or curriculum personalisation, are categorised as high-risk technologies. As such, they are subject to stringent obligations of transparency, technical robustness, and human oversight (EU, 2024).

For the education sector, the AI Act marks a decisive shift from voluntary ethics to enforceable compliance. Article 4 of the EU AI Act specifically mandates that organisations deploying or using AI systems must ensure their personnel possess adequate AI literacy and technical training. This legal expectation creates explicit responsibility for school leaders and teachers to understand and interrogate AI-generated decisions that influence pedagogical or assessment outcomes. Professional training thereby becomes both a professional right and a statutory obligation.

The Act further requires that AI tools used in education remain explainable and auditable, meaning that teachers must be able to interpret how algorithms generate outputs or recommendations. Such explainability clauses are integral to protecting teacher agency and mitigating algorithmic bias. Compliance requires providers to document decision-making processes and ensure human oversight at every stage. Education ministries and agencies such as Ireland's Department of Education and Youth therefore must develop sector-specific guidance and support systems, aligning school governance with the AI Act's provisions. In Ireland, this has been operationalised through the recently published Guidance on use of Artificial Intelligence in Schools (DEY, 2025) and through Oide's Technology in Education's training resources on ethical use, both of which will be discussed in further detail in sections 5.3.3 and 5.3.4 respectively.

5.2.2 General Data Protection Regulation (GDPR, 2016)

Running parallel with the AI Act, the GDPR (2016/679) continues to form the European legal backbone for all personal data processing, including that mediated by AI. Within education, GDPR compliance governs how student data is collected, processed, and shared by AI systems. The legislation stipulates key principles of lawfulness, fairness, and transparency, mandating explicit consent mechanisms and limiting data usage to specified educational purposes.

For teachers, this translates into a professional and ethical duty to safeguard learners' digital footprints. AI systems often rely on large datasets. For example, learning platforms, adaptive assessments, or behavioural tracking tools may inadvertently capture sensitive information such as learning difficulties or socio-emotional indicators. Under GDPR, schools must designate data controllers (typically boards of management) responsible for ensuring lawful processing and for conducting Data Protection Impact Assessments (DPIAs) before introducing AI-driven technologies into classrooms.

In Ireland, guidance provided by the Department of Education's Data Protection Toolkit for Schools (2023) and the Data Protection Commission reinforces these expectations. The toolkits instruct schools to assess algorithmic decision-making systems for potential discrimination or noncompliance, embedding data literacy within school governance. This positions data ethics as an organic component of AI literacy, further entwining GDPR with the AI Act's literacy requirements.

5.2.3 The United Nations Convention on the Rights of the Child (UNCRC, 1989)

The foundational human-rights dimension of AI deployment in education is articulated through the UNCRC, ratified by Ireland in 1992. The Convention asserts children's rights to privacy (Article 16), access to information (Article 17), and education that promotes their fullest potential (Article 29). These principles extend into the digital domain, ensuring that technological advances do not compromise dignity, equality, or participation.

AI applications in educational settings, for example, adaptive learning engines, predictive analytics, or generative tools, must therefore be evaluated against the best interests of the child criterion (Article 3). UNESCO's *Guidance for Generative AI in Education and Research (2023b)* echoes this requirement by urging governments to safeguard children from surveillance or bias embedded in AI models. In Irish practice, this ethos underpins the Department of Education and Youth's insistence that all AI implementations be accompanied by human oversight and that pedagogical benefits demonstrably outweigh any potential risk to learners' wellbeing.

Futhermore, special education contexts demand heightened sensitivity to these legal guarantees. Many AI learning tools claim to enhance accessibility or communication for both teachers and students with additional needs, yet these systems often require invasive data collection processes by default as part of their functionality (Yim, 2024). Under both GDPR

(2016) and UNCRC (1989) provisions, the principle of proportionality[6] applies - only data essential to pedagogical objectives may be processed. Schools are consequently required to seek parental or guardian consent and to guarantee that AI usage does not generate discriminatory or exclusionary outcomes.

5.2.4 From Legal Frameworks to Classroom Reality: Translation Challenges

While the EU AI Act, GDPR, and UNCRC provide complementary safeguards, their application in schools reveals practical tensions. Each framework operates within distinct regulatory logic - risk management (AI Act), data localisation (GDPR), and rights protection (UNCRC) - creating overlapping yet sometimes conflicting obligations (European Union, 2024).

The AI Act's transparency requirements, for example, mandate explainable outputs (European Union, 2024, Article 13), yet GDPR's data minimisation principle restricts documentation of algorithmic processing involving student data. Teachers are expected to interpret AI recommendations without full visibility into underlying datasets or decision rules. Similarly, the UNCRC's best interests principle requires demonstrable learner benefit (United Nations, 1989, Article 3), but the AI Act focuses primarily on harm prevention rather than positive outcomes (European Commission, 2024). A system may be technically compliant yet pedagogically ineffective (Gattupalli, Maloy & Edwards, 2023).

Accountability is further complicated by ambiguous roles. Is a school licensing an AI platform a 'deployer' or 'user?' GDPR designates schools as data controllers, but many AI tools involve third-party providers with unclear data-sharing practices (DEY, 2025 pp. 13-14, 29). Teachers may be unaware of where student data is stored or whether it trains proprietary models, leaving them legally exposed and unable to exercise informed professional judgement. For governments and education authorities, the challenge is pedagogical translation: converting legal

[6] The principle of proportionality, under GDPR and in the context of education, means that any collection or use of personal data must be appropriate and necessary for achieving the intended purpose and must not go further than required to meet that aim.

obligations into actionable guidance (Chiu et al., 2024). This requires cultivating legal literacy as a core professional competence (Casal-Otero et al., 2023), positioning teachers as both guardians of student rights and architects of ethically grounded curriculum design. Effective AI governance depends not on regulation alone, but on equipping educators to navigate these intersecting obligations with confidence (DEY, 2025).

Having established the European legislative framework, the following subsection examines how Ireland has translated these obligations into national policy and institutional practice.

5.3 National Policy Context - Ireland's Strategic Direction

This section examines Ireland's strategic response and its direction.

Ireland's national policy response to AI in education exemplifies how legislative obligations, ethical standards, and pedagogical innovation can be aligned within a coherent governance framework. Anchored in the Digital Strategy for Schools to 2027 and the AI: Here for Good (2024 Refresh) strategy, Ireland's approach links digital infrastructure with teacher professional development and curriculum modernisation.

These priorities are reinforced through the Department of Education and Youth's Guidance on Artificial Intelligence in Schools (2025), which operationalises European requirements of transparency, fairness, and human oversight within day-to-day pedagogical practice (DEY, 2025). Together, these strategic instruments reflect a policy ecosystem characterised by proactive adaptation and teacher empowerment rather than passive compliance.

5.3.1 Digital Strategy for Schools to 2027

The Digital Strategy for Schools (2022–2027) represents the structural foundation of Ireland's educational digitalisation agenda. Building on the earlier *2015–2020 framework,* it establishes four interconnected themes: digital infrastructure, inclusive access, capacity development, and

innovation in learning and assessment (DEY, 2025). The document explicitly references AI as an emerging technology requiring pedagogical and ethical literacy, positioning AI not as a discrete field but as an extension of digital competence.

At implementation level, Oide Technology in Education plays a pivotal role in translating strategy into practice which will be discussed in greater depth in section 5.3.4. As noted by Choi et al., (2025), sustainable AI adoption depends critically on teachers' ability to integrate technology within sound pedagogical frameworks balancing innovation and inclusion; a point further confirmed in SRQ2.

5.3.2 AI: Here for Good (2024 Refresh)

The AI: Here for Good national strategy articulates Ireland's vision of human-centred artificial intelligence and identifies education as a strategic domain for ethical innovation. Its Refresh update (2024) prioritises three aims: (a) developing AI literacy across society; (b) ensuring fair participation in an AI-driven economy; and (c) fostering innovative, trustworthy AI research. Within education, these translate into initiatives that promote teacher and learner autonomy alongside system-level guardianship of ethics and equity.

Consistent with this vision, research conducted by Yim (2024) highlights the need for intelligence-based AI literacy frameworks that account for cognitive and ethical dimensions of learning. Yim's findings reinforce Ireland's emphasis on 'responsible intelligence' - an approach that develops critical understanding of AI's technical logic while engaging with its moral consequences. The correspondence between Yim's framework and Irish strategic objectives illustrates how policy and research intersect to inform curriculum design for younger learners.

5.3.3 Department of Education 2025 Guidance on Artificial Intelligence in Schools

Ireland's Guidance on Artificial Intelligence in Schools (2025) serves as the principal national policy document implementing the obligations of the EU AI Act (2024). Developed collaboratively by the Department of Education and Youth (DEY) and Oide, the Guidance uses a pragmatic '4P model' as illustrated in Figure 8 in section 5.1.2 - Purpose, Planning, Policies, Practice - to scaffold responsible decision-making in schools (DEY, 2025).

- Purpose: Schools must define clear educational rationales for AI use consistent with curricular aims and ethical principles.
- Planning: AI integration must align with existing digital learning frameworks and school self-evaluation (SSE) cycles.
- Policies: Local governing bodies are required to update acceptable-use and data-protection policies to encompass AI technologies.
- Practice: Teachers remain the human arbiters of AI-assisted outputs, ensuring fairness and inclusivity in teaching and assessment.

This 4P model embeds legal and ethical considerations into everyday practice, promoting human-in-the-loop oversight while encouraging renewal of pedagogical creativity. It reflects broader findings from Casal-Otero et al. (2023), who emphasised that frameworks integrating governance and pedagogy yield stronger teacher confidence and learner outcomes.

5.3.4 Oide's Role in Professional Development and Pedagogical Innovation

Oide's emergence as Ireland's integrated national support agency represents a milestone in professional learning consolidation. By unifying previously separate entities, such as the Professional Development Service for Teachers (PDST), Junior Cycle for Teachers (JCT), and the National Induction Programme for Teachers (NIPT), Oide coordinates professional learning across the continuum of teacher development. Its Technology in Education division administers

the AI in Schools Hub, providing teachers and school leaders with practical guidance, consistent with GDPR requirements and EU AI Act compliance.

The Hub functions not merely as a resource repository but as a professional community of enquiry, aligning with Olurinola's reference to the ED-AI L Framework (Allen & Kendeou, 2023) which advocates iterative teacher reflection and contextual responsiveness when integrating digital technology. Similarly, Chiu et al., (2024) identify process-oriented teacher competence by linking ethics, collaboration, and reflective praxis - the continuous cycle of critically examining, adapting, and refining one's practice as being central to effective AI pedagogy. Oide has embedded these principles operationally through blended delivery models, online courses, and collaborative workshops.

The organisation's inclusivity mandate is also explicit: it extends AI-related professional development to support teachers working with learners with special educational needs (SEN). Consistent with the UN Convention on the Rights of the Child (Article 23), Oide's framework ensures that AI use in special settings upholds the rights and dignity of children with disabilities. This focus mirrors arguments by Chiu et al., (2024), who warn against algorithmic bias that could magnify educational inequalities. While Oide's *AI in Schools Hub* represents an important national step toward ethical and informed AI adoption, its impact is constrained by limited depth of professional learning, insufficient contextual differentiation, and the absence of robust evaluation data. Strengthening practitioner co-design, continuous feedback, and targeted support for primary and special schools would make the initiative more equitable and pedagogically meaningful.

5.3.5 Strategic Coherence and Future Directions

The coherence of Ireland's approach lies in how these initiatives interlink across governance layers. The Digital Strategy for Schools to 2027 provides the infrastructural foundation; the AI Strategy (2024) offers ethical direction; the AI Guidance (2025) enacts operational policy;

and Oide delivers capacity-building supports. Each component is grounded in trustworthiness, inclusion, and teacher empowerment. These are themes that are echoed across international frameworks such as UNESCO's AI Competency Framework (2024), the OECD EU Commission AI Lit model (2023).

Empirical and desk-based research strengthens the policy's pedagogical credibility. Yim (2024) connects AI literacy with human intelligence theory, arguing for transdisciplinary curriculum integration; Choi et al. (2025) underscore ethical competence and critical use, and Olurinola (2025) emphasises contextually adaptive teacher reflection. Together, these sources align with Oide's practice-based agenda. As documented in The Department of Education and Youth's Guidance on Artificial Intelligence in Schools, (2025) its alignment with EU and international frameworks, teacher agency initiatives, and explicit inclusion agenda, Ireland is among Europe's leading countries in harmonising digital policy, teacher agency, and learner inclusion (DEY, 2025). This endeavour is evolving, forward-looking and educator-centred with a promise of updates, providing schools with evolving guidance that reflects emerging evidence and practice.

Frameworks from research literature - AI literacy (Chiu et al., 2024); AI thinking (Yim, 2024); inclusive design (Choi et al., 2025); and teacher coherence (Olurinola, 2025) - provide theoretical validation for Ireland's focus on contextually responsive, ethical, and collaborative AI integration. This multifaceted alignment positions Ireland as a policy case study in translating legislative governance into pedagogical empowerment for teachers and learners alike.

5.4 International and Comparative Policy Frameworks

5.4.1 Introduction: Policy Diversity and Convergence

Globally, the governance of AI in education is rapidly evolving, marked by a mix of binding legislative acts, ambitious skills frameworks, strategic national guidelines, and ethical standards. Comparative research attests that while many frameworks share principles such as child-centred design, professional agency, and algorithmic transparency, implementation remains

shaped by national histories, institutional cultures, and the pace of technological change (Yim, 2024; DEY, 2025). The following sections categorise leading regulatory and policy resources and surface their practical implications for teachers, especially in primary and special education.

5.4.2 Binding Legislative & Regulatory Frameworks

The European Union AI Act (2024) anchors Europe's approach to AI in education. It requires human oversight, technical robustness, and auditable transparency for AI systems impacting learning, student profiling, or personalisation. Ireland's Department of Education and Youth has mapped these requirements directly into school-based governance and training, echoing best practice calls in the scholarly literature for clarity in operational compliance and teacher rights (Yim, 2024; DEY, 2025). Australian privacy and anti-discrimination law, while less directly targeted to AI, similarly provides educators with legal recourse and obligations for student data protection in AI deployment.

5.4.3 Curriculum & Skills Frameworks

UNESCO's AI Competency Framework for Teachers and for Students (2024) sets a new bar for embedding human agency, critical thinking, and lifelong digital literacy throughout the curriculum. Its logic of skills staging, '*acquire - deepen - create*' recognises that technical fluency must be matched with ethical judgment and transdisciplinary thinking. The OECD/EC AILit Framework (2023) advances a complementary focus on cross-curricular AI literacy, practical classroom scenarios, and teacher scaffolding. Australia's new Generative AI Framework, first approved in December 2023 and updated in 2025 (Commonwealth of Australia, 2023), aligns with these global benchmarks; it empowers schools with guidance for safe adoption, digital equity, and phased professional upskilling tied to curriculum renewal and local community context.

Empirical research caution, however, that embedding policy frameworks into real-world practice depends on well-supported professional learning and resource availability, especially in special and primary education, where differentiated pedagogy and inclusion are paramount (Yim, 2024).

5.4.4 National and EU Policy Guidelines

Ireland's Guidance on Artificial Intelligence in Schools (2025) is a paradigmatic example of a national guideline translating legislative requirements and global ethical principles into practice. It delivers clear protocols for risk assessment, ethical review, teacher upskilling, and continuous policy renewal, often cited in the literature as effectively linking macro-level legislation to micro-level teacher agency and school governance (DEY, 2025; Yim, 2024). The 'AI in Schools Hub' and Oide's professional learning model underpin this policy by providing practical resources, peer learning, and iterative professional dialogue as discussed in greater detail before.

Australia's *Framework for Generative AI in Schools* and the *Guidelines for the Responsible Use of AI in the Public Service (UNESCO, 2023b)* take a similar approach. They focus on managing risks, ensuring transparency, and keeping humans in control. Both also offer step-by-step, professional learning to help staff use AI safely, ethically, and effectively in their work.

5.4.5 Influential International Ethical Guidelines

Finally, the EU Ethics Guidelines for Trustworthy AI (EU, 2019), UNESCO's guidance, OECD Principles, and UNICEF Policy Guidance represent a 'meta-framework' of principles now referenced by most national agencies. These documents collectively enshrine priorities of transparency, fairness, ongoing review, and children's wellbeing. Importantly, they serve as an ethical compass as well as a technical reference point for all national AI policies (DEY, 2025).

This list of guidelines, frameworks and policies is not exhaustive. It is important to note that many countries and states are developing or revising additional guidelines as AI use in education

accelerates. The selection is current as of October 2025 and focuses on high-impact, widely adopted policies and frameworks. A comparative table with the examples from this section and some additional legislation is available in Appendix B.

5.4.6 Implications and Recommendations

While it has been repeatedly stated throughout this report, one recurrent challenge was finding specific examples of literature relating to primary and special schools. However, there are valuable, applicable and relevant considerations for teachers and schools in these contexts that are teased out below under the following headings:

- Primary school teachers
- Teachers in bilingual contexts
- Teachers in special schools

Together, these frameworks create an environment where teachers, especially in primary and special education, are supported, protected, and guided by clear laws and policies. The international evidence underscores that successful AI integration requires regular, context-sensitive professional learning, a school culture of critical reflection, and implementation models that promote inclusion, trust, and continual review (Yim, 2024; DEY 2025).

For Primary School Teachers

- Developmental Appropriateness: Most frameworks (UNESCO's AI Competency, AILit Framework, Irish Guidance) emphasise the need to adapt AI literacy to age and developmental stage, making practical, project-based, and interdisciplinary approaches essential for primary setting (Yim, 2024; DEY Guidelines, 2025).
- Pedagogical Agency: The policies prioritise teacher agency in selecting and adapting AI resources, supporting personalised and creative classroom practices well-suited to diverse primary classrooms (Yim, 2024; DEY Guidelines, 2025).

- Professional Learning: Mandatory ongoing AI literacy training, as required by the EU AI Act and built into Irish Continuous Professional Development (CPD), equips primary teachers to confidently implement AI-aligned pedagogy and assessment (DEY Guidelines, 2025).
- Co-Designing with Teachers: Recommendations emerging from a systematic review of 28 empirical studies (out of 8,175 papers screened) on AI interventions in K-12[7] highlights a policy/practice gap where adoption of frameworks exist but remains inconsistently implemented. The review further underscores that teacher education and professional learning are significantly under-researched areas. Its core recommendations emphasise the necessity for teacher involvement in the co-design of AI curricula, enhancing teacher agency, and the development of a unified framework for age-appropriate AI education across schools. (Rizvi, Waite & Sentence, 2023).

For Teachers in Bilingual Contexts

- Language Equity: All legal frameworks (GDPR, AI Act, UNCRC) require that AI tools support multiple language communities, avoid bias, and foster inclusivity—bilingual teachers must critically evaluate AI resources for language accuracy, accessibility, and cultural fit (Yim, 2024; DEY, 2025).
- Policy Translation: National guidelines (Guidance on AI in Schools) direct schools to use examples and co-created content, encouraging bilingual adaptation and teacher-led innovation in home languages (DEY, 2025).

[7] K-12, an international term, is an abbreviation for the 13 years of education from kindergarten through the 12th grade.

For Teachers in Special Schools

- Data Sensitivity & Consent: Legislation and policy highlight stricter standards for consent, privacy, and data proportionality, requiring special schools to implement particularly rigorous data management and ethical review practices (DEY, 2025; Yim, 2024).
- Universal Design: Frameworks such as the DEY's Guidance and international ethical codes stress Universal Design for Learning (UDL), ensuring AI tools are accessible, customisable, and support differentiated learning for students with additional needs (Olurinola, 2025; DEY, 202).
- Professional Collaboration: Policies support interdisciplinary teamwork and contextualised professional development, building collective capacity for special school educators to assess, select, and use AI safely and inclusively (Yim, 2024; Olurinola, 2025).
- Identifying Equipment barriers: The findings of Tomczyk and Majkut (2025) carry significant implications for primary school leaders and educators navigating AI integration. Their survey of teachers in Poland (n=289) across primary and secondary settings identifies critical implementation barriers, particularly insufficient equipment and inadequate institutional support. These barriers disproportionately affect primary schools serving students with Special Educational Needs (SEN)[8]. However, the study's scope is limited by its failure to provide dedicated evidence, strategies, or recommendations tailored to the unique pedagogical and resource needs of primary SEN contexts. This gap underscores the urgent need for targeted research in this area.

[8] The term 'Special Educational Needs' is used throughout this report as it reflects current Irish legislative and educational policy frameworks, while recognising ongoing discussions regarding inclusive terminology.

5.5 Conclusion

While the core rights, responsibilities, and policy frameworks remain universal, their successful implementation requires context-sensitive translation and additional professional learning for teachers in primary, bilingual, and special school environments. Inclusive policy documents like Ireland's Guidance on AI in Schools explicitly call for such differentiation, recognising unique classroom, student, and community needs as central to safe, ethical, and effective AI adoption (DEY, 2025; Olurinola, 2025; Yim, 2024).

Ireland's approach to AI in education demonstrates strong legislative and policy alignment but reveals persistent challenges in translating these frameworks into classroom-based reality. While the EU AI Act, GDPR, and UNCRC collectively establish a clear rights-based foundation, their technical and legal complexity often exceeds the practical capacity of teachers, particularly in primary schools and special schools, to interpret and apply them confidently. National strategies such as the Digital Strategy for Schools to 2027 and AI: Here for Good (2024 Refresh) set ambitious goals for ethical innovation and teacher empowerment, yet the corresponding infrastructure, resources, and sustained professional learning required for meaningful enactment remain unevenly distributed. The Department of Education and Youth's 2025 Guidance on AI in Schools offers a well-structured 4P model for ethical implementation, but it stops short of providing operational clarity on what effective AI integration actually looks like in early years and primary classrooms. For many teachers, limited access to training, inconsistent digital capacity across schools, and the absence of age-appropriate AI literacy frameworks make implementation aspirational rather than achievable. This gap in research is also evident and reported in the literature analysed for this report. Oide's AI in Schools Hub represents a valuable support mechanism, but its reach and contextual relevance to diverse primary settings are still developing. International frameworks such as UNESCO's AI Competency Framework (2024) and the OECD/EC AILit model (2023) reinforce the importance of human oversight and

inclusivity, yet they, too, lack detailed guidance for younger learners or differentiated pedagogies.

These frameworks offer key lessons for improving teacher practice. They highlight the importance of ongoing, collaborative professional learning, empower teachers to be co-designers of curriculum, and highlight the need for practical, age-appropriate examples for primary and special education contexts (Yim, 2024). By prioritising context-specific support as described above and fostering communities of reflective practice, frameworks can move beyond being aspirational and theoretical to effectively support sustainable and ethical classroom integration of AI in a pedagogically meaningful way (Yim & Su, 2025).

In the following section, this report will highlight and discuss AI tools for curriculum design and their impact.

6. AI tools for Curriculum Development and their Impact

This section will answer SRQ2.

SRQ2 asks: *What are some current open source and proprietary AI-based tools that support curriculum design for primary and special school teachers and what is their impact (positive or negative) on their teaching and learning practices?*

This is achieved through the classification of AI-based tools designed to support curriculum development. Followed by that, the current state of reported impact (positive and negative) of AI tools for curriculum development from both grey and academic literature perspective is presented. In addition, the need for long-term curriculum planning for maximised impact with AI Tools is discussed which is then followed by a conclusion.

6.1 Classification of AI Tools for Curriculum Development

It is important to have a classification system to make it easier for teachers to select an AI tool for their specific needs. There are different ways in which this can be done e.g. based on their functionality, focus on teachers, institutions or students. However, we built our classification on existing research, which suggests that broadly classifying these into three categories can benefit all stakeholders to include teachers, students and administrators. These three categories are Instructional, Analytical and Administrative (Kwid et al., 2024) as shown in Figure: 9.

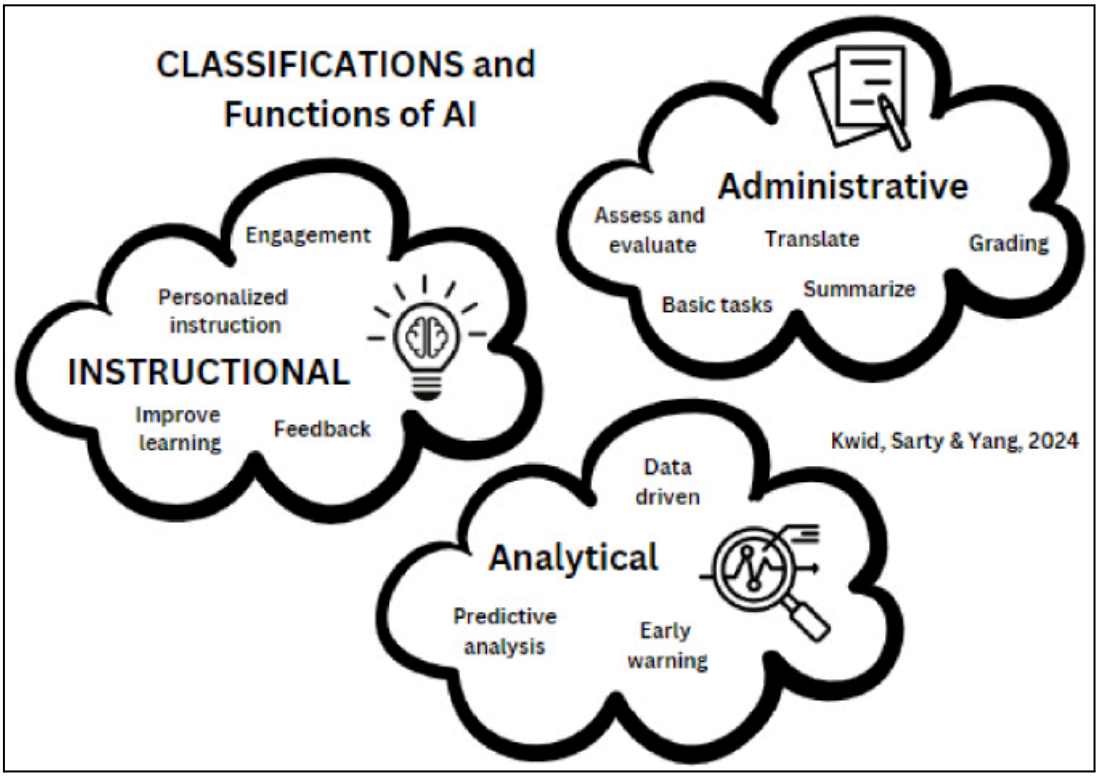


Figure: 9 Classification of AI Tools (Kwid et al., 2024)

Table 2 shows the tools sourced from Teacher Academy's curated blog and classified based on the category definition (Teacher Academy, 2024). These tools were selected for their relevance to curriculum development tasks from lesson planning to evaluation rubrics. While most current tools focus on resource and lesson generation rather than full curriculum sequencing, they offer valuable insights into how AI might evolve to support broader planning functions. Some tools serve multiple purposes, where this is the case they are included in multiple categories e.g. ChatGPT, Eduaide. From this classification exercise, it appears that instructional tools are widely available followed by Administrative and Analytical. Some of the findings related to special purpose tools (e.g. Eduaide, Twee) are based on the data collected from their respective websites, so an element of bias may exist. However, in section 8.2.1 a third party evaluation is also presented. Tools highlighted in bold in this table are those whose impact have been researched and reported in section 6.2.1. Some of the findings related to special purpose tools (e.g. Eduaide, Twee) are based on the data collected from their respective websites, so an element of bias may exist. However, in Section 8.2.1 a third party evaluation is also presented.

Category	Definition	AI Tools
Instructional	Improve teaching and learning activities through personalised instruction, intelligent tutoring and adaptive curriculum.	• **Eduaide, Twee, Diffit, MagicSchool, Genially, ChatGPT, Gemini.** • Curipod, Gamma, Quizgecko, Yippity, Claude, DeepSeek, Character.ai.
Administrative	Assist with lesson planning, grading, communication and classroom management to reduce teacher workload and improve focus on student engagement.	• **Eduaide, MagicSchool, ChatGPT, Gemini.** • Pinokio AI Browser, Claude, DeepSeek.
Analytical	Analyse data to generate insights, predict learning patterns and support personalised education decisions.	• **Gemini, ChatGPT** • Meshy, Luma AI, DeepSeek, Claude

Table: 2 Classification of Selected Tools for AI-Based Curriculum Development

This classification provides a foundational framework in understanding the diverse roles Generative AI tools can play in curriculum development. It can also serve as a structured way to select and implement Generative AI tools for specific goals like instruction. For example, tools like Eduaide can support the creation of lesson plans and Genially can help to create learning that is interactive, enhancing engagement and comprehension. This sets the stage for evaluating their real-world impact and how they shape current teacher practices and long-term planning. Therefore, the next section examines the reported impact of curriculum development across both grey and academic literature.

6.2 State of Reported Impact of AI Tools for Curriculum Development

This section begins with an overview of the selected tools and their reported impact according to their developers. Subsequently, an analysis is presented on the reported impact of general-purpose Generative AI tools on primary schools and beyond. To augment these findings, an in-depth synthesis of academic literature is provided covering opportunities, models and frameworks and specific education contexts for curriculum development and gamification.

6.2.1 Overview and Impact of Selected Tools

We have conducted an in-depth analysis of five proprietary AI tools for curriculum design that can support primary school teachers and special school teachers. In some instances, examples of impact in higher education may be cited, however, the features of these tools can have a comparable impact in primary schools. These are Eduaide, Twee, Diffit, MagicSchool and Genially. Table: 3 describes the purpose of these tools, along with a list of countries where they are reported to have had an impact.

Tool	Purpose	Impacted Countries
Eduaide	It helps to develop instruction materials e.g. lesson plans, graphic organisers, educational games.	Canada
Twee	It helps to create, share and grade language lessons.	Poland, Germany, UK
Diffit	It helps teachers to create and adapt instructional materials for diverse classrooms.	USA
Magic School	It helps teachers to create immersive learning experiences (e.g. lesson plans, differentiation, assessments).	USA
Genially	It helps teachers to create interactive and gamified teaching resources.	Spain

Table: 3 Purpose of Selected Tools and Impacted Countries

These tools were selected based on their relevance to classroom practice, accessibility for teachers and interestingly a subset of them i.e. Eduaide and MagicSchool are created by teachers (Texas Computer Education Association (TCEA), 2024). However, by no means does this report prescribe one over the other, but rather aims to present a balanced overview of each tools' capabilities to support informed decision making in specific contexts. These tools also represent a range of features from lesson planning to interactive content creation, offering a balanced view of current capabilities in AI-assisted curriculum design. Moreover, with the growing landscape of AI tools in education, it was necessary to limit scope to a manageable number to allow for meaningful analysis and comparison.

According to a case study published on a SaskOER website, Eduaide has been reported to help reduce teachers workload, improve lesson quality and engagement with their students (Fischl, 2023). In addition, it helps teachers align content with pedagogical frameworks like Bloom's Taxonomy (Krathwohl, 2002) and Gagne's Nine Events of Instruction (Kruse, 2009). It supports up to 16 languages, but it appears that the Irish language is not supported yet. Also, its AI assistant called Erasmus helps modify lesson plans and activities for learners with varying abilities including those with special educational needs.

Twee is saving time for teachers for language (ESL, EFL) and special school teachers while creating lesson plans. Twee's website claims that numerous teachers have shown support for this tool and there are several testimonials available on their website (TWEE, n.d.). It supports up to 10 languages, but again Irish support is not yet available. It has also positively impacted institutions like University of Wroclaw Poland, Valentin-Heider-Gymnasium and Schillerschule Hannover School and University of Sheffield.

Diffit is also a tool that can support primary and special school teachers by allowing them to create personalised learning paths based on their students' needs. A 2024 survey conducted by Diffit during November, in partnership with a third-party evaluator, gathered responses from 2,517 elementary and secondary users and highlighted the platform's reported impact on

teaching practices. 96% of the teachers reported it saving their time, 93% reported it reaching students where they are and 86% reported it making them better teachers (Diffit, n.d.). Although the website cites a third-party evaluator, the outputs may be biased due to limited details of the survey process.

MagicSchool has 80+ tools for reducing teacher workload and enhancing their efficiency whilst designing and developing curriculum. They have several case studies on their website to indicate how schools are using their technology to personalise learning and transform student outcomes (MagicSchool AI, n.d.-a). For example, Aurora public schools in Colorado USA report a 28% improvement in students meeting literacy grade level expectations through using MagicSchool tools. Similarly, West Vancouver schools report rapid adoption of MagicSchool in K12, with nearly half of teachers using it. In addition, Dublin City schools in Ohio, USA which has 25 schools (Dublin City Schools, n.d.) in total report 90% teacher adoption through intentional policy and professional development. Also, recent technology reviews have started to report that teachers can use five features for inclusion i.e. text leveller, text scaffolders, sentence starters, exemplars, and non-exemplars as modifications and accommodations tools to include all students in the classroom and have equal access to the content (Li & Li, 2025) .

Genially can be used by teachers to create visually engaging presentations, gamification and images and audio creation for their lessons. A non-English study, that appears to be non-peer reviewed, reported through case studies and classroom observations that Genially's use can lead to increased motivation of students and improved understanding of history education in secondary schools. It enhanced meaningful learning and the active participation of students (Montero Reyes et al., 2024). In addition, a peer reviewed study published a case study about using Genially games, indicating that it injected vitality into the learning environment (Aldalur, 2025). Moreover, it also enhanced student engagement, fostered a sense of social involvement, and positively influenced how students perceive academic challenges. However, this is evaluation in the context of degree level students, and not targeted towards primary school teachers' curriculum development practices.

In summary, there are a variety of AI-based tools available that can support primary school and special school teachers with curriculum design activities like lesson planning, differentiation, assessments, and adapting content for diverse classrooms. The key areas of reported impact are improving teacher efficiency and reducing workload, inclusion, enhanced student outcomes, increased motivation of students, and improvement in teaching practice. Language support is available in most of the tools, but the Irish language is not yet supported by these tools.

6.2.2 Impact of General and Specialised Tools

In addition to this analysis, there are some case studies reporting the impact of general purpose Generative AI tools like OpenAI's ChatGPT, Google Bard (renamed to Gemini in early 2024 (Nieva, 2024). Others report impact with special purpose tools like Memrise (Memrise, n.d.), and Teachermatic (Teachermatic, n.d.) when adapted to the needs of teachers and students. The following section documents three case studies, reporting how the use of such AI-based tools had a positive impact on teaching practices like curriculum development to include lesson planning and content creation in the UK (The Open Innovation Team & Department for Education, 2024).

6.2.2.1 King Edward VI School - Use of ChatGPT and Memrise

King Edward VI School explored the use of Generative AI for student learning, in particular language education. Teachers at the school used ChatGPT as well as subject specific Generative AI tools such as Memrise, which is a GPT-3 powered AI tool for language learning. Teachers were experimenting with using this tool as a tutor for A-level students to practice exam-style oral questions. Students could practice speaking with this tool, which could correct their speech and continue the conversation. Students reported that this was a gentle and engaging approach and less intimidating than interacting with teachers. In addition to Memrise, ChatGPT is being trialed as a personal revision assistant, helping students to write prompts to generate arguments for an essay.

6.2.2.2 Basingstoke College of Technology - Use of Google Gemini (formerly Bard)

Basingstoke College of Technology used Generative AI tools like Google Gemini, ChatGPT and Teachermatic for lesson planning and content creation to save teachers time and improve the quality of teaching. Teachers were supported by provision of prompt templates tailored to their lesson planning needs. In addition, teachers used apps like Conker for quizzes.

The main reason to use Google Gemini was its intuitive user interface, clear GDPR policy and ease of auditing, as a staff login was required. They were also offered group and individual training. Both new and experienced teachers reported an improvement in quality of teaching plans, activities and resources generated, along with time savings. Notwithstanding these benefits, it's important that teachers remain vigilant of the accuracy and potential bias in the outputs.

6.2.2.3 Bolton College - Use of In House ADA tool and ChatGPT

Bolton College has been using an in-house chatbot called ADA, which was developed using IBM Watson. It was used for supporting students' course-related queries, with the aim of saving staff time. Initially, it was a generic chatbot, but due to the need to train it on vast amounts of data, it was limited to course-related questions only. To further improve it, ChatGPT is now being integrated for faster information retrieval, enabling two-way conversations and reducing the time needed to train it on a specific subject. Through this integration, users can upload course documents or provide URLs (Mozilla Developer Network, n.d.) to obtain relevant answers. It is still limited to college content only, to ensure accuracy and contextualised responses. Early use of ADA indicated a 3% rise in student retention and an extra £200k in revenue. The enhanced ChatGPT-ADA's impact still needs to be assessed (as it was launched only in September 2023); however, it is expected that it will empower teachers to create subject specific chatbots that will help students personalise their learning.

6.2.3 Limitations of Grey Literature

While grey literature has provided insights into how AI tools are impacting the curriculum development practices of teachers across primary schools and beyond, it generally lacks methodological rigour, peer review and theoretical grounding. Practitioners tend to publish case studies and share experiential insights often through blogs and informal platforms, offering valuable real-world perspectives, but the absence of formal peer-review process may affect the quality of articles. Additionally, long-term access to these sources can be uncertain, as they are frequently shared on temporary or changing web links. Such issues can make it challenging to understand the long term effects and evaluate the outputs. To address this gap, the following section synthesises and presents a detailed analysis of recent academic research on AI tools integration in curriculum development by teachers.

6.2.4 Academic Literature Perspective

The fundamental role of AI in the context of curriculum development is to augment, enhance and elevate the curriculum development process by acting as a collaborative partner and supportive agent that automates time intensive tasks (Elkordy & McVey, 2025; Lusi et al., 2025; Zagkotas, 2025). Combining the latest academic research reveals that the integration of AI in curriculum design and development aligns with three key objectives i.e.,

1. Alignment with standards
2. Adapting content for diverse learners and
3. Generating specialised instruction materials.

One such example is the use of a conversational agent developed using Microsoft Copilot Studio which accessed Thai Qualifications Framework (TQF) aligned metadata to generate personalised course recommendations for second year IT undergraduate students in Bangkok (Nattawuttisit et al., 2025). By utilising techniques such as scoring of courses based on the

alignment of learning outcomes, the system ensured that each recommended course corresponds with student preferences and the academic criteria outlined by TQF. Similarly, ChatGPT and DALL-E facilitated adapting content to diverse learners in Iran, Iraq, Kuwait and Egypt. With these tools, nuanced resources like bilingual storybooks, bicultural calendars and intercultural communication handbooks were created (Mahmoudi-Dehaki & Nasr-Esfahani, 2025). In academic literature, AI is also reported to have assisted in project planning, provision of learning resources and evaluation as part of Pancasila Student Profile Strengthening Project in Indonesia, which falls under generating specialised instruction materials (Aliyyah & Amalia, 2025). For example, in contextual project planning, it can analyse demographic data, local culture and needs of students to generate project ideas that are meaningful and relevant to the school environment in which they are studying and reflects student preferences and national standards.

These are just a few examples of the types of impact of the mainstream Generative AI tools in curriculum development, as reported in the academic literature. To help illustrate the most frequently discussed Generative AI tools in the 11 selected academic studies through snowballing for this particular research question, a word cloud is created as shown in Figure: 10. It is evident that the mainstream Generative AI tools are more discussed, or used for research, in comparison with special purpose tools for curriculum creation.

Subsequent sections present a synthesis of the opportunities, models and frameworks, specific educational contexts such as maths, STEM, second language curriculum and gamification for AI-driven curriculum development based on the latest academic literature. This helps to build a comprehensive understanding by integrating theoretical insights with practical applications across diverse educational contexts.

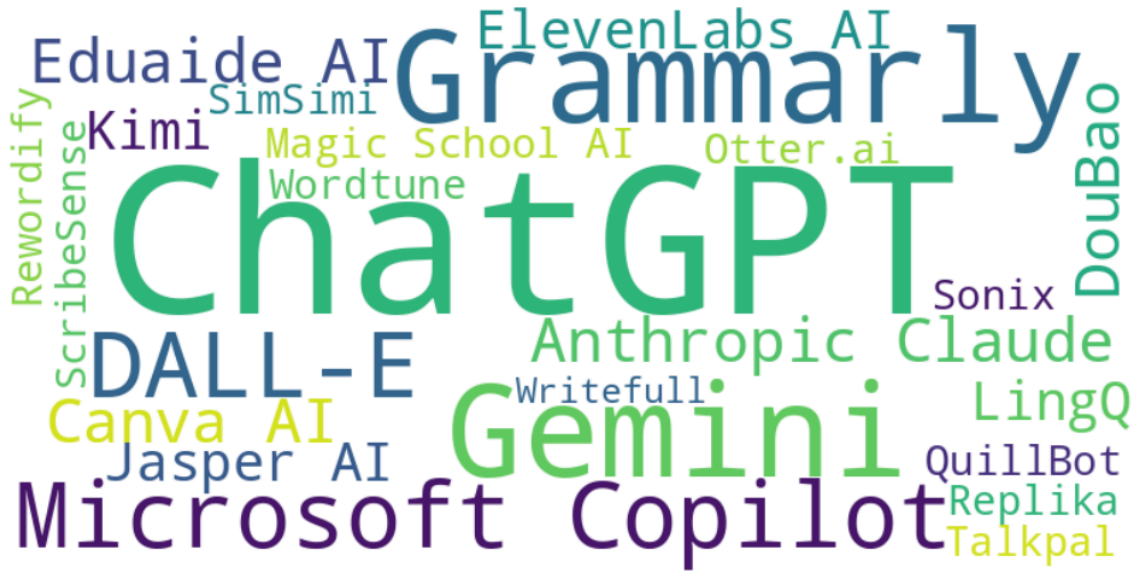


Figure: 10 Generated Wordcloud of Generative AI tools for Curriculum Design (as reported in peer reviewed academic literature)

6.2.4.1 Opportunities

The potential afforded by AI in curriculum development for teachers is immense. This section outlines some of the opportunities identified and demonstrated in academic literature.

6.2.4.1.1 Personalisation and Adaptability

Current research is consistent in reporting that personalisation and adaptability are the core opportunities of integrating AI in curriculum design. AI enables a fundamental shift from static curriculum to a dynamic, student-centered learning environment that targets individual needs, pace and preferences. Moreover, by making use of machine learning techniques and data analytics, AI can support the creation of a curriculum that adapts to the needs of diverse student populations as well (Zagkotas, 2025). It has been demonstrated in existing studies that AI-based solutions like intelligent tutoring systems can dynamically adjust to learners' progress and preferences (Aliyyah & Amalia, 2025). Moreover, a framework called SCALE (Substitution, Co-construction, Automation, Learning, Evolution) has a stage Learning (L) focused on

personalised learning (Elkordy & McVey, 2025). It is a progressive framework for faculty AI literacy that uses five stages to guide educators towards transformative instructional design. Generative AI offers real-time feedback and adaptive curriculum recommendations. For example, Copilot introduces new possibilities for academic decision-making and curriculum design, paving the way for a more flexible and student-centred learning environment (Nattawuttisit et al., 2025). Furthermore, AI-based tools can adapt content to learners' regional and cultural contexts that are linguistically appropriate and personally meaningful (Mahmoudi-Dehaki & Nasr-Esfahani, 2025). To conclude, adaptive learning systems have long enabled personalised learning by creating multiple versions of the same content; however, Generative AI advances this by enabling real time content adaptation, sometimes referred to as hyper personalisation (Saranya & Sankaradass, 2023).

6.2.4.1.2 Automation of Content Creation

Another key benefit of integrating AI in curriculum design is the automation of content creation. This helps to improve efficiency by reducing workload and facilitates creation of personalised high quality instructional materials at an unprecedented scale. Educators can now focus on pedagogical and creative aspects of teaching, rather than spending time on drafting explanatory text or retrieving scientific data (Zagkotas, 2025). One prominent example reported in this context is AI-assisted authoring of school textbooks (Zagkotas, 2025). In addition, such tools can automatically generate exercise and assessment questions from existing text books, facilitating large scale production. One study has reported that AI tools have helped educators to reduce time for creation of a single Multiple Choice Question (MCQ) by up to 80% (Raskob et al., 2025). Teachers already report that Generative AI tools are helping them save time while creating lesson plans and resources and help them streamline administrative processes (Iqbal et al., 2025). It can also support the creation of contextually rich materials across various learning strands for second language curriculum (Rahmawati et al., 2025). However, AI should not be seen as a substitute for teachers but rather as a feasible resource that reduces the design burdens for educators that can augment curriculum development

process giving them sufficient time to dedicate to effective teaching and student engagement (Lusi et al., 2025) . Despite the speed of content creation with these tools, educators must act as curators and quality gatekeepers of the outputs ensuring accuracy, language and sensitivity (Zagkotas, 2025).

6.2.4.1.3 Updating Content (Align with Advancements)

AI tools can analyse thousands of publications and references to recommend specific concepts or content updates to teachers. This approach has already been applied in higher education contexts where learning analytics tools are used to detect content gaps and identify outdated segments within syllabi (Zagkotas, 2025). This suggests that AI-enhanced curriculum can remain dynamically aligned with contemporary scientific advancements, incorporating up-to-date examples and real world applications. This can, in turn, make learning more responsive to societal and technological change. Adaptability and continuous updating have been emphasised by the ReKnow AI model[9] suggesting that AI systems should incorporate feedback loops based on learning data and performance analytics to enable refinement of curriculum (Zagkotas, 2025). Other researchers have found through case studies that curriculum development supported by data-driven insights can be implemented more effectively and consistently across diverse educational contexts (Lusi et al., 2025). However, care should be taken as AI's role is to augment, not replace, the educator.

6.2.4.1.4 Curriculum Mapping Efficiency

AI can also enhance efficiency and creativity of curriculum mapping in specific education contexts. As referred to previously, a study in the field of Medical Education has provided 12 tips for medical educators on how AI can enhance efficiency and creativity of the curriculum

[9] The term "ReKnow-AI" is a composite abbreviation that encapsulates the core logic of the proposed model. The prefix "ReKnow" derives from "Recontextualized Knowledge", referencing the process through which scientific knowledge is selected, adapted, and transformed to become teachable within the school context—a process conceptually grounded in didactic transposition theory (Zagkotas, 2025).

mapping process, while highlighting its limitations and boundaries as well (Raskob et al., 2025). These tips demonstrate the utility of AI applications for textual analysis, synthesis and transformation in different stages of curriculum development. For example, AI is shown to reduce the time required for tasks like identifying curriculum gaps and categorising learning objectives with promising accuracy along with helping to draft competency-based goals and objectives for rotations, which can be collaboratively refined and finalised within an hour. However, this efficiency makes it necessary to have human oversight to ensure content accuracy and pedagogical appropriateness, as human educators retain the moral agency and responsibility of the educational outcomes.

6.2.4.1.5 Teacher Support (Lesson planning, Question banks)

Generative AI is documented in existing research as a collaborative partner for automating routine tasks, alleviating the design burden and saving time (Elkordy & McVey, 2025; Zagkotas, 2025). It helps users to focus on pedagogical planning, narrative construction and quality assurance (Zagkotas, 2025) and enhances the agency of educators (Iqbal et al., 2025). It enables educators to efficiently adapt curriculum by omitting, adding and revising content to enhance engagement and personalisation. It can generate comprehensive resources like comparison tables, helping teachers to make decisions and save time (Raskob et al., 2025). These promising benefits of AI are an opportunity to involve teachers to reform outdated curriculum while utilising its remarkable proficiencies along with training teachers to be effective prompt engineers[10] (Lusi et al., 2025).

[10] Prompt engineering is a skill that will enable teachers to guide and customise Generative AI tools to produce desired outputs.

6.2.4.2 Models and Frameworks

Analysis of the latest research studies helped to recognise the available models and frameworks that can be deployed across AI-driven curriculum design processes. Reviewing their descriptions helped to understand they align with the following objectives:

- Structuring the development process
- Maintaining pedagogical coherence
- Ensuring teacher competency and agency
- Evaluating integrity and intellectual scope of generated content.

This is in line with the general expected objectives of AI integration in curriculum design as discussed earlier, from alignment of curriculum with standards to adapting content for diverse learners and generating specialised instruction materials. For each of the four objectives, this section describes two relevant frameworks and models which are also shown in Figure: 11.

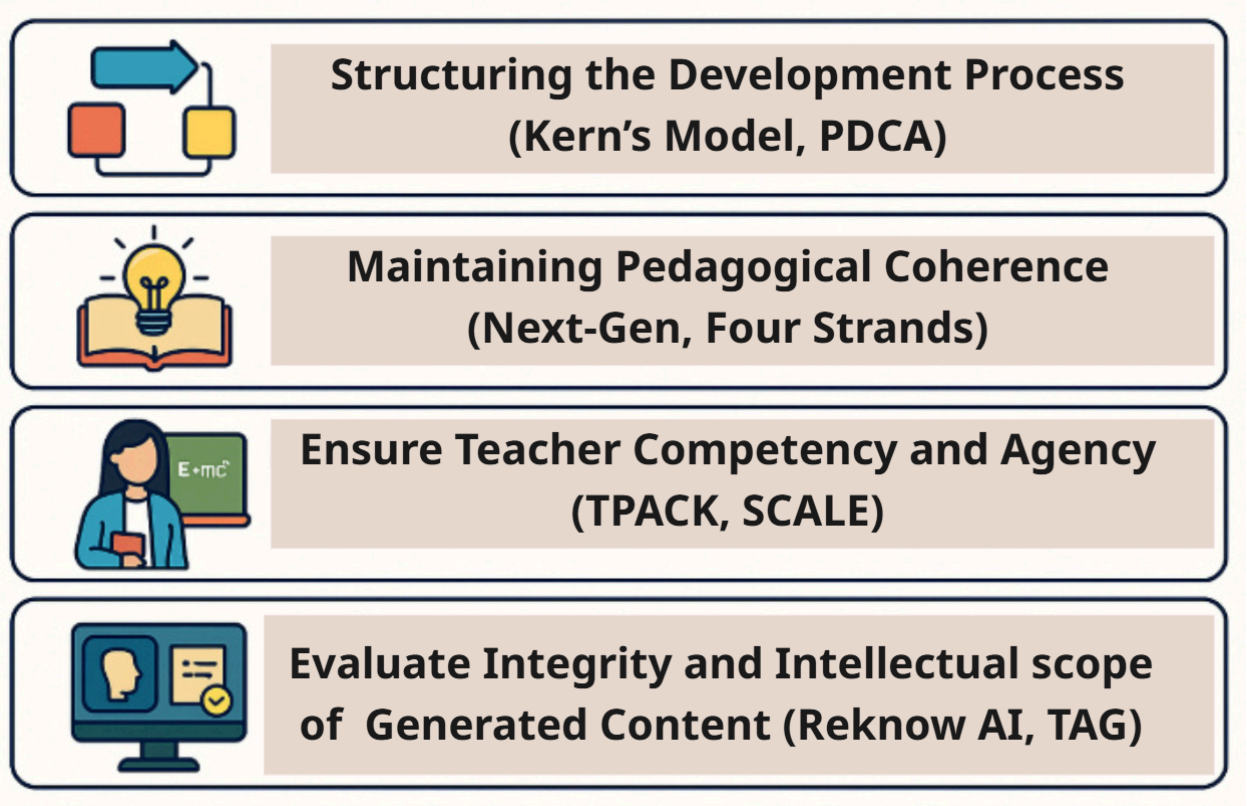


Figure: 11 Purpose of Models and Frameworks for AI-Driven Curriculum Development

6.2.4.2.1 Structuring the Development Process (Kern's Model, PDCA)

Models and frameworks are utilised to provide a defined, systematic structure for integrating AI in curriculum development, moving away from unstructured or purely manual approaches. For example, Kern's model provides a systematic structure for the curriculum mapping process in Medical Education (Raskob et al., 2025). It helps educators design and implement effective medical curricula which are evidence based, student centred and aligned with educational goals. The six key steps of this model are:

1. Needs assessment
2. Targeted needs assessment
3. Goals and objectives
4. Educational methods
5. Implementation
6. Evaluation

Although this model is targeted to medical education curriculum development, these six steps reflect universal pedagogical principles making it applicable for any modern student-centred curriculum development including primary education.

Another model that can serve as the foundational framework for Generative AI-based curricula design is Plan-do-check-act (PDCA) (Lusi et al., 2025), which was originally developed for Digital public infrastructure education. As the name suggests, it has four steps:

1. Curriculum assessment during **Plan** phase
2. Goal setting during **Do** phase
3. Curriculum alignment during **Check** phase
4. Curriculum review during **Act** phase.

A detailed overview of these four phases with a total of 14 sub activities are presented in *LLM-Augmented Curriculum Design: A Framework for Curriculum Innovation in Digital Public Infrastructure Education* (Lusi et al., 2025). In essence, PDCA is intended to ensure a

continuous improvement loop where curriculum development is regularly evaluated, refined and aligned with learner needs and outcomes.

6.2.4.2.2 Maintaining Pedagogical Coherence (Next-Gen, Four Strands)

The application of models and frameworks is very important to ensure that the efficiency gained through AI does not undermine the educational quality and coherence of the learning experience. For example, Next-Gen Learning pathways is a framework proposed for higher education in Thailand that combines AI-powered semantic analysis with structured national education needs (Nattawuttisit et al., 2025). It maintains pedagogical coherence by fusing AI with Thai Qualifications Framework (TQF), so that each recommended course corresponds with both student-specific preferences and the academic criteria outlined by TQF.

Another interesting framework in the context of second language curriculum design in Indonesia is Four Strands Framework, which is used as guidance for creating pre-class learning modules (Rahmawati et al., 2025). This framework has been reported to be specifically valuable for conversational English as a foreign language (EFL) instruction because it mirrors the naturalistic conditions of language acquisition while maintaining systematic attention to formal aspects of language. It emphasises balancing the four key elements (meaning focused input, meaning focused output, language focused learning, fluency development) to make it an ideal foundation for developing comprehensive pre-class materials that address the complex requirements of conversational skills development. Pedagogical coherence is maintained by requiring balanced attention across all four elements, mitigating the risk of pedagogical fragmentation[11] which is inherent when AI generates content for isolated instructional purposes.

[11] Pedagogical fragmentation is the risk where AI's efficient generation of content for specific, isolated instructional purposes undermines the integrated and balanced learning structure required by a framework, causing materials to lack pedagogical coherence.

However, the teacher's role remains critical to maintain coherence ensuring that the generated content is unified and pedagogically sound. In addition, it has been reported that AI models can support informed decision making (Raskob et al., 2025). For example, they can create comprehensive comparisons that evaluate various instruction methods across critical factors like learning autonomy, cognitive load, and real time adaptability assessment. These comparisons provide teachers with an in-depth view of how various instructional methods address specific competencies while at the same time empowering them to make informed decisions rather than dictating the approach.

6.2.4.2.3 Ensure Teacher Competency and Agency (TPACK, SCALE)

Frameworks are introduced in the context of AI-based curriculum development for teachers to manage AI effectively and safeguard their professional judgement from being marginalised by automation. For example TPACK (Technological Pedagogical Content Knowledge) emphasises that teachers require integrated knowledge combining technological expertise, pedagogical insight, and disciplinary understanding to effectively use AI (Zagkotas, 2025). It is a fundamental framework in understanding teacher readiness, development and ethics in AI-enhanced teaching (Iqbal et al., 2025). Although TPACK has existed long as a foundational framework in educational technology, its emphasis on integration of content, pedagogy, disciplinary understanding and technology makes it more important than ever in navigating the complexities introduced by Generative AI.

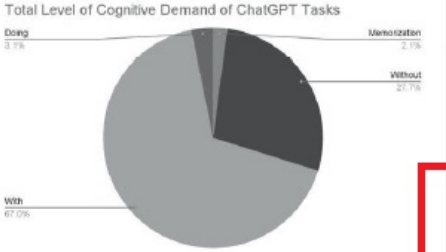
As referred earlier, SCALE is another framework that positions AI as a collaborative partner to augment human expertise (Elkordy & McVey, 2025). It guides educators in higher education to automate routine tasks (Substitution, Automation) to complex collaboration (Co-construction), supporting personalised learning (Learning) and enabling transformative instruction redesign (Evolution). The aspect of augmenting human expertise aligns with related research, which reports that AI should be primarily used as an assistive tool, with humans remaining central to

the curriculum design process (Lusi et al., 2025; Zagkotas, 2025), thereby furthering teacher agency (Nattawuttisit et al., 2025) .

6.2.4.2.4 Evaluate Integrity and Intellectual scope of Generated Content (ReKnow AI, TAG)

Models and frameworks also provide criteria for critically evaluating the quality, ethical profile and appropriateness of content produced or curated by AI systems. For example, ReKnow AI is a framework that focuses on transparency and accountability, ethics and inclusivity (Zagkotas, 2025). It advocates for the need to have safeguards against algorithmic bias to ensure content is culturally responsive and representative of diverse perspectives. Without awareness of and adherence to guidelines provided by such frameworks, the use of AI risks reinforcing epistemic biases[12] and diminishing teacher agency in curriculum decisions. An example of this is AI models replicating the patterns found in existing commercially successful teaching resources, rather than designing original pedagogical content. In addition, less experienced teachers e.g. those in pre-service may demonstrate over confidence in AI's abilities to generate resources and are less critical when selecting them (Sawyer & Aga, 2025). Similarly, frameworks like TAG (Task Analysis Guide) can reveal if the tasks generated by AI like ChatGPT are appropriate for a specific grade level (Sawyer & Aga, 2025). One example of the use of this framework in Saudi Arabian primary schools revealed that the tasks (for mathematics curriculum) generated required higher-level cognitive demand (over 70% of tasks, as shown in Figure: 12) than the students' specific grade level and also the activities were repetitive and inappropriate.

[12] Epistemic injustice within educational settings is a pervasive issue that significantly impacts students' access to knowledge and their experiences in learning environments. This form of injustice occurs when individuals are unjustly treated or excluded based on their social identities, such as race, gender, or socioeconomic status, resulting in the devaluation or dismissal of their knowledge and perspectives (Omodan, 2023).



Level of Cognitive Demand		Frequency	Percentage
Lower Levels of Cognitive Demand	Memorization	4	2.1%
	Procedure Without Connections	53	27.7%
Higher Levels of Cognitive Demand	Procedures With Connections	128	67%
	Doing Mathematics	6	3.1%

Figure: 12 Total level of cognitive demand on ChatGPT's tasks (Sawyer & Aga, 2025)

Reviewing the models and frameworks in this section suggests that if frameworks like ReKnow AI, TAG or any other in this context are applied, it is possible to maintain integrity of the curriculum creation using AI. To re-iterate, all of these models and frameworks emphasise the need of human oversight and judgement to guide AI systems efficiently for development of curriculum (Lusi et al., 2025; Zagkotas, 2025).

6.2.4.3 Specific Educational Contexts

This section gives examples of specific education contexts like Maths, STEM and second language education where AI-driven curriculum development has been shown to enhance efficiencies, support alignment with frameworks and transform pedagogical practices. However, these studies still advocate for the need of final reviews by teachers and training them in AI concepts like prompt engineering.

6.2.4.3.1 ChatGPT for Mathematics Curriculum Development

As referred to previously in the context of the TAG framework, a study in Saudi Arabia has explored ChatGPT for creating an elementary school Mathematics curriculum (Sawyer & Aga, 2025). Through this research, it was found that ChatGPT can generate tasks with a significantly higher level of cognitive demand than traditional online resources, requiring students to explain

their thinking. Although the quality of output was good, the tasks suffered from a repetitive nature such as using identical language and boilerplate phrases like 'discuss real-life scenarios' which may lead to classroom implementation being repetitive and boring. In addition, one key weakness across all of the 191 analysed tasks was the lack of mathematical explanation or description of underlying concepts. This indicates the need for teachers to act as critical curators who must refine the output using their pedagogical expertise. This highlights that ChatGPT alone is not currently a reliable curriculum creation tool for mathematics due to its difficulty with mathematical reasoning and its tendency to produce inaccurate content, advocating for the need to teach teachers AI techniques like prompt engineering for effective use of AI. However, the scope of studies used in this section was limited to those identified as part of snowballing for this particular research question. This may have excluded related research in other areas. Further research and inclusion of other studies beyond applications of mathematics could enrich and expand these findings.

6.2.4.3.2 Copilot for STEM Education

In order to address the rigidity of traditional programmes and failure to adapt to dynamic needs of 2nd year college IT students in Bangkok, AI i.e. Microsoft Copilot was integrated to generate personalised recommendations and enhance curriculum design in STEM education (Nattawuttisit et al., 2025). A scalable curriculum framework (called Next-Gen Learning Pathways) as described in previous section, was introduced that combines semantic relevance, outcome alignment and structural flexibility into a weighting scoring system. Along with recommending courses, it classifies the modules into five qualitative tiers from No Match to Strong Match, to guide academic planning. This helps to quickly see which modules best align with the goals.

While this study is targeted at degree level students, the scoring system can be adapted in primary education level as well because of its potential to support personalisation. The initial pilot demonstrated that the outputs i.e. recommended courses strongly align with learner

profiles and Thai Qualification Framework (TQF) domains. This study also notes that effective integration of AI in curriculum design requires human expertise. For instance, to review AI recommendations for accuracy, language and sensitivity to mitigate risk of hallucination and ensure pedagogical coherence, which is in line with related research findings (Zagkotas, 2025).

6.2.4.3.3 Second Language Curriculum

The integration of AI in second language curriculum can help to transform pedagogical strategies and increase efficiency. One particular application of AI in this context is the creation of culturally responsive resources like bilingual storybooks and localised conversation booklets[13] (Mahmoudi-Dehaki & Nasr-Esfahani, 2025). However, to effectively integrate AI tools such as ChatGPT, Copilot, DALLE-3, Kimi (Kimi, n.d.), DouBo (Doubao, n.d.), to develop second language curriculum, teachers need professional development (Iqbal et al., 2025) , which is a recurrent theme in the research studies. This is essential due to the key limitations of AI such as it can struggle to understand context, give reliable feedback and keep teaching consistent. That's why teachers need to stay involved to make sure that the learning stays true to sound educational principles. Moreover, the systematic deployment of AI across all four strands of Nation's Four Strands Framework[14] in Indonesia suggests that it is not a replacement for pedagogical expertise. However, it is a pedagogical amplifier that extends educators' capacity to implement theoretically grounded instruction at scale (Rahmawati et al., 2025). These findings align with Vygotsky's concept of mediation, which suggests that tools extend human cognitive capabilities (Troitsky et al., 2023). Therefore, it is apparent that the future of AI integration in the context of second language learning e.g. EFL is not about choosing between human expertise and AI, but understanding how both can collaborate to create more effective, accessible and meaningful learning experiences (Rahmawati et al., 2025).

[13] Teachers created localised conversation booklets to adapt dialogues to regional contexts, such as marketplace bargaining scenarios, complete with culturally specific phrases and phonetic transcriptions.

[14] The Nations Four Strand Framework is a foundational approach to language learning and teaching that advocates for a balanced curriculum incorporating four essential strands i.e. 1) meaning-focused input, 2) meaning-focused output, 3) language-focused learning and 4) fluency development (Rahmawati et al., 2025).

6.2.4.4 AI-Driven Gamification in Primary Schools for Improved Learning Outcomes

Alenezi's study (2023) focused on primary school teachers' perceptions of AI-driven gamification reported that this synergistic approach can enhance motivation, engagement and learning outcomes in students. Gamification integrates game-like features into the learning process to harness students' motivational impact in education. Common elements include points, badges, leader boards, and progression through levels. Teachers could use AI-driven gamification to customise content and challenges according to each student's individual needs and preferences. Hence, they observed heightened enthusiasm, increased participation and a stronger commitment to learning among their students due to enhanced effectiveness of gamification. However, challenges like professional development, technical glitches and curriculum alignment were uncovered as well. Other studies also raise similar concerns like lack of adequate training, technical and infrastructure problems e.g. unreliable internet issues and seamless integration of gamification into existing curriculum (Aliyyah & Amalia, 2025; Iqbal et al., 2025).

Teachers had a consensus on conducting longitudinal studies to adequately assess the long term effects of AI driven gamification (Alenezi, 2023). This study proposed five recommendations out of which one key suggestion was the need for collaboration between educational authorities and institutions to ensure seamless integration of AI-driven gamification into the curriculum. This involves aligning gamified activities with educational objectives to maximise learning benefits.

6.3 Long Term Curriculum Planning for Maximised Impact with AI Tools

While grey and academic literature has explored how AI can enhance curriculum development for primary schools and beyond and highlighted areas of improvement, long-term curriculum planning remains a critical yet under addressed area requiring focused attention. This is

important, because one of the most common use cases of AI reported by mainly primary and secondary teachers in UK in the last couple of years is creating lessons and/or curriculum resources (62% in 2023, n=280) and planning lessons/curriculum content (42% in 2024, n>9k) (Cutler, 2025). However, without a common understanding of AI's role in curriculum processes (e.g. the described opportunities, models and frameworks, adoption in specific contexts) the use of these tools could be limited and potentially detrimental. In addition, detailed presentations of legislations, frameworks, success stories and ethical alignment are provided in the answers to the other research questions.

One manifestation of this can be the lack of understanding of medium and long-term curriculum by teachers, and utilising current general purpose Generative AI tools for generating short term lesson outlines. The reason behind this is that current Generative AI tools do not appear to be trained on any one coherent curriculum sequence and are therefore unable to create lessons that will sufficiently build on prior learning using appropriate vocabulary and achieve the objectives of a lesson in appropriately sized steps (Cutler, 2025). Copilot's Teach (Microsoft Education, 2025) feature or Notebook LM (Google, n.d.) can be a potential workaround by allowing teachers to feed their internal curriculum documents to guide lesson generation and resources like mind maps, rubrics, flash cards and quizzes. However, currently its effectiveness is limited by issues such as inconsistent output quality, lack of pedagogical nuance and potential privacy concerns when uploading sensitive institution content. Nonetheless, only teachers know what has been taught previously, how knowledge will build in the future and the specific outcomes that need to be mastered to enable students to progress in a wider curriculum sequence. There is a need to train Generative AI tools with such contextual knowledge in order to improve the quality and relevance of the generated resources (Cutler, 2025). However, it is not a straightforward process due to two key reasons i.e.

1. How to feasibly collate and store all the information in a given curriculum in one place, from the progression in important concepts, to specific vocabulary and definitions to the ways in which students might be expected to apply their knowledge in different contexts?

2. How to give this information to Generative AI tools safely by avoiding the issues of privacy, inaccuracy of outputs and more importantly the intellectual property (IP) of curriculum?

An initial attempt to overcome these issues in the context of primary schools has been made, and has shown promising results (Cutler, 2025). However, this is a challenge for the sector as a whole, so collaboration between educators and technical experts is a necessity to achieve this goal and fully reap the benefits of AI-driven curriculum development in the long term.

6.4 Conclusion

While AI-driven curriculum development tools can transform teaching practices in primary schools, their full potential depends on thoughtful integration. The fundamental purpose of AI in this context is to augment, enhance and elevate the curriculum development process, functioning as a collaborative partner that automates time intensive tasks. This assistive nature aligns with research advocating for teachers to remain central to this process, thereby furthering their agency.

AI tools available to stakeholders are broadly classified into three categories: Instructional, Administrative and Analytical. Instructional tools are the most widely available. This type of tools include features from lesson planning to interactive content creation. The key reported impacts of AI tools are improved teacher efficiency and reduced workload. For example, one study reported that the time taken to create multiple choice questions was reduced by up to 80% (Raskob et al., 2025). In addition to efficiency, such tools have the potential to enhance inclusion

e.g. through features like text levellers and scaffolders. Language support is generally available, however, the Irish language still requires specific support.

Moreover, Generative AI is a progression towards personalised learning, enabling real-time content adaptation. However, the speed and complexity of the AI-generated curriculum makes it inevitable that teachers act as curators and quality gatekeepers, ensuring pedagogical appropriateness and accuracy. Teachers retain the moral agency and responsibility of educational outcomes.

Nonetheless, a potential threat to validity is the limited availability of research on AI-based tools (in particular open-source) for curriculum development in primary and special schools. An illustrative example of open source AI tools i.e. Aila has emerged from the UK, which is described in detail in the section on ethical alignment. To conclude, the promise of AI in curriculum development will be realised not just through these tools, but through strategic alignment with pedagogical goals, long-term planning and following well-structured models and frameworks.

7. Success Stories and Case Studies

This section will answer SRQ3.

SRQ3 asks: *What are some success stories or case studies in the context of AI-supported preparation for learning and teaching for primary and special school teachers from which we can derive learnings and recommendations?*

In order to address this, six core case studies are profiled, followed by a synthesis of key themes that emerged, success factors, critical considerations, and recommendations for Irish primary and special education contexts.

7.1 Introduction

The integration of artificial intelligence in education represents a significant shift in how teachers prepare for and deliver learning experiences. This section presents six peer-reviewed case studies representing the tier of primary education from Turkey, Uruguay, Ukraine, UK and a K-12 Innovation with Generative AI in Australia and New South Wales. Two of these examples first emerged in the grey literature, and more recent publications have enabled their inclusion as peer-reviewed studies to substantiate these initial findings. The case studies highlight the integration of Generative AI technologies in educational settings, with a substantial focus on primary school contexts, second language contexts and their relevance for teachers preparing learning experiences. Collectively, they represent diverse pedagogical approaches, teacher populations, and learner demographics. While the reviewed cases are predominantly situated in primary education, three studies span K–12 (kindergarten to secondary; 3-18 years old) contexts; their findings demonstrate substantial transferable relevance to primary school settings and teacher professional practice.

7.2 Scope and Limitations

This selection of six peer-reviewed studies reflects the current state of the academic evidence based on AI in primary education: empirically rigorous, geographically diverse, and increasingly attentive to bilingual and multilingual learning contexts. A particular strength of this selection is the inclusion of two case studies with an explicit focus on bilingual education, recognising the critical importance of language-responsive pedagogy in diverse societies. However, it is important to note that research specifically targeting special schools and students with complex additional support needs remains notably limited in the available literature. Nonetheless, one case study includes substantive evidence on classroom applications for students with special educational needs within mainstream contexts, offering some insights transferable to special school settings.

To extend the peer-reviewed foundation with applied evidence, two supplementary case studies from grey literature were included, encompassing government-led initiatives and bilingual educational contexts. These are presented in Appendix C. These supplementary examples include case studies from Spain and Brazil providing further evidence on real-world implementation, scalability, and policy considerations with potential relevance to the Irish educational context. Additionally, Appendix D showcases prominent examples of AI tool adoption across nine countries: the United States, China, South Korea, Finland, India, Singapore, Greece, Armenia, and Switzerland. These examples draw on grey literature sources. Trends and case studies often originate from very recent industry surveys and company reports, which have yet to be extensively scrutinised within the academic publication cycle. Inclusion is justified on the ground of relevance and timeliness while acknowledging potential positivity bias as an inherent limitation. Through this comparative overview, the table presented in Appendix D provides an international perspective on the types of AI tools and initiatives currently in use, highlighting the key features that characterise each country's distinct approach to AI integration in education.

7.2.1 ChatGPT in Primary Education (Turkey, 2024)

7.2.1.1 Context and Participants

Ugras et al. (2024) conducted a comprehensive qualitative case study involving 40 primary school teachers in Turkey who had no prior experience with ChatGPT. The study focused on evaluating ChatGPT's potential for sustainable educational practices aligned with United Nations Sustainable Development Goal 4: Quality Education.

7.2.1.2 Key Success Factors

Structured Professional Development: The research implemented a systematic 4-week training programme (10 hours per week), introducing teachers to ChatGPT's capabilities, practical applications, and integration strategies. This scaffolded approach enabled teachers to develop confidence and competence progressively, moving from basic awareness to practical application.

Personalised Resource Creation: Teachers particularly valued ChatGPT's ability to generate personalised activities, suggest materials, prepare lesson plans, and develop creative activities tailored to individual student characteristics. One participating teacher stated: "*The most difficult issues for me were preparing inclusive activities and conducting the lesson in line with different, creative ideas. Meeting with ChatGPT to solve these difficulties made me very excited*" (Ugras et al., 2024, p.9).

Subject-Specific Applications: Teachers identified ChatGPT as especially suitable for Mathematics, Turkish (mother tongue), and English lessons, with applications spanning explanation, application, and evaluation phases of instruction. The technology proved particularly effective in making associations with daily life and providing supplementary information across these subjects.

7.2.1.3 Outcomes and Impact

Teachers emphasised that ChatGPT could enrich teaching processes while also being user-friendly, contributing to SDG 4.1 (ensuring free, equitable, and quality primary education) and SDG 4.2 (increasing access to quality early childhood development services). However, teachers also raised critical concerns about potential misinformation, addiction risks, decreased communication, and appropriateness for younger age groups. Some of these views are evident in Figure: 13 below (Ugras et al., 2024, p. 13).

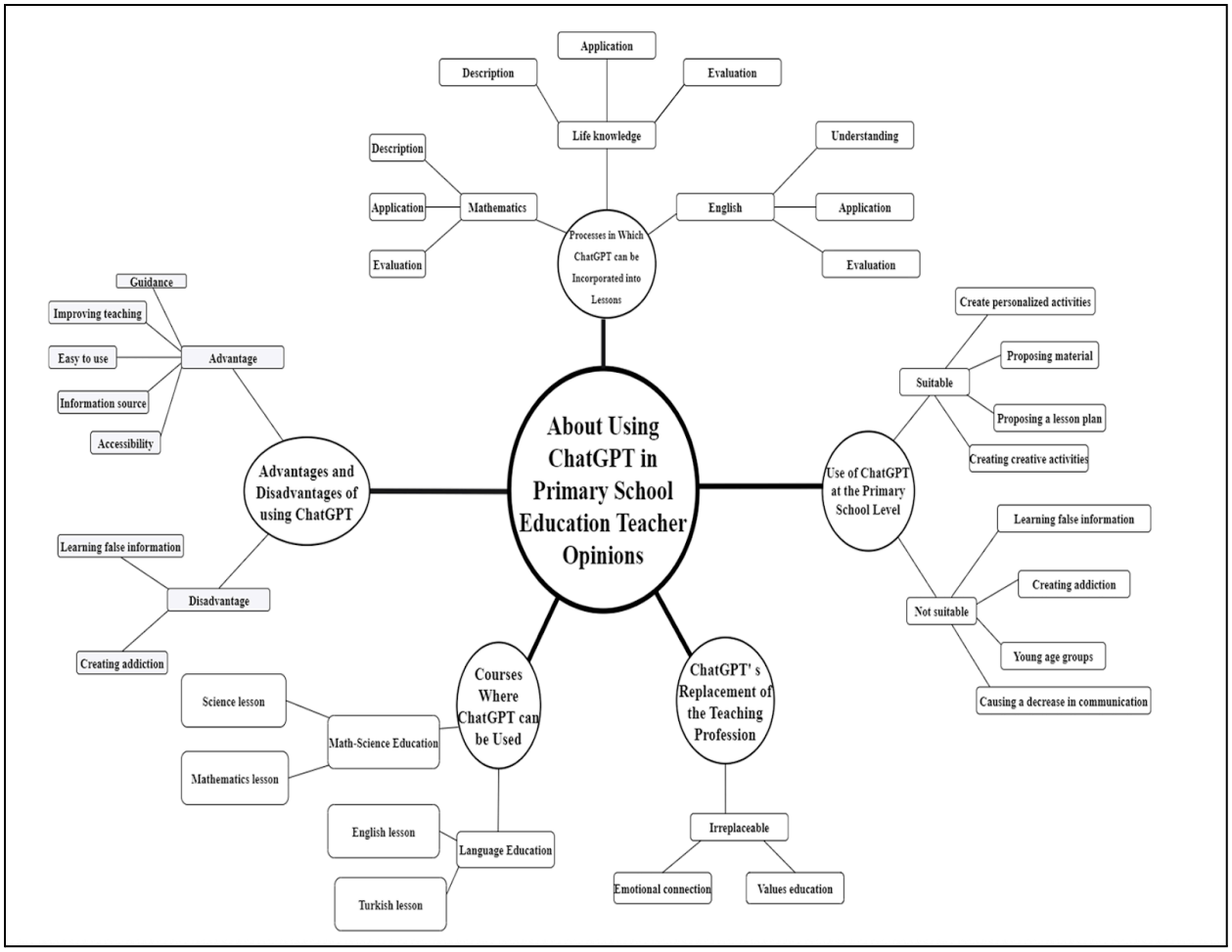


Figure: 13 Teachers' views on the use of ChatGPT at the primary school level.

Figure: 13 illustrates primary school teachers' perspectives on using ChatGPT in education, highlighting both opportunities and challenges. Teachers identified advantages such as improving teaching, providing accessible information, and supporting lesson design across subjects including mathematics, science, English, and Turkish. They viewed the tool as valuable for

creating personalised and creative learning activities, proposing materials, and developing lesson plans. However, concerns were raised about ChatGPT misinformation, dependency, and reduced communication. Overall, teachers regarded ChatGPT as a useful aid rather than a substitute for teachers.

7.2.1.4 Case Summary

The study further underscored that while ChatGPT can enhance instructional practice, it cannot replace the human dimensions of teaching. Teachers stressed that emotional connection, role modelling, and values education remain core elements of effective pedagogy, beyond the capabilities of AI tools.

7.2.2 Generative AI and Personalised Learning in Bilingual Primary Education (Uruguay, 2023)

7.2.2.1 Context

Jauhiainen and Guerra (2023) conducted an empirical study with 110 primary pupils aged 8–14 years (Grades 4–6) across four classes in two Montevideo schools. The study examined how generative AI (ChatGPT-3.5 and ChatGPT 4) could personalise learning materials to match pupils' diverse knowledge levels, interests, and backgrounds in a bilingual context where Spanish was the language of instruction. This study was described as **"globally one of the initial comprehensive tests"** (Jauhiainen and Guerra, 2023, p.9) examining Generative AI implementation in actual school curriculum contexts (not university settings), with real primary school students during regular lessons, making it a pioneering empirical study for its time.

7.2.2.2 Innovative Methodology

The research employed a sophisticated differentiation approach, using ChatGPT-3.5 to generate three levels of content (basic, intermediate, advanced) for each lesson topic in Social Sciences (History). Pupils were initially placed into knowledge groups based on their school grades, then dynamically reassigned based on their performance during the lesson, creating a responsive,

adaptive learning environment. Students did not interact directly with ChatGPT. Instead, the lessons were pre-generated by the researchers using ChaptGPT - 3.5/4 and then uploaded to the Digileac platform.[15] Students then accessed the content through laptops. Rather than a one-size-fits-all content, the study systematically created and tested content at basic, intermediate, and advanced levels for the same curriculum topic. Foundational lesson material was sourced from validated open educational resources (World History Encyclopedia) and translated into Spanish using ChatGPT-3.5 and ChatGPT-4 for grades 4 to 6. Both models demonstrated accurate translation capabilities with minimal hallucination due to controlled temperature settings[16] (Davis et al., 2024). A key difference emerged: ChatGPT-3.5 exercised flexibility in formatting source attribution, whilst ChatGPT-4 maintained consistent adherence to original text format. Following validation in English and Spanish, this verified foundational content was established as the basis for integrating into the adaptive Generative AI model for classroom delivery.

7.2.2.3 Key Findings on Personalisation and Bilingual Education

Enhanced Motivation Through Appropriate Content Matching: When AI-generated materials were well-matched to pupils' prior knowledge and interests, students reported significantly higher engagement. Two-thirds of pupils enjoyed learning with the generative AI-modified material, and only one in ten disliked it. Pupils who perceived the lesson content as appropriately pitched for their abilities demonstrated higher motivation and perceived learning gains.

Language and Accessibility: The study demonstrated that generative AI could successfully adapt content in Spanish, a high-resource language, enabling personalised learning in pupils' mother tongue. This has significant implications for bilingual education, as AI-generated content can potentially bridge language barriers and provide culturally responsive materials.

[15] The Digileac platform: https://sites.utu.fi/digileac/ supports digitally-assisted learning environments with Generative AI for all contexts.

[16] Temperature is a setting that controls how 'creative' or 'predictable' a language model like ChatGPT becomes when generating text. See https://gptforwork.com/guides/openai-gpt-ai-temperature for further information.

Cognitive Ergonomics: The research introduced the concept of "cognitive ergonomics"; the motivated cognitive interaction between pupils and curriculum content, optimally adapted through AI for pupils' cognitive abilities. This personalised approach helped prevent pupils from experiencing anxiety or boredom, both factors that contribute to educational dissatisfaction.

7.2.2.4 Success Metrics

A clear majority of pupils (57.2%) reported having learnt "much" or "very much" during the test lesson. There was a positive correlation between pupils' interest in the topic and their perceived learning experience ($r=0.389$, $p<0.001$), and between enjoyment of the lesson and perceived learning ($r=0.524$, $p<0.001$).

7.2.2.5 Case Summary

Jauhiainen and Guerra (2023) demonstrated that generative AI has promising potential to provide personalised learning experiences that cater to individual needs and help bridge educational gaps, especially in diverse communities taking into account differences in pupils' backgrounds. However, the authors stressed that these tools require further development, refinement, and optimisation to ensure proper adaptation and create impactful, inclusive, and sustainable learning in schools.

7.2.3 AI Tools for Literary-Artistic Content Generation in Primary Teacher Education (Ukraine, 2024)

7.2.3.1 Context

Nezhyva et al. (2024) explored the use of AI tools for generating literary-artistic content in preparing primary school teachers for professional activities in Ukraine. The study involved 138 bachelor students specialising in Primary Education and focused on creating engaging, multimodal content for literature reading lessons.

7.2.3.2 AI Tools and Applications

The research examined several AI platforms: Suno, Udio, and Boomy for literary-musical content generation, and Pictory, Lumen5, and InVideo AI for creating educational videos. These tools enabled future teachers to transform traditional text-based literary instruction into multi-sensory, interactive learning experiences.

7.2.3.3 Key Success Factors

Multimodal Engagement for Diverse Learners: AI-generated songs based on poems facilitated text perception and memorisation, which proved particularly valuable for students with special educational needs whose access to conventional text-based learning might be limited. One significant finding was that "rendering poems in song form aids in better memorisation of the text, enriching the active vocabulary" (Newhyva et al., 2024, p.138). This multimodality for engagement speaks to one of Universal Design for Learning's key pillars and underscores the validity of this example for catering to the needs of all students, pioneering inclusive education. (CAST, 2024).

Differentiation and Personalisation: The AI tools enabled pre-service teachers to create differentiated materials matched to students' language skills, learning interests, and developmental stages. This was especially instrumental in motivating less engaged learners and those with SEN by offering alternative learning pathways and representation forms.

Efficiency and Creativity: The platforms reduced planning time significantly whilst allowing teachers to focus on creativity and innovation in lesson design. Teachers could quickly generate high-quality, dynamic educational products without requiring special video editing skills.

7.2.3.4 Critical Considerations

The study identified important challenges including the need for content validation, technical support, and addressing ethical concerns. Researchers proposed measures to ensure responsible implementation, including rigorous content validation processes, teacher education, and development of clear policies for transparent and ethical AI usage.

7.2.3.5 Case Summary

Nezhyva et al. (2024) examined how AI tools support Ukrainian pre-service primary teachers in creating multimodal literary-artistic learning materials. Using platforms such as Suno, Udio, Boomy, Pictory, and Lumen5, participants transformed text-based lessons into interactive, multi-sensory experiences. The approach enhanced engagement, differentiation, and inclusion, particularly for students with special educational needs, while improving teachers' efficiency and creativity. Challenges included ensuring content quality, addressing ethical considerations, and providing adequate technical and pedagogical support. The study highlights AI's potential to foster inclusive, creative teaching when supported by strong training and governance frameworks.

7.2.4 K-12 Teacher Innovation with Generative AI (Australia, 2025)

7.2.4.1 Context

Blundell, Mukherjee, and Nykvist (2025) conducted an exploratory case study with 44 Australian K-12 teachers to understand their decision-making processes when considering Generative AI (Gen AI) use in teaching and learning. The research employed innovation theory to examine teacher actions and attitudes during the early adoption phase. This case study profile is expanded as the depth of the teacher narratives and the relevance of the direct quotations warrant a more comprehensive presentation of the context and experiences involved.

7.2.4.2 Key Findings on Teacher Professional Practice

Self-Directed Professional Development: Teachers (n=44) primarily developed Generative AI knowledge through a combination of self-exploration (77% explored independently), learning from knowledgeable colleagues (55%), and following online instructions (43%). Formal professional development was utilised by only 41% of teachers, indicating a largely autonomous, teacher-driven learning process. See Figure: 14 below.

Professional Learning and Development (PLD) strategies	Count
I explore GenAI on my own	34
I learn about GenAI from more knowledgeable colleagues/ friends	24
I explore GenAI with colleagues/friends	19
I follow written, audio and video instructions (e.g. social media, websites, YouTube) about GenAI	19
I attend formal professional learning-development activities about GenAI	18
Other…	6

Figure: 14 Teachers' strategies for developing Generative AI knowledge and skills (Blundell, Mukherjee, and Nykvist, 2025, p.7)

Pedagogical Applications: Teachers reported using Generative AI for lesson planning and differentiation (55%), with specific applications including personalising learning materials, adjusting reading levels of texts, generating ideas for alternative strategies, and adding language captions to videos. One teacher noted: "It offers the ability to truly differentiate the curriculum and help students understand concepts at their level" (Blundell, Mukherjee, and Nykvist, 2025, p.7). A total of 24 teachers indicated that they believed Generative AI could support their planning and administrative responsibilities, with eight specifically highlighting its potential to enhance efficiency. As one respondent explained, "it will reduce the workload of teachers in administrative tasks" (Blundell, Mukherjee, and Nykvist, 2025, p.7). A frequently mentioned benefit (n = 14) concerned the use of Generative AI to plan differentiated learning experiences,

such as generating alternative instructional strategies, adjusting the reading level of texts, and providing additional language captions for videos. One participant observed, "It offers the ability to truly differentiate the curriculum and help students understand concepts at their level" (Blundell, Mukherjee, and Nykvist, 2025, p.7).

Support for Inclusion and Wellbeing: Four teachers specifically reported encouraging student use of Generative AI to make learning more inclusive and promote wellbeing. Teachers valued AI's potential as a tutor or writing assistant and as a tool to assist thinking and ideation.

Critical Success Factor: Balancing AI Literacy with Age-AppropriatenessWhen deciding whether to incorporate Generative AI into lessons, teachers' key consideration was balancing the development of students' AI literacy with their age and readiness. Developing students' AI literacies, including ethical, responsible, and safe use, was cited by 27% of teachers as their primary reason for encouraging Generative AI use.

7.2.4.3 Innovation Theory Insights

The study revealed that Generative AI was not viewed as a replacement for established practices or technologies, but rather as a tool to enhance teachers' work and support teaching and learning. This represents a teacher-led innovation where accessibility enabled experimentation, and teachers maintained professional agency in determining appropriate integration. Some teachers highlighted complexities associated with the individuals and stakeholders who influence the use of Generative AI in schools with different expressions noted. For example, one respondent noted:

> "[There is an] enormous amount of work for teachers in redeveloping the curriculum, leaders gaslighting staff by saying AI is going to make their workload easier, when its challenges far outweigh its opportunities, the notion that AI can do lesson plans (it can to an extent, but what about teacher expertise, agency and ownership over their own lessons?). Most teachers WANT to plan their own lessons and enjoy curriculum - they just need time to do it (Blundell, Mukherjee, and Nykvist, 2025, p.9).

Another, curriculum related aspect was expressed by three of the teachers, with one offering, "current assessment, curriculum, and prescribed syllabuses are not designed with students having access to Generative AI" (Blundell, Mukherjee, and Nykvist, 2025, p.9). A reflection of teacher reported responses of school leaders to Generative AI is illustrated in Figure: 15, below:

Statement	Count of reported senior leaders' (Principals and Deputy/Assistant Principals) response	Count of reported Middle leaders' (Heads of Curriculum/Heads of Learning) response
Leaders encourage use and provides training/support.	7	8
Leaders encourage use but do not provide help/training/support.	14	15
Leaders neither encourage or discourage use.	16	11
Leaders allow use but discourage it.	1	3
Leaders seem unaware of GenAI.	3	4

Figure: 15 Teacher reported responses of school leaders to Generative AI (Blundell, Mukherjee, and Nykvist, 2025, p.8)

Some teachers (n=5) share how challenging it was to implement AI with some stating: "There are few educators in schools exploring how it is best used…I fear that the best that Generative AI can do, will go untouched" (Blundell, Mukherjee, and Nykvist, 2025, p.9). Teacher's and students' access to Generative AI at school is illustrated in Figures: 16 and 17 below.

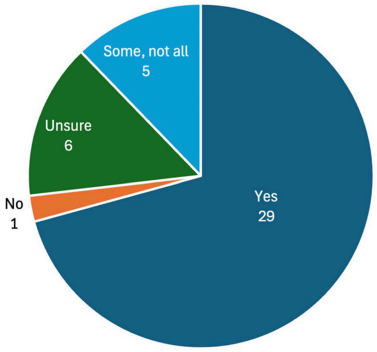


Figure: 16 Teachers' access to Generative AI school (p.10)

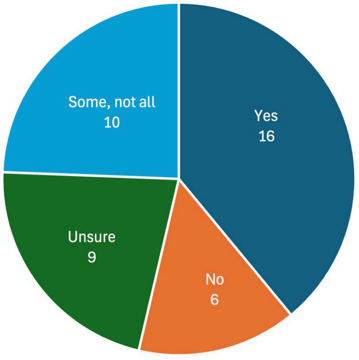


Figure: 17 Students' access to Generative AI at school (p.10)

The comparison between teachers' and students' access to Generative AI highlights important differences in how such technologies are currently implemented within schools. Higher access among teachers would suggest that AI is being adopted primarily to support planning and administrative tasks, reflecting an early, staff-focused phase of integration. Conversely, more limited student access may indicate ongoing caution regarding classroom use, ethical considerations, or institutional policy constraints. Together, these patterns reveal the emerging contours of Generative AI adoption in education and underscore the need for balanced strategies that build both teacher capacity and equitable student access.

As part of the 'decision stage' of this study, teachers identified benefits and challenges of using Generative AI with students for learning as indicated in Figure: 18 below:

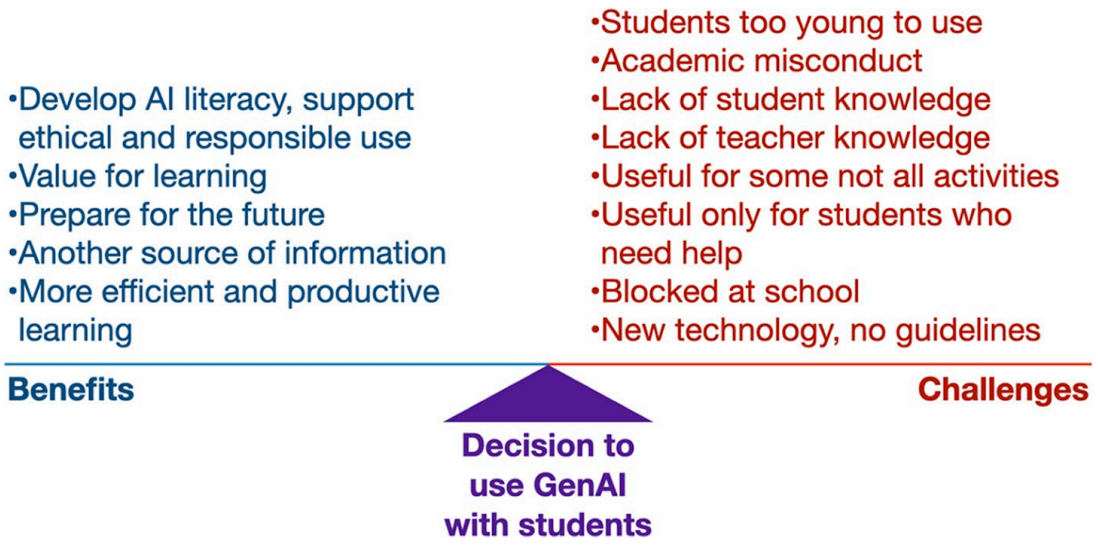


Figure: 18 Visual summary of identified benefits and challenges of using Generative AI with students for learning (Blundell, Mukherjee, and Nykvist, 2025, p. 11)

Figure 18 presents teachers' perceptions of the benefits and challenges of using Generative AI with students. Teachers recognised AI's potential to enhance learning efficiency, develop AI literacy, and prepare students for future digital demands. However, they also identified significant barriers, including limited user knowledge, risks of academic misconduct, lack of institutional guidance, and restricted access in schools. Overall, the findings reflect cautious

optimism, underscoring the need for clear policy direction and professional development to support responsible implementation.

7.2.4.4 Case Summary

This case study, based on questionnaire data from 44 Australian teachers, provides early insights into how educators are engaging with AI but is limited to teachers' initial adoption experiences. The study did not examine the confirmation stage of the innovation-decision process or classify teachers by adopter categories, suggesting areas for future research on sustained use. Findings indicate that teachers engaged in bottom-up innovation, developing their understanding of AI through exploration and collaboration rather than top-down direction. They viewed AI as a tool to enhance existing practices, prioritising contextual relevance and balancing AI literacy development with student readiness. To avoid repetition, a synthesis of successes and challenges across all case studies will be presented in Section 7.3.

7.2.5 Oak National Academy's Aila: Government-Backed AI Lesson Planning Assistant (UK, 2025)

7.2.5.1 Context

Oak National Academy (Clark et al., 2025a), established as an Arms Length Body of the UK Department for Education following the COVID-19 pandemic, developed Aila, the UK Government's first Generative AI lesson planning assistant for education. It operates through a chat interface using a large language model (currently GPT-4o). Lesson plans are generated via a retrieval-augmented generation process that draws on Oak's existing lesson materials. A separate, context-free language model moderates outputs to identify and flag any unsafe, guidance-required, or toxic content (Oak AI Experiments n.d.-b).

Oak's mission is to improve pupil outcomes and close the disadvantage gap by providing high-quality curricula and resources for teachers of pupils aged 5 -16 years. Teachers plan lessons, with AI proposing content for review and approval. While this age range does not sit

specifically within the primary school context but overlaps with middle school, the learnings that can be derived from this case study deems it worthy for inclusion.

7.2.5.2 Pedagogical Foundation

Over two years, Oak worked with curriculum partners to create over 10,000 lesson resources designed by subject experts and aligned to the national curriculum and exam boards. This foundation, grounded in pedagogical rubrics and cognitive science research, positioned Oak uniquely to develop Aila with strong quality and safety guardrails. Oak's ethical elements are explored in more detail in SRQ4, section 8.2.2.1, later in this report.

7.2.5.3 Key Success Factor: Comprehensive Safety Guardrails

Oak implemented four key safety guardrails to ensure age-appropriate, curriculum-aligned content:

1. Prompt Engineering: Extensive prompts codify best practices in pedagogy and cognitive science, ensuring outputs are generated within pedagogically sound and curriculum-aligned parameters.
2. Input Threat Detection: Monitors user inputs for inappropriate, manipulative, or malicious prompts to reduce jailbreaking risks.
3. Independent Asynchronous Content Moderation Agent (IACMA): A context-unaware AI agent evaluates outputs against predefined safety categories ('safe', 'content guidance', or 'toxic'), with toxic content blocked and flagged for review.
4. Human-in-the-Loop: Teachers lead the lesson planning process, with AI suggesting content for review, adaptation, and approval before classroom use. This design ensures that a qualified teacher is always positioned between AI-generated content and pupils.

7.2.5.4 Design Philosophy

Aila was intentionally designed to co-plan lessons with teachers, not for them, maintaining teacher agency and professional expertise as central to the process. This human-centred design acknowledges that teachers know their curriculum and pupils best, positioning AI as a supportive tool rather than a replacement.

7.2.5.5 Challenges and Ongoing Iteration

The study identified several challenges including exceptional or unanticipated classroom scenarios (e.g., lessons on current affairs after the LLM's training cut-off, topics outside the national curriculum), the need for ongoing evaluation with real user data, and ensuring safety guardrails evolve as the technology develops. Oak's commitment to open-source code and sharing illustrative datasets demonstrates sector-wide collaboration to build effective, safe AI tools for education.

7.2.5.6 Policy and Sector Implications

Oak's work exemplifies how government-backed initiatives can set standards for ethical AI integration in education, providing transparency through open-source resources and contributing to broader sector learning about safety, quality, and pedagogical effectiveness.

7.2.5.7 Case Summary

Oak National Academy, an Arms Length Body of the UK Department for Education, developed *Aila*, the first government-backed generative AI lesson planning assistant. Grounded in Oak's curriculum expertise and cognitive science, Aila integrates robust safety guardrails and a human-in-the-loop design to maintain teacher agency. While challenges remain, such as handling out-of-scope topics and ensuring safeguards evolve, Oak's open-source approach demonstrates transparent, collaborative, and ethical AI integration, setting a benchmark for responsible innovation in public education.

7.2.6 Using AI to Boost Evidence-Based Teaching and Learning: A Collaborative Approach across a Network of Schools (New South Wales, Australia, 2025)

7.2.6.1 Context

Hoare & Smith-Ferguson's case study (2025) documents the collaborative implementation of Generative AI tools, primarily ChatGPT and later the bespoke NSWEduChat, across primary and secondary schools in New South Wales (NSW), Australia. It was led by Joseph Hoare and Jules Smith-Ferguson in partnership with the NSW Department of Education and the Centre for Education Statistics and Evaluation (CESE). The focus is on upskilling teachers to integrate AI in a way that strengthens evidence-based teaching, with explicit teaching and curriculum alignment as guiding principles.

7.2.6.2 Key Success Factors

The following six factors underscore the key success of the NSW study.

1. Strategic System and School Leadership

Leadership at both department and school level prioritised evidence-based practices, particularly explicit teaching, as the foundation for AI integration. The initiative was rolled out with alignment to the Department's strategic plan for excellence and equity and supported by national and state frameworks for the responsible use of Generative AI.

2. Embedded, Collaborative Professional Development (PD)

Ongoing, school-based PD sessions were designed to upskill teachers in both foundational AI literacy and advanced, pedagogically-aligned applications of Generative AI tools. Sessions were led by experienced school leaders (such as Principal Karen May of Glenbrook Public School), and intentionally collaborative - leveraging peer learning, discussion, and resource sharing. The PD model scaffolded best use of Generative AI through practical demonstrations, iterative prompts, and critical evaluation of AI outputs with colleagues.

3. Explicit Focus on Evidence-Based Pedagogy

The training was structured around the science of learning and explicit teaching. This included modelling how ChatGPT/NSWEduChat could assist in lesson planning, creating differentiated texts and resources, and developing assessment rubrics directly aligned with high-impact teaching strategies. Teachers were taught to 'position' AI with high-quality educational research as context, resulting in outputs that more closely reflect research-informed practice - for example, Australia's What Works Best (CESE, 2020) and explicit instruction rubrics).

4. Teacher Agency, Validation, and Critical Use

Teachers were empowered as experts who lead, critique, and validate AI outputs. There was strong emphasis on prompt engineering, iterative refinement of outputs, and professional judgement regarding instructional appropriateness. Additionally, teachers investigated AI outputs for rigour, curriculum alignment, and engagement potential, rather than using AI-generated materials uncritically.

5. Differentiation and Equity

The case demonstrates how Generative AI can assist with content differentiation; modifying texts and formative assessment tasks for a variety of reading levels and learning needs, including phonics and comprehension scaffolds. Equity was supported by providing *all* networked schools with free access to NSWEduChat, ensuring no school or learner was disadvantaged by lack of resources or access. This reflected notable investment.

6. Efficiency, Collaboration, and AI Literacy

Teachers reported significant time savings for lesson planning, assessment design, and administrative tasks (e.g., permission slips). This allowed more time for core teaching.

Professional learning communities were strengthened, with teachers sharing prompts, outputs, and collaborative refinements to AI-assisted resources. Both staff and students developed foundational AI literacy through safe, department-curated tools tailored to the NSW context.

7.2.6.3 Risks, Safeguards, and Limitations

The study recognises well-documented risks: data privacy concerns, propagation of bias, AI 'hallucination', and the risk of over-reliance on generic AI outputs. Ethical alignment is critical and will be discussed in depth in the following sub-research question of this report.

NSWEduChat was developed as a secure, domain-specific Generative AI tool with content safeguards, curriculum alignment, filtering, and user guidelines. Strong professional guidelines encourage teachers to use AI as a collaborative partner, not a substitute for professional expertise. All outputs remain open to teacher challenge, critique, and adaptation.

The cost of developing bespoke, secure AI infrastructure (such as NSWEduChat) and providing large-scale, ongoing professional development is acknowledged as a significant investment, highlighting the importance of system-level funding for equity and impact.

7.2.6.4 Outcomes and Teacher Feedback

Surveys of participating teachers report that 95% believed the PD would save them time, and 100% would recommend the training to colleagues. Teachers found AI most helpful in generating differentiated resources and lesson plans aligned with evidence-based practices.

Teachers also valued improved collaboration and dialogue around AI use. The system-wide roll-out of NSWEduChat brought consistent standards and shared AI literacy across the state. Early evidence shows that both teachers and students benefited from increased engagement, resource quality, and accelerated feedback cycles.

7.2.6.5 Case Summary

While situated in NSW, the case study is framed as a blueprint for other large education systems seeking to harness AI for professional learning and teaching quality. The emphasis on explicit pedagogy, structured PD, critical teacher agency, and system-level equity provides a replicable model for responsible Generative AI adoption in both primary and secondary school contexts. The collaborative, network-wide approach and the inclusion of domain-specific AI tools such as NSWEduChat stand out as key innovations supporting safe, equitable, and effective Generative AI integration.

7.3 Synthesis of Success Factors and Learnings from all Peer-Reviewed Case Studies selected during the snowballing phase

The following synthesis brings together the key success factors, learnings and limitations that were evident from the analyses. In total 16 different themes were identified. These can be found in a table with the correlating studies in Appendix D. For the discussion, the most prevalent will be detailed below.

7.3.1 Teacher Efficiency and Workload Reduction

Across the diverse contexts examined in this research, a consistent and striking finding emerges: Generative AI tools significantly reduce teachers' lesson planning time and administrative workload. In the Australian case study, 95% of participating teachers reported belief that professional development in AI use would save them time, representing substantial consensus on efficiency gains (Hoare & Smith-Ferguson, 2025). More concretely, Aila users in the UK reported time savings ranging from 1 to 15 hours per week, with lesson planning time reduced from approximately 30 minutes to between 5 and 10 minutes per lesson (Clark et al., 2025a). In the USA, Walter's case study (2024) documented how a middle school science teacher reduced planning time substantially through strategic use of language-generating AI, which assumed responsibility for routine task generation whilst the teacher focused on pedagogical refinement. Across these geographically dispersed and methodologically diverse studies, the consistency of reported efficiency gains suggests this is a genuine and replicable benefit.

However, this finding must be contextualised within important limitations. The studies reporting highest efficiency gains represent either relatively small-scale research pilots, ranging from 40 teachers in Turkey (Ugras et al., 2024) to 110 pupils in Uruguay (Jauhiainen-Guerra, 2023) or government-backed, early-stage rollouts characterised by considerable institutional support and enthusiasm (Clark et al., 2025a). The New South Wales (NSW) study by Hoare & Smith-Ferguson (2025), involving a network of schools, reports positive teacher attitudes but represents an early phase of implementation, with potential for selection bias toward

enthusiastic adopters or better-resourced schools. Furthermore, it is important to recognise that the NSW findings primarily capture teacher perceptions or expectations of future AI impacts - areas where human foresight is limited. This suggests that while reported optimism is valuable, it may overstate the permanence or generalisability of initial gains.

These tensions around reducing teacher workload and the risk of diminishing creativity in education are critically important because, while new technologies like AI can automate routine tasks and save time, they also risk disempowering teachers and making classrooms less innovative if implemented without care. These tensions arise when efficiency-driven cultures, mandatory technology use with inadequate training, or over-reliance on standardised outputs limit teachers' professional judgment and reduce space for creative pedagogy, reflection, and experimentation. Thus, striking a balance where technology is harnessed to free up time that is then reinvested in creative, meaningful teaching is essential for ensuring both educational effectiveness and teacher well-being.

Other important limitations persist around the long-term sustainability of reported time savings, particularly as tools scale, as teachers become less novel-seeking, or as implementation challenges emerge. This remains unclear and warrants further longitudinal research.

7.3.2 Personalisation, Differentiation, and Support for Diverse Learners

The case studies collectively provide compelling evidence that AI-supported tools enable rapid personalisation of learning content tailored to diverse student needs. The Uruguay study (Jauhiainen-Guerra, 2023), involving 110 primary pupils across Grades 4–6, demonstrated that when AI-generated materials were well-matched to pupils' prior knowledge and ability levels, two-thirds of pupils enjoyed the learning experience, with only one in ten expressing dissatisfaction. Critically, pupils who perceived content as appropriately pitched for their abilities demonstrated significantly higher motivation and perceived learning gains ($r=0.524$, $p<0.001$, between enjoyment and perceived learning). The study from Ukraine by Nezhyra et al., (2024), involving 138 pre-service teachers, highlighted that AI-generated multimodal content, including literary-musical and video resources, proved particularly valuable for engaging

students with special educational needs by offering alternative learning pathways and representation forms.

The New South Wales case study (Hoare & Smith-Ferguson (2025), exemplifies how personalisation operates in practice; teachers used AI to adjust text lexile levels, modify content complexity, and generate differentiated assessment tasks for students with varying abilities. Importantly, these applications align with evidence-based practices in differentiation, ensuring that personalisation serves high expectations rather than low-ceiling expectations. This also echoes best practise within Universal Design for Learning (CAST, 2024) where, with multiple modalities of engagement, representation and action and expression, the learning objective should never be diluted. The Turkish study by Ugras et al., (2024) of 40 primary teachers similarly documented teachers' enthusiasm for ChatGPT's capacity to generate personalised activities tailored to individual student characteristics, particularly in inclusive, mixed-ability classrooms.

Nonetheless, this evidence emerges predominantly from research involving self-selected, motivated participants in contexts where institutional or research support was available. The Uruguay study (Jauhiainen-Guerra, 2023), while rigorous and involving a substantial sample of pupils, was conducted as a controlled research project with dedicated time and researcher involvement, conditions not typically present in routine classroom practice. The Turkish study (Ugras et al., 2024), though involving 40 teachers, represented a voluntary cohort who participated in a 4-week professional development programme. This is not likely to be representative of the broader teacher population. The risk exists that reported benefits of personalisation reflect early-adopter enthusiasm and may diminish in broader implementations lacking comparable support and training. Additionally, evidence remains limited regarding whether AI-generated personalisation leads to sustained improvements in learning outcomes compared to teacher-designed, research-informed differentiation; most studies report proxy measures such as pupil perception and motivation rather than rigorous achievement data (Nezhyra et al., 2024). Given the evolving status of the topic, research gaps exist and longitudinal studies would substantiate, or not, the points mentioned.

7.3.3 Teacher Mediation, Agency, and Human-in-the-Loop Design

One of the most robust and consistent learnings across all case studies is that teacher mediation and professional agency are non-negotiable for effective and ethical AI integration. The USA case study by Walter (2024) of a middle school science teacher, analysed through the TPACK framework, revealed that meaningful AI use emerged only through active teacher engagement: the teacher posed clarifying questions to AI, evaluated outputs against pedagogical criteria, adapted or rejected suggestions based on classroom context, and maintained ultimate authority over instructional decisions. This finding was echoed across the Polish (Pyalski, 2024), Turkish (Ugras et al., 2024), and Australian contexts (Blundell, Mukherjee & Nykvist, 2025; Hoare & Smith-Ferguson, 2025) where teachers emphasised their responsibility for validating AI outputs, ensuring curriculum alignment, and contextualising suggestions for their specific learners.

Significantly, the UK's Oak National Academy deliberately embedded human-in-the-loop design into Aila, ensuring teachers review and approve all AI-generated content before classroom use. This design philosophy acknowledges that teachers possess irreplaceable knowledge of their curriculum, learners, and community context, and that AI must support rather than supplant professional expertise (Clark, 2025). The NSW case study reinforced this principle through its emphasis on teachers as experts who validate and contextualise AI outputs within evidence-based practice (Hoare & Smith-Ferguson, 2025).

These findings collectively suggest that teacher mediation is essential, not only as a quality assurance measure but as a fundamental pedagogical principle. Unmediated or lightly mediated AI use risks producing superficially plausible but pedagogically inappropriate, contextually misaligned, or factually inaccurate content. The Turkish study explicitly documented teacher concerns about misinformation, with teachers noting that ChatGPT occasionally produced fabricated references and incorrect information (Ugras et al., 2024). Without robust teacher oversight, such misinformation risks embedding misconceptions, particularly in primary classrooms where pupils have limited critical evaluation capacity.

However, it must be acknowledged that the evidence supporting teacher mediation comes predominantly from studies involving relatively small samples of teachers who had received professional development emphasising critical evaluation and pedagogy. The Australian study of 44 teachers, for instance, involved teachers with varying levels of AI experience and training (Blundell, Mukherjee & Nykvist, 2025). The generalisation of these findings to contexts with minimal professional development or institutional support remains uncertain. Additionally, the emphasis on teacher mediation and agency (Hoare & Smith-Ferguson, 2025), while educationally sound, may mask a practical reality: the high demand for teacher time and expertise required to validate all AI outputs may prove unsustainable in under-resourced or under-staffed contexts, potentially creating inequity in the quality of AI integration.

7.3.4 Professional Development

Across all case studies, professional development emerges as essential but often inadequate. The Turkish study implemented a systematic 4-week training programme (10 hours per week) introducing teachers to ChatGPT's capabilities, practical applications, and integration strategies. This structured approach yielded positive outcomes: teachers developed confidence and competence progressively, moving from basic awareness to practical application (Ugras et al., 2024). The NSW case study goes further, describing embedded, collaborative professional development led by experienced school leaders, fostering peer-to-peer learning, collective efficacy, and ongoing iteration of practice. Notably, 100% of surveyed NSW teachers reported they would recommend the training to colleagues, suggesting high perceived value and relevance (Hoare & Smith-Ferguson, 2025). The professional development offered to participating teachers, in this study, was notable in its level of detail and quality.

Contrasting sharply with these examples, the Australian K–12 study of 44 teachers found that only 41% had access to formal professional development despite widespread interest in AI use (Blundell, Mukherjee & Nykvist, 2025). The UK grey literature reveals an even starker picture: 74–75% of teachers have received no formal AI training despite adoption rates of 47.7%–60% (Teacher Tapp, 2025). This divergence suggests that while research pilots prioritise professional

development, system-wide implementation often lags, leaving many teachers to develop AI competence informally through self-exploration, peer learning, or online resources. The pedagogical consequences of unsupported, informal AI adoption remain largely undocumented and warrant investigation.

The evidence regarding optimal professional development models remains limited. The Turkish 4-week programme (Ugras et al., 2024) and NSW networked approach (Hoare & Smith-Ferguson, 2025), represent relatively intensive models; their transferability to under-resourced contexts or systems with high teacher turnover is uncertain. Additionally, most evidence comes from early-adoption phases; long-term sustainability and evolution of professional development needs as AI tools mature and become routine rather than novel is underexplored.

7.3.5 Evidence-Based Pedagogy and Alignment with Research on Learning

A distinctive feature of the NSW case study is the explicit integration of AI use with research-informed teaching practice, particularly the science of learning and explicit instruction. Teachers were trained to position AI-generated content alongside evidence-based pedagogical principles (e.g., spaced retrieval, worked examples, formative assessment), (Hoare & Smith-Ferguson, 2025). This approach exemplifies how AI can augment rather than replace research-based practice. Similarly, Oak National Academy's Aila is grounded in over 10,000 lesson resources designed by subject experts and aligned to pedagogical rubrics informed by cognitive science (Clark et al., 2025a). This deliberate alignment with evidence-based pedagogy represents a significant success factor, ensuring that AI adoption strengthens rather than undermines pedagogically sound practice.

However, this alignment is not automatic or inevitable. Most commercial AI tools, including ChatGPT, are not specifically designed or trained to embody evidence-based pedagogical principles. The NSW (Hoare & Smith-Ferguson, 2025) and Aila (Clark et al., 2025a) examples required substantial human investment in prompt engineering, content curation, and quality assurance to achieve this alignment. In contexts where such investment is unavailable,

AI-generated content may reflect generic, less pedagogically sophisticated approaches. The USA study (Gattupalli, Maloy & Edwards, 2023) comparing AI-generated versus teacher-written mathematics resources found that AI outputs often lacked the pedagogical depth, growth mindset language, and developmental sensitivity embedded in teacher-authored materials. This suggests that alignment with evidence-based pedagogy, whilst achievable, is not the default outcome of AI use without deliberate intervention and expertise.

7.3.6 Addressing Ethical Concerns and Safety Guardrails

The case studies collectively identify significant ethical concerns including misinformation and hallucination, bias, data privacy, and age-appropriateness of content. This is a particular concern for primary and special schools. Turkish teachers explicitly raised concerns about ChatGPT's potential for factual error and misinformation (Ugras et al., 2024). The Polish study documented teacher uncertainty regarding permissible and responsible AI use, particularly in sensitive contexts. Rather than dismissing these concerns as overcome, the evidence suggests they are legitimate, persistent, and require systematic, multi-layered safeguarding (Pyzalski, 2024).

Oak National Academy's implementation of four safety guardrails: prompt engineering, input threat detection, independent content moderation, and human-in-the-loop validation, represents a rigorous approach to addressing these concerns (Clark et al., 2025a). Similarly, the NSW system implemented filtering, content safeguards, and user guidelines in its bespoke NSWEduChat tool (Hoare & Smith-Ferguson, 2025). These examples demonstrate that safety is achievable but requires deliberate design, ongoing iteration, and substantial investment. The implication is sobering: responsible AI adoption in education cannot rely on off-the-shelf tools used without safeguards, but rather requires systems-level commitment to safety infrastructure and ongoing quality assurance.

Importantly, the sample sizes and contexts of these safety implementations remain limited. Aila's safeguards are implemented within a well-resourced national system with significant government backing and expertise. The generalisability of these approaches to under-resourced

schools or systems with limited technical infrastructure is uncertain. Additionally, the effectiveness of safety guardrails remains partially untested in large-scale deployment; early evidence from Aila suggests safeguards work, but long-term efficacy, edge cases, and unintended consequences of overly conservative filtering (e.g., blocking legitimate educational content) remain to be fully evaluated (Clark et al., 2025a).

7.3.7 Collaborative Professional Learning and Equity

The NSW case study's emphasis on networked professional development and collaborative learning represents an important success factor. By positioning experienced school leaders (such as Principal Karen May) as facilitators of professional learning, the approach builds capacity, distributes expertise, and fosters collective problem-solving. This contrasts with more isolated, top-down training models and suggests that professional communities enhance both the quality and sustainability of AI integration (Hoare & Smith-Ferguson, 2025).

Regarding equity, the NSW approach of providing universal access to NSWEduChat for all schools and students in Years 5–12 addresses a critical barrier identified in other studies. The cost of premium AI tools represents a formidable obstacle for resource-constrained schools. The NSW model demonstrates that government-backed infrastructure can ensure equitable access (Hoare & Smith-Ferguson, 2025). However, the UK grey literature reveals disparities: AI access is higher in private schools (31%) than state schools (17%), suggesting that without deliberate equity measures, AI adoption can widen existing gaps (The Sutton Trust, 2025). The case studies offer limited evidence regarding how equity can be assured across diverse contexts, particularly in under-resourced schools, rural areas, or regions with limited digital infrastructure (Kotsiovos, Doyle & Chicone, 2024). This concern with equity naturally extends to the financial dimension of implementation, where the high costs associated with deploying AI technologies further exacerbate disparities in access and opportunity across diverse educational settings, as the next section explicitly addresses.

7.3.8 High Cost of Implementation: Why Comprehensive Investment Matters

A substantial barrier to equitable AI adoption in schools is the high cost of implementation, which research evidence clearly documents. Kotsiovos, Doyle & Chicone (2024), specifically investigated the financial challenges of implementing generative AI in educational settings, finding that while some AI tools offer free versions with basic functionality, the full-featured, premium tools necessary for effective curriculum integration are costly. The study identified that institutional or system-wide investment is required to provide universal access; without such support, AI tools primarily benefit institutions and individuals with adequate funding, thereby exacerbating existing educational inequalities.

This cost barrier manifests in multiple dimensions. For example, subscription fees for premium platforms, infrastructure investment for adequate technology, ongoing training and technical support, and the substantial time required for comprehensive teacher professional development. For primary schools and special schools operating under budget constraints, particularly in rural, urban disadvantaged, or non-English-speaking areas, these costs represent formidable obstacles. The risk is that AI integration becomes a luxury accessible primarily to well-resourced schools, whilst under-resourced schools fall further behind, reinforcing systemic educational disadvantage.

Notably, while the UK has invested significantly in government-backed AI infrastructure through Oak National Academy, the deliberate choice to develop bespoke, secure AI infrastructure (Aila) coupled with large-scale professional development reflects this substantial investment requirement. The UK government provided £2 million specifically for lesson planning work and £43 million for broader curriculum development, alongside support for trustworthy content stores and teacher-centric tool design (UK Department for Education, 2023a, 2023b). The development of domain-specific tools like NSWEduChat in Australia (Hoare & Smith-Ferguson, 2025) similarly demonstrates that responsible, equitable AI implementation requires substantial system-level investment in secure infrastructure, content moderation, and ongoing teacher support rather than reliance on unvetted, cost-free alternatives. The critical implication is clear:

the financial commitment demonstrated by the UK and NSW governments is substantial but it may not be universally replicable or available to all education systems. Without comparable investment and funding mechanisms, many schools and systems risk either proceeding without adequate safeguards or being unable to implement AI at all, thereby widening rather than narrowing educational inequality.

7.3.9 Limitations, Biases, and Evidence Gaps

The evidence base presented in these case studies, while encouraging, carries important limitations requiring transparent acknowledgement. First, sample sizes are modest: the Turkish study involved 40 teachers (Ugras et al., 2024); the Australia K–12 study (Blundell, Mukherjee & Nykvist, 2025), 44 teachers; the Uruguay study (Jauhiainen-Guerra, 2023), 110 pupils across four classes; the Ukraine study (Nezhyva et al., 2024), 138 pre-service teachers; and the NSW study (Hoare & Smith-Ferguson, 2025), a network of schools in one state. These are meaningful research efforts, but not large-scale implementations, and participants likely represent self-selected, more motivated cohorts than the broader teaching population. Early-adopter effects and selection bias risk inflating reported benefits.

Second, research timeframes are relatively short, most spanning weeks to months rather than years. Long-term sustainability of reported efficiency gains, the persistence of changed practice, and the emergence of unintended consequences over extended periods remain largely unknown.

Third, evidence regarding special schools is substantially absent. While one case study addresses students with SEN within mainstream settings (Nezhyva et al., 2024), dedicated research in special school contexts (with the exception of Jauhiainen-Guerra, 2023), where learners may have a broader range of learner requirements and teachers may face distinct resourcing challenges, is lacking. This represents a critical evidence gap for a particularly vulnerable and underserved population.

Fourth, most data are self-reported or derived from internal evaluations rather than independent validation. Teachers surveyed about time savings and engagement may experience social desirability bias or may report perceived rather than actual changes. Organisations developing AI tools (such as Oak National Academy reporting on Aila) have vested interests in demonstrating success, potentially inflating positive findings.

Finally, causal evidence is limited. Most studies lack comparison groups or control conditions, making it difficult to isolate the specific impact of AI tools from confounding factors such as increased professional attention, heightened teacher motivation, or school-level support. Correlations between AI use and reported benefits do not establish causation and so should be interpreted with caution.

7.4 Conclusion

The case studies collectively present a cautiously optimistic picture of AI-supported preparation for learning and teaching in primary education. When implemented with robust professional development, explicit attention to teacher agency, alignment with evidence-based pedagogy, and deliberate safety guardrails, AI can enhance personalisation, reduce teacher workload, and strengthen inclusive practice. The convergence of findings across geographically diverse contexts (Turkey, Uruguay, Ukraine, USA, UK, Australia) and diverse methodological approaches (qualitative, survey-based, design research) suggests that core benefits are not artefacts of single contexts or research designs but reflect genuine possibilities of AI integration.

Central to this promise is the critical role of teacher mediation and human agency. Evidence underscores that teachers must remain responsible for making decisions and be empowered to do so, validating and adapting all AI-generated content before classroom use. Similarly, professional development and collaborative learning emerge as non-negotiable conditions for success: Structured, sustained, school-based training, ideally networked across schools, enables teachers to develop the pedagogical judgement necessary to harness AI responsibly. Furthermore, successful implementations demonstrate deliberate alignment with

evidence-based pedagogy, ensuring AI tools support rather than undermine recognised principles of effective learning and teaching.

Equally important, the evidence base highlights the centrality of ethical concerns and safety guardrails. Multi-layered safeguards including prompt engineering, content moderation, and age-appropriate filtering protect pupils from misinformation, bias, and inappropriate content, a point further confirmed by the UK and Australian case studies. Where such safeguards are absent or weak, the risk of technical compliance masking pedagogical ineffectiveness substantially increases.

Yet this optimism must be tempered by stark recognition of the conditions enabling success in these studies. These show relatively intensive professional development, substantial institutional backing, teacher motivation, and deliberately designed safety and pedagogical frameworks. Critically, many reported efficiency gains originate from small-scale pilots or early-stage governmental rollouts characterised by considerable resources and enthusiastic adoption. The high cost of implementation and equity barriers identified across contexts present a profound challenge. Premium AI tools risk widening disparities between well-resourced and under-resourced schools, rural settings, Gaelscoileanna, DEIS institutions, and special schools unless deliberate, system-level investment in universal access is prioritised.

The generalisation of these findings to under-resourced contexts, systems with limited training or support, or schools serving particularly vulnerable populations remains substantially uncertain. Additionally, consistent references to the significant research gaps and evidence limitations constrain confidence. Questions persist regarding long-term sustainability of reported time savings as novelty fades, scalability at system-wide implementation, the specific efficacy of AI in special school settings, alongside the durability of teacher engagement and pedagogical quality over sustained periods. The New South Wales (NSW) study is encouraging with regards to teacher attitudes but it captures primarily perceptions and expectations of future impact, areas where human foresight can be limited, and warrants validation through longitudinal, outcome-focused research.

As Ireland contemplates AI integration in primary and special education, the case studies provide invaluable advice and necessary cautions. Policy and practice decisions must be informed by ongoing, rigorous, and contextually responsive evaluation; adaptive, equity-centred implementation; and unwavering commitment to evidence and inclusion. Specifically, Ireland should commission dedicated pilot research in special schools and Irish-medium settings, invest substantially in universal access models, adhere to the robust national safety guidance published by the DEY, and build sustainable professional learning infrastructure aligned with the Primary School Curriculum and inclusive education principles. The future impact of AI in Irish education will ultimately depend not on technological sophistication, but on the quality of implementation architecture, professional capacity, and institutional commitment to ensuring that AI serves all learners equitably and advances genuine educational excellence.

7.5 Five Key Recommendations for Ireland: Learnings from International Case Studies

The following five recommendations are described below and illustrated in Figure: 19 that follows.

1. The international case studies examined provide clear guidance for responsible, effective AI integration in Irish primary and special schools. First and foremost, substantial system-level investment in professional development is essential. The Turkish and NSW examples demonstrate that structured, sustained training programmes, ideally networked and school-based, enable teachers to develop both technical competence and pedagogical judgement necessary for effective AI use. Ireland should prioritise funding for comprehensive, evidence-based professional development aligned with the Primary School Curriculum and inclusive education frameworks.
2. Teacher agency and human-in-the-loop design must be non-negotiable**.** Evidence across all contexts confirms that teachers must lead AI integration, validating and adapting all outputs before classroom use. Irish policy should mandate that AI tools support rather than replace teacher expertise, with explicit safeguards

ensuring content is reviewed, contextualised, and aligned with curriculum standards and learner needs.

3. Equity must be central to implementation strategy. The high costs of premium AI tools risk widening existing disparities between well-resourced and under-resourced schools. Ireland should invest in universal access models, potentially developing bespoke, curriculum-aligned tools or subsidising verified platforms, ensuring rural schools, Gaelscoileanna, DEIS schools, and special schools have equitable access to AI infrastructure, training, and ongoing support.
4. Robust safety guardrails are essential. Following the UK and NSW examples, Ireland should establish multi-layered safeguards including prompt engineering, content moderation, filtering mechanisms, and explicit user guidelines protecting pupils aged 4–12 from inappropriate content, misinformation, and bias.
5. Dedicated research targeting special schools and bilingual (Irish-medium) contexts is urgently needed. Current evidence gaps mean policy risks overlooking the specific needs and opportunities for these critical contexts. Ireland should commission pilot studies examining AI integration in special schools and Gaelscoileanna, ensuring evidence-informed, contextually appropriate adoption that advances equity, inclusion, and excellence for all learners.

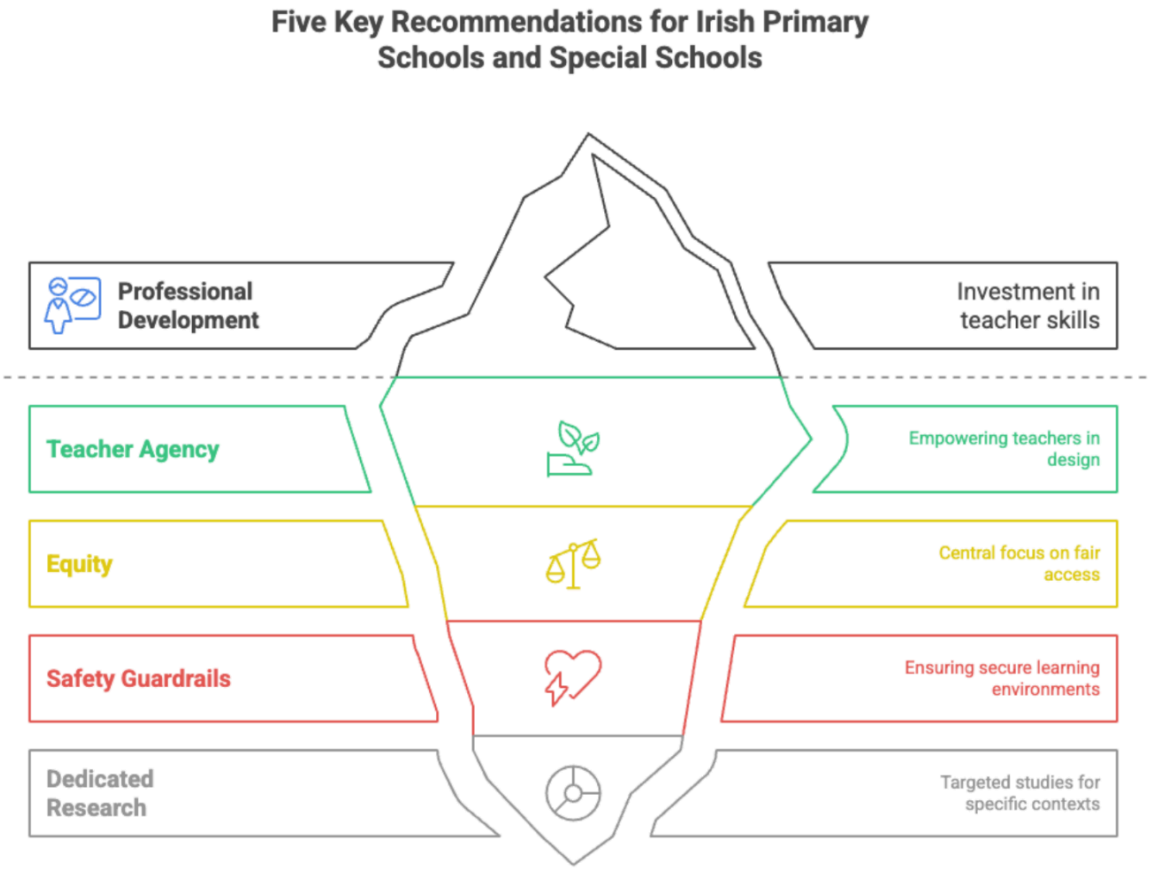


Figure: 19 Five Key Recommendations for Irish Primary Schools and Special Schools

The following section will discuss AI Tools for Curriculum Development and Ethical Compliance.

8. AI Tools for Curriculum Development and Ethical Compliance

This section will answer SRQ4.

SRQ4 asks: *How is AI currently being used by primary and special school teachers in Ireland and internationally and to what extent do they align with ethical practices?*

This is achieved through a detailed analysis of current academic literature on the ethical integration of AI in primary schools, followed by the current state of the ethical alignment from both grey and academic literature perspectives. In addition, the discussion addresses Irish teachers' early adoption, concerns and training needs, followed by the conclusion.

This section is focused more on ethical alignment of AI-based curriculum development tools rather than on the adoption of such tools by Irish primary school teachers. The reason is twofold: to provide a broad and comprehensive understanding of what ethical compliance entails in this context and a scarcity of studies on adoption of AI-based tools by Irish school teachers. Recent research and news articles (Irish Times, 2025) have started to report the perceptions of Irish teachers regarding the use of Generative AI for lesson planning (Hsu et al., 2024). It will be discussed as part of the Academic Literature perspective section. However, limitations were noted about this study (Hsu et al., 2024). These were a focus on pre-service or student teachers rather than experienced teachers and reliance on convenience sampling, which is inherent to making the results less generalisable. Also, the adoption of Generative AI was in early stages in the context of this study. Therefore, this section presents a synthesis of the extent to which the general and special purpose Generative AI tools (whether proprietary or open source) align with the ethical principles. A number of concerns voiced by Irish teachers are provided relating to their adoption of AI tools in this context, however, they come from a single source, not a detailed empirical study and also reflect only limited perspectives. Therefore, this section will describe the ethical considerations for primary schools starting from challenges to mitigation strategies and essential ethical competencies of teachers.

8.1 Ethical Integration of AI in Primary Schools

In general, the ethical considerations for AI in education e.g. Transparency, Privacy, Freedom and Autonomy need to be considered, but several unique considerations are required to cater for the rights of children and primary schools (Gouseti et al., 2025). Recent studies have started to propose frameworks for seamless integration of ethical considerations into AI systems for primary education (Alawneh et al., 2024). Four specific principles for primary education have emerged namely pedagogical appropriateness, children's rights, AI literacy and teacher well-being (Adams et al., 2023).

Pedagogical appropriateness emphasises that AI tools in education must adhere to educational values by empowering teachers to choose a tool that truly enriches children's learning and well-being. The second principle, children's rights acknowledges the special rights and vulnerabilities of minors. It extends beyond just general human rights and requires considerations like age appropriate language for easier understanding. The third principle of AI Literacy stresses the importance of teaching children and teachers about key concepts of AI like ethical considerations and potential biases. The goal of this principle is to foster critical thinking and informed decision making about the use of AI and its implications. The fourth principle, teacher well being, addresses the impact of AI on teachers physical and psychological well being. It includes concerns related to increased workload, the need for professional development, the potential erosion of meaningful pedagogical relationships and even unemployment due to technology. This principle emphasises that AI should be a source of empowerment for teachers and not their replacement (Adams et al., 2023).

These principles can be a good starting point, but there are conceptual and systemic challenges associated with implementing AI ethics in primary education. Challenges include, the complexity of conceptualising AI ethics, national context and geo-political influence, lack of clear and actionable recommendations, western centric bias in guidelines and research, disparities in participation, speed of AI advancement and regulation. The complexity of

conceptualising AI ethics means there are different interpretations and applications (Wieczorek et al., 2025). For example, one group may prioritise fairness while another focuses on privacy. The challenge of national and geopolitical contexts in AI ethics is that global rules may differ from local laws and cultural values, which may make fair and inclusive implementation difficult (Wieczorek et al., 2025). The literature is focused on presenting benefits and concerns, rather than engaging in analysis and formulation of substantive responses, which makes it hard to implement the recommendations (Wieczorek et al., 2025). Most of the ethical guidelines for AI in primary and secondary education appear to be promoting Western-centric learning methods and values, which may endanger the languages, cultures and ideologies of the Global South (Tagare et al., 2025). Moreover, disparities in participation can occur because increasing use of AI could reduce the influence of human stakeholders on key educational decisions, such as what to teach and how (Wieczorek et al., 2025). Lastly, with the speed at which this technology is advancing, regulatory and ethical frameworks are often left behind, which has caused high levels of concern and anxiety in teachers regarding ethical integration of AI (Gouseti et al., 2025; Berson et al., 2025).

One potential strategy to overcome these challenges is to adopt a constructivist pedagogical approach by placing students in the role of AI designer. For example, tasking students with collaboratively designing and developing a chatbot that helps them study for exams, whilst considering ethics (Gouseti et al., 2025). Adopting constructivist pedagogy like hands-on design and real-world problem solving helps demystify the complexity of AI ethics and overcome the lack of clear and actionable recommendations by engaging students in analysing and creating ethically sound applications. Embedding ethical awareness across the curriculum through culturally responsive and interdisciplinary teaching directly addresses Western-centric bias and national context and geo-political influence, empowering students to recognise and challenge disparities in participation. This emphasis on critical analysis builds resilience and adaptable skills for lifelong learning, enabling stakeholders like teachers and students to keep pace with the speed of AI advancement and regulation. Although these recommendations to adapt constructive pedagogy and embed ethical awareness across curriculum are framed within a

K-12 context (Gouseti et al., 2025), they may also be relevant to Irish primary schools, provided appropriate adaptations are made to local curricular stages.

Furthermore, a recent systematic literature review study argues that empirical research and in-depth engagement with ethical theory and philosophy of education are critically needed to adequately assess the challenges introduced by the use of artificial intelligence in primary and secondary education (AIPSED) (Wieczorek et al., 2025).

The adherence to these principles identified in literature while overcoming the systemic challenges can support development of ethically aligned AI-based curriculum development tools that provide personalised learning, automation of administrative costs, and intelligent tutoring (Adams et al., 2023; Alawneh et al., 2024; Berson et al., 2025; Crompton et al., 2024; Gouseti et al., 2025; Tagare et al., 2025; Wieczorek et al., 2025). This section, therefore, re-iterates the core ethical concerns, mitigation strategies and essential ethical competencies teachers require, as highlighted in the peer reviewed literature for ethical integration of AI in primary schools. These are also illustrated in Figure 20.

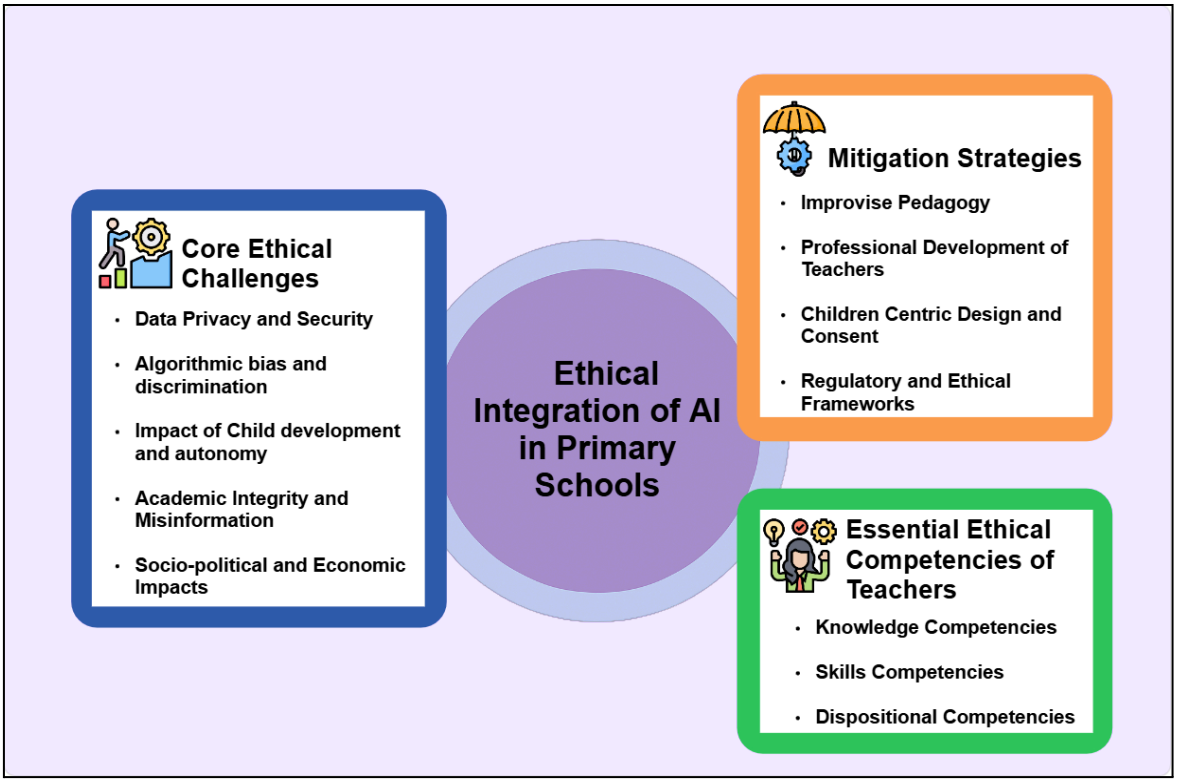


Figure: 20 Challenges and Mitigation Strategies for Ethical Integration of AI in Primary Schools

8.1.1 Core Ethical Challenges

The core ethical challenges synthesised from recent academic studies include data privacy and security, algorithmic bias and discrimination, impact on child development and autonomy, academic integrity and misinformation and socio-political and economic impacts.

8.1.1.1 Data Privacy and Security

One of the key ethical concerns is data privacy and security, in particular, because of the unique vulnerabilities of young students (Berson et al., 2025; Gouseti et al., 2025; Tagare et al., 2025). Informed consent cannot be taken from children under the age of seven, because they lack the maturity to fully grasp concepts like 'privacy' or 'data security' (Berson et al., 2025). Even by age 11, their ability to apply privacy related judgments in real-life situations remains limited. This in turn becomes the responsibility of parents, teachers and developers to protect this information (Berson et al., 2025).

Generally, AI based systems in education are known to collect highly sensitive data e.g. personal information to developmental milestones, behaviour patterns, facial expressions, gaze detection and voice patterns (Berson et al., 2025; Gouseti et al., 2025). This can lead to unintended consequences like data breaches, unauthorised access, profiling and commercialisation of students data for non-educational purposes like advertising (Berson et al., 2025; Gouseti et al., 2025; Tagare et al., 2025). In addition, the ownership of data collected by AI is a controversial topic with different perspectives among parents, teachers and developers (Berson et al., 2025).

8.1.1.2 Algorithmic Bias and Discrimination

Another important ethical concern is algorithmic bias and discrimination, which is primarily due to the data that was used to train AI (Berson et al., 2025; Gouseti et al., 2025; Tagare et al., 2025). This can lead to discriminatory outcomes that may disadvantage marginalised

communities, because the data fails to reflect the socio-economic, cultural and linguistic diversity of students (Berson et al., 2025; Gouseti et al., 2025; Tagare et al., 2025). For example, one study reported that when a female student used generative AI to imagine her future self as a doctor, AI responded with a male doctor by default. This demonstrates the inaccuracy of such systems requiring more identity details from students for better responses (Tagare et al., 2025). Additional types of bias included misinterpretation of verbal cues like facial expressions and tone of voice due to cultural differences leading to ineffective or even stigmatising learning environments and unjustified profiling (Berson et al., 2025). Issues like this further the digital divide due to inaccessibility based on factors like economic and infrastructural limitations(Berson et al., 2025; Tagare et al., 2025), which disproportionately affects marginalised communities by restricting their access to digital tools, reliable internet connectivity and opportunities for digital literacy and participation.

8.1.1.3 Impact on Child Development and Autonomy

One of the important ethical risks that can negatively impact early school students is their development and autonomy (e.g. undermining independent thought, limiting choices) through overreliance on AI and undermining crucial relational learning (Berson et al., 2025; Gouseti et al., 2025). Learning experiences can be narrowed by overly prospective algorithms that guide students towards predetermined paths instead of encouraging them towards open-ended exploration and creativity (Berson et al., 2025). Another key concern involves the potential for children to form parasocial attachments with these tools, perceiving them as companions or confidants (Berson et al., 2025). This can blur the lines between artificial and human relationships.

In addition, children have limited understanding of causation and agency, leading to potential over-disclosure of sensitive information (Berson et al., 2025). Moreover, AI systems that incentivise engagement through gamification, persuasive algorithms and emotional cues can

shape students' behavioral responses in ways that prioritise system objectives[17] over their well being (Berson et al., 2025).

8.1.1.4 Academic Integrity and Misinformation

The easy availability of Gen AI tools like ChatGPT, Microsoft Copilot, Perplexity, etc introduces ethical concerns around academic integrity and misinformation (Gouseti et al., 2025; Tagare et al., 2025). Teachers are concerned about cheating and plagiarism fearing that this could lead to students becoming cognitively lazy (Gouseti et al., 2025). In addition, one example of the risk of misinformation and disinformation is students struggling to differentiate between genuine and deepfake images (Gouseti et al., 2025; Tagare et al., 2025). Another study found that US middle school students frequently held a range of 'naive' or simplistic views about ethical issues linked to AI, such as the belief that AI cannot be biased or that there are no privacy issues associated with AI applications and data collection (Gouseti et al., 2025).

8.1.1.5 Socio-Political and Economic Impacts

Social-political and economic impact can also arise e.g. if AI tools are designed based on Western values or datasets and are not value-neutral, they can prompt corporate values and endanger languages, culture, values and ideologies of the Global South (Tagare et al., 2025). As highlighted in answer to research question 2, the Irish language is still not widely supported by AI-based tools for curriculum development, which could potentially endanger cultural preservation. In addition, there is also a tension between a philosophy of AI for education (enhancing teaching and learning) and education for AI (an AI-ready workforce and training more AI experts), raising questions about the goals of AI integration in schooling (Gouseti et al., 2025).

[17] The system objectives are the commercial or institutional goals of the For-profit actors rather than students' or educators' needs. For example, developers may not disclose biases and limitations to avoid criticism, prioritise skills related to their own labour and market needs, inflate test scores to make the systems seem more effective, ignore security risks and use data for non-educational purposes (Wieczorek et al., 2025) .

Recognising these ethical challenges is good, but only the first step. It is important to translate these concerns into actionable recommendations.

8.1.2 Mitigation Strategies

Several strategies have been proposed in the academic literature to overcome these ethical challenges. These include improvising pedagogical approaches, professional development of teachers, children centric design and consent and regulatory and ethical frameworks. These four mitigation strategies are explained in this section.

8.1.2.1 Improvise Pedagogy

To effectively foster ethical awareness in students, improvising pedagogical approaches e.g. the use of constructivist pedagogy (J. G. Brooks, 1999) by involving students as designers or developers of AI is crucial. This means students are provided with an environment where they can collaborate to design AI tools like a chatbot, which helps them think about ethical considerations like bias, privacy and responsible use of data.

In addition, opting for real world scenarios, hands-on activities and elements of gamification for teaching can make ethical issues more tangible and engaging (Gouseti et al., 2025; Tagare et al., 2025). Ethical issues should be taught explicitly and integrated across the curriculum rather than in isolation (Gouseti et al., 2025; Tagare et al., 2025). A glass box approach, where teachers support students to understand the inner workings of AI (e.g. how input data is processed) is suggested to increase transparency (Gouseti et al., 2025).

8.1.2.2 Professional Development of Teachers

It has been repeatedly suggested in current literature that well-designed pre-service and in-service professional development courses are needed that focus on societal and ethical issues of AI, not just technical aspects (Crompton et al., 2024; Gouseti et al., 2025; Tagare et al., 2025). The recommendations drawn from case studies such as NSW and the UK, as part of the answer to RQ3 were also inline with this. For example, modules on the use of GenAI in teaching and learning may focus on ethical competencies such as critical analysis of AI, culturally responsive and inclusive pedagogy, and human in the loop (Tagare et al., 2025). Such professional development should involve new pedagogical approaches like constructivist pedagogy, provide real world problems and scenarios and adopt a holistic approach that builds cognitive and affective competencies (Gouseti et al., 2025; Tagare et al., 2025).

8.1.2.3 Children Centric Design and Consent

For early childhood education, AI systems must incorporate age appropriate privacy safeguards and transparent design features and consider both parental oversight and children's developing agency (Berson et al., 2025). It is important that AI systems minimise unnecessary data collection and remain transparent about data retention by adopting privacy by design principles (Berson et al., 2025). Obtaining child assent should be made accessible, and learning materials in AI based systems should be tailored to their age and development level (Berson et al., 2025).

8.1.2.4 Regulatory and Ethical Frameworks

As referred to earlier, the widespread publication of ethics guidelines indicates the recognition of the problem in the context of AI in education (Gouseti et al., 2025). But, AI ethics policy guidance specifically for primary schools and children has lagged and current frameworks appear to be fragmented and inconsistent across jurisdictions (Berson et al., 2025; Gouseti et al., 2025). There is a clear need for global and cohesive regulatory frameworks tailored to the

unique characteristics of primary schools that prioritise transparency, informed consent, data minimisation and accountability (Berson et al., 2025; Gouseti et al., 2025;).

Emerging research argues that pre-emptive regulatory models like the EU AI Act are more suitable for early childhood education than reactive approaches, which are often focused on post deployment monitoring (Berson et al., 2025). It is important to ensure that the frameworks reflect children's interests and uphold ethical standards by adopting a collaborative oversight mechanism through involvement of parents, teachers, policymakers and developers (Berson et al., 2025).

Although adoption of these mitigation strategies has the potential to alleviate ethical concerns, the ultimate success is dependent on how well trained the teachers are. Therefore, capacity building programs are indispensable for teachers to develop ethical competencies in the context of AI for education (Berson et al., 2025). Because one of the emerging themes across recent systematic literature reviews is lack of teacher preparedness to address the ethical issues (Crompton et al., 2024; Gouseti et al., 2025; Tagare et al., 2025). It has been noted in existing literature that teachers demonstrate a lack of awareness and understanding of AI's ethical implications and hold misconceptions e.g. AI cannot be biased or misunderstand how algorithms generate biased results (Gouseti et al., 2025; Tagare et al., 2025). In addition, they are concerned about their ability to teach about or use AI for teaching ethically (Gouseti et al., 2025; Tagare et al., 2025). Most teachers feel un-prepared in this context due to lack of suitable professional development opportunities and a sense of disempowerment when **curriculum is** developed by external agencies without involving them as co-designers (Gouseti et al., 2025). Therefore, to effectively navigate this landscape, teachers require a well rounded ethical foundation i.e. knowledge, skills and dispositional competencies (Tagare et al., 2025), each of which are described in this section.

8.1.3 Essential Ethical Competencies of Teachers

8.1.3.1 Knowledge Competencies

Teachers need awareness of ethical issues of AI integration in education e.g. bias, privacy and emotional harm. They also need to understand the limitations of AI e.g. how datasets and algorithms can introduce errors. Moreover, teachers should be able to demonstrate awareness of local and global impact of AI and the crucial role of human agency in AI design and development (Tagare et al., 2025). For example, a teacher explains that while a chatbot can answer questions, humans decide what knowledge it would share.

8.1.3.2 Skills Competencies

Recent academic research states that teachers need to acquire the following skills to ethically integrate AI in the classroom, as detailed in Figure: 21 (Tagare et al., 2025).

1. AI Transparency and Explainability
2. Critical Analysis of AI
3. Culturally Responsive and Inclusive Pedagogy

They do not necessarily need to be expert in these areas, however, having some understanding can be highly beneficial. Also, the professional development in the context of Generative AI for teaching and learning is something that has been advocated by the case studies presented in RQ3.

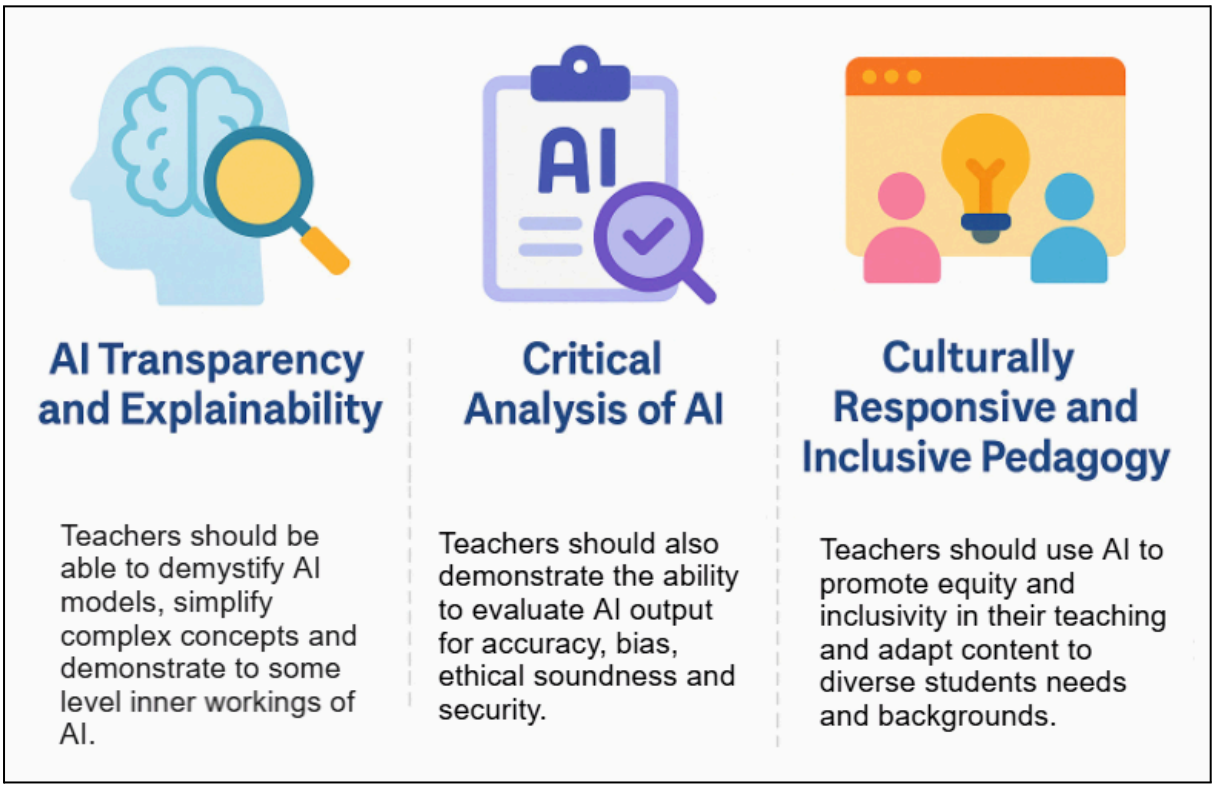


Figure: 21 Skills to ethically integrate AI in the classroom

8.1.3.3 Dispositional Competencies

Teachers must possess dispositional competencies like AI ethics sensitivity i.e. be aware of ethical issues and a sense of responsibility. In addition, they should develop a critical attitude towards AI by showing willingness to question the AI outputs and engage students in conversations to distinguish between what is right or wrong based on ethical principles and values. Furthermore, teachers should demonstrate an inclusive and culturally responsive mindset by actively fostering a welcoming and supportive learning environment for all students (Tagare et al., 2025).

These competencies are inter-dependent, meaning that successfully demonstrating one requires the activation of others (Tagare et al., 2025). For example, AI ethics sensitivity is highly dependent on awareness of AI ethics and critical analysis of AI requires understanding of AI's limitations and socio-political context. However, developing these competencies is challenging due to the opaque nature of most AI-based systems (Tagare et al., 2025). This underscores the

need to critically examine the current landscape of AI-based curriculum development tools for primary school teachers focusing on their ethical alignment through both grey and academic literature. The following section presents a synthesis of the current state of ethical guidelines adoption of AI-driven curriculum development tools from both of these perspectives.

8.2 State of Ethical Guidelines Alignment of AI-Driven Curriculum Development Tools

8.2.1 Grey Literature Perspective

To explore how ethical principles are reflected in practice, a subset of five AI driven curriculum development tools suitable for primary school teachers were selected for review. These include Diffit, TWEE, Eduaide, MagicSchool and Genially. Their ethical alignment was assessed based on publicly available information, including their official websites, blog posts, articles and other forms of grey literature. These tools were selected for their relevance to classroom and curriculum development tasks, from lesson planning to evaluation rubrics, as discussed earlier in answer to research question 2.

Reviewing the websites of the selected tools, it appeared that Eduaide, Diffit, MagicSchool and Genially are following laws and regulations e.g. FERPA (Family Educational Rights and Privacy Act), COPPA (Children's Online Privacy Protection Act) and GDPR (General Data Protection Regulation). However, Twee's privacy policy does not explicitly refer to these laws and regulations by name, though alignment with some practices is outlined. While the relevant laws in other jurisdictions may differ, a comparison of these three laws along with the EU AI Act is presented in Table: 4 highlighting their purpose and focus along with the audience as well, as the selected tools only had adhered to some of them. Although the EU AI Act did not appear to be explicitly addressed by these tools, it has been included in the comparison table to provide a broader regulatory context.

Name	Audience	Purpose	Focus
FERPA (U.S. Department of Education, 1974)	Students and parents	Protect privacy of student education records.	Educational records of students in schools receiving federal funding.
COPPA (U.S. Federal Trade Commission, 1998)	Children under 13	Regulate online data collection from children.	Personal information collected by websites, apps, and online services.
GDPR (European Union, 2016)	Everyone	Protect personal data and privacy.	Broad personal data including names, emails, IP addresses, etc.
EU AI Act (European Union, 2024)	Developers, users and providers of AI systems	Establish rules for safe and trustworthy AI development in use.	Risk based regulation of AI systems across sectors and applications.

Table: 4 Data Protection Regulations in US and Europe

FERPA, COPPA, and GDPR each protect personal data but differ in focus and audience. FERPA focuses on protecting student education records in U.S. schools, COPPA regulates online data collection from children under 13 in the US, while GDPR offers broad protections for all EU residents' personal data, with strict consent and transparency requirements. FERPA and COPPA are U.S. specific and more narrowly targeted, GDPR is global in reach and comprehensive in its data protection standards. Moreover, the EU AI Act is the world's first comprehensive legal framework for AI, designed to ensure AI systems are safe, respect fundamental rights and EU values and foster trustworthy AI innovation.

Eduaide's website states that it does not save student work or store personally identifiable information, though this relies only on their own disclosure. MagicSchool also complies with state level student privacy laws (Seifeur, 2024). It also has built-in prompts to warn users about potential bias or factual errors in AI outputs (YesChat AI, 2024). Moreover, as indicated on

their website, it is recognised for data privacy standards in EdTech (MagicSchool AI, n.d.-b). Genially is also compliant with these three regulations i.e. FERPA, COPPA, GDPR.

In addition, a mixed methods research (Genially, 2025) study explored prospective foreign language teachers' attitudes towards integrating AI into their teaching practices focusing on the TWEE tool (Galán-Rodríguez et al., 2025). This revealed concerns of teachers e.g. their major concern is the superfluity of their role (28.6%) considering AI may take over some of their tasks (e.g. material design). From the students' side, 42.9% of teachers' concern was AI misuse by them. Interestingly, this study revealed that teachers themselves should consider diverse preferences and approaches of students and be mindful of ethical concerns whilst using this tool and also training is regarded as essential for effective integration of AI e.g. TWEE in their teaching practice.

Although the publishers of these tools focus on their compliance with laws such as FERPA, COPPA and GDPR, there is a need to investigate this from the lens of ethical issues as well, a subset of which are identified as misuse, superfluity or loss of pedagogical agency (Galán-Rodríguez et al., 2025). Furthermore, while this compliance is marketed on their respective websites and through blog posts, there is a lack of rigorous peer reviewed validation. One example of such a vendor independent third party validation is the Edtech Index (EdTech Index, 2025), an initiative of International Society for Technology in Education (ISTE). The Edtech Index provides structured insights into educational technology tools and their verified third-party certifications. Its primary purpose is to help educators efficiently identify tools that genuinely support student learning, rather than relying on marketing claims or ambiguous product descriptions. The five selected tools were searched on this platform, however, only three (Diffit, Genially and MagicSchool) were listed. The Index assesses products across five validation criteria, which are safe, evidence-based, inclusive, usable and interoperable. These are marked as verified where applicable. Figure: 22 illustrates the validation status of the three identified tools, showing an average adherence of only 27%, indicating a relatively low level of

verified compliance within a sample of selected tools. In addition, inclusiveness and usability are the two criteria that are yet to be verified by third party providers for these tools.

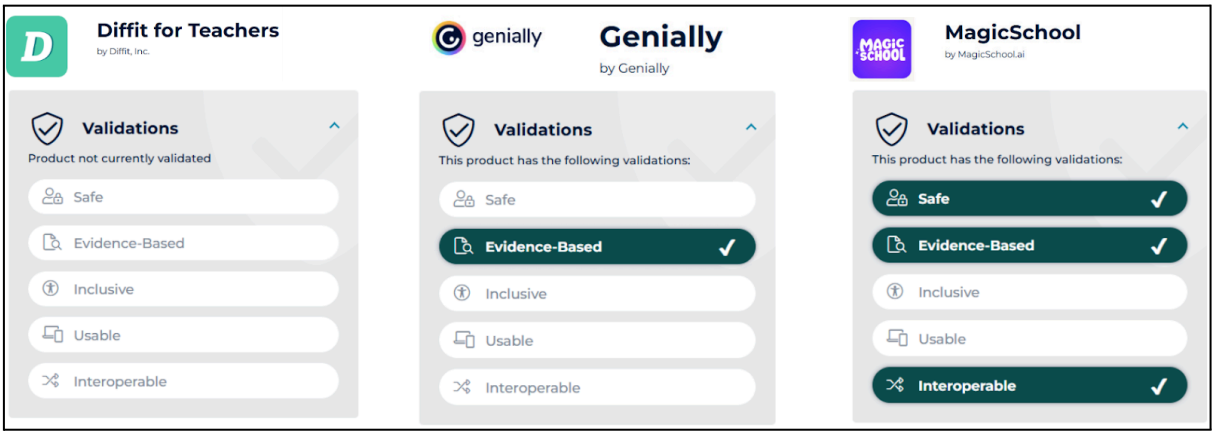


Figure: 22: Validation Status of Diffit, Genially and MagicSchool (as listed on Edtech Index as of November 2025)

These findings advocate for the need to further examine ethical alignment of AI driven curriculum development tools for primary school teachers, as reflected in academic literature.

8.2.2 Academic Literature Perspective

A comprehensive list of ethical principles for AI is defined in UNESCO's document called Recommendation on the Ethics of Artificial Intelligence (*Recommendation on the Ethics of Artificial Intelligence - UNESCO Digital Library*, 2022), is listed below and illustrated in Figure 23.

1. Proportionality and do not harm
2. Safety and security
3. Fairness and non-discrimination
4. Sustainability
5. Right to Privacy, and Data Protection
6. Human oversight and determination
7. Transparency and explainability

8. Responsibility and accountability
9. Awareness and literacy
10. Multi-stakeholder and adaptive governance and collaboration

In this section, we will focus on recent research that aimed to evaluate the alignment between a subset of these ethical principles (safety, age appropriateness, cultural bias) when developing AI driven curriculum development tools. Also, what available tools and frameworks (e.g. CEAT, Autoeval) exist to evaluate ethical alignment.

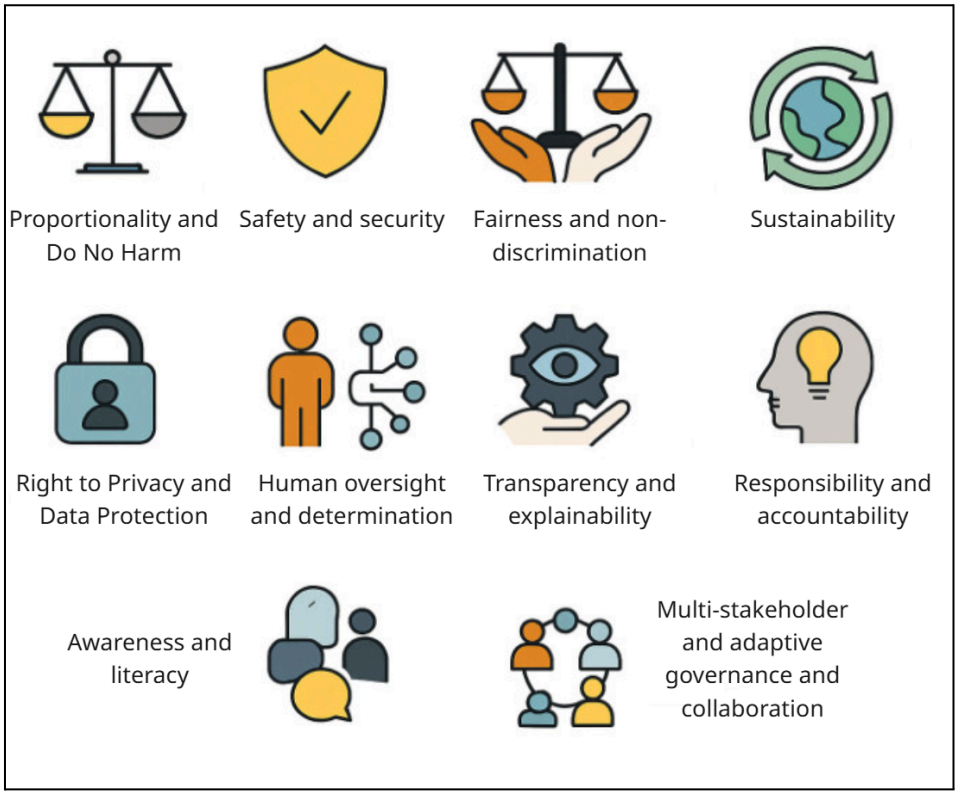


Figure: 23 UNESCO Ethical Principles for AI

8.2.2.1 Current Ethical Alignment of a Special Purpose Open Source Tool Aila

Aila, as profiled in answer to research question 3 under case studies, is the UK Government's first publicly available generative AI tool, developed by Oak National Academy to support teachers of children aged between 5-16 years old with planning national curriculum-aligned

lessons (Clark et al., 2025a), while overcoming ethical concerns like safety and age appropriateness. It is used as a case study to examine the question of ethical alignment, as it represents one of the two documented initiatives (along with NSW in Australia, as discussed in research question 3) that have made substantial investments in both teacher professional development and financial sources. Moreover, the peer-reviewed study aligns with this discussion, covering ethical and safety aspects of AI integration (Clark et al., 2025a) and matching the research question's target age group.

The creators of Aila have used a corpus of 13000 open educational resources (OERs) aligned with the national curriculum for England to build this tool (Clark et al., 2025b). These include slide decks, quizzes, worksheets and videos quality assured by subject specialist teachers. To mitigate the safety risks associated with AI generated content, they have implemented 4 safety guardrails (Clark et al., 2025a).

1. Prompt Engineering: To ensure AI outputs are generated within pedagogically sound and curriculum aligned parameters.
2. Input Threat Detection: To mitigate or block attacks like jailbreaking, which is crafting prompts that override built-in safeguards.
3. Independent Asynchronous Content Moderation Agent (IACMA): To assess outputs against predefined safety categories i.e. Safe, Content Guidance or Toxic.
4. Human in the Loop Approach: To encourage teachers to act as a final safety guardrail and review generated content before it's used in the classroom

An example of how Prompt Engineering helped to write a prompt that guided Aila tool to take into account students' age, subject and topic before creating lesson plans is a lesson on cannabis. Aila used the prompt and generated age-appropriate lessons informed by Relationships, Sex and Health Education (RHSE) curriculum for years 7-11(age 11-16), covering the effects of cannabis use as well as its legal and societal implications. This ensured that the generated content is age-appropriate and aligns with the national curriculum.

In addition, their goal of ethical adoption is further reflected from their commitment to openness i.e. making the code and prompts open source to enable cross sector collaboration to build effective safety guardrails (Oak National Academy, n.d.-b). Also, before launch of this tool rigorous testing was conducted to evaluate the initial effectiveness of safety guardrails (Clark et al., 2025a) and how well it aligns with IACMA. They also conducted red teaming[18] exercises to ensure their tool aligns with the HarmBench[19] (Mazeika et al., 2024) standardised evaluation framework. After launching they were able to identify improvements needed in quality and safety. In one example, a lesson on current affairs was identified as not being accurate. This was due to the data that it was trained on not being recent. In a second example, it struggled with topics that were not part of the national curriculum but still taught in schools, for example lessons on special needs or outdoor skills (Clark et al., 2025a).

Future plans include addressing these concerns and testing it further as well as introducing multimodality of output by including imagery and audio, which will require updates in safety procedures as well. Moreover, they also plan to use their auto evaluation framework (using Generative AI as a judge), which already checks for biases like cultural and gender bias, to investigate the use of more complex technical approaches such as fine tuning and Retrieval Augment Generation to improve quality (Clark et al., 2025b). Another interesting update they are planning is the implementation of an improvement agent which will utilise feedback from an auto-evaluation tool to automatically enhance lesson content quality before its present to the user or suggest specific areas for the teacher to carefully check (Clark et al., 2025b).

As there appears to be limited empirical studies to evaluate safety, other organisations (e.g. NCCA) can also build on Oak National Academy's model for effective safety guardrails (Clark et al., 2025a). In addition, Oak National Academy's open source code and prompts, as noted

[18] Red teaming is a process for testing cybersecurity effectiveness where ethical hackers conduct a simulated and nondestructive cyberattack. The simulated attack helps an organization identify vulnerabilities in its system and make targeted improvements to security operations.
[19] HarmBench is a standardized framework for automated red teaming, designed to address previously overlooked evaluation criteria.

earlier, can serve as a first step towards building an ethically aligned curriculum. They have also created and made available an illustrative dataset of 1000 lessons which will allow other organisations to test their AI guardrails effectiveness using a representative educational data set (Clark et al., 2025a). Also, they suggest that other organisations must first codify their open education resources to be of high quality before delving into developing prompts and evaluation systems for AI-driven curriculum tools.

Although subjective, this analysis indicates that even with the adoption of safety guardrails, red teaming frameworks and quality assured data, there still exists opportunity for improvements in ethical alignment of these tools. And this is just a subset of ethical principles, implementing the full set of principles from the UNESCO framework (*Recommendation on the Ethics of Artificial Intelligence - UNESCO Digital Library*, 2022) will require a substantial effort requiring deep cross-disciplinary collaboration, robust governance structures and scalable technical solutions to ensure fairness, transparency, accountability and inclusivity across all dimensions of AI deployment.

8.2.2.2 Current Ethical Alignment of General Purpose Proprietary Tools (ChatGPT, Gemini and Copilot)

There is limited empirical research on evaluating the use of Generative AI for curriculum development (Lee & Zhai, 2024). A few recent research studies have started to explore how proprietary generative AI tools are used by teachers for developing curriculum e.g. lesson planning, and the ethical issues related to it. A study conducted with 29 pre-service Korean elementary teachers who used ChatGPT for science lesson creation revealed that while it can be beneficial, ethical concerns like accuracy of output and risk of overreliance by students, require systemizing classroom dynamics between teachers and students (Lee & Zhai, 2024). Another study was conducted during 2023-2024 with 40 primary school teachers, who did not have experience with ChatGPT in Turkey (Uğraş et al., 2024). This study found that teachers believe ChatGPT is user friendly, saying that it enriches their teaching process and is suitable for

primary education (in particular Mathematics, Turkish and English) and can contribute to achieving UNESCO's Sustainable Development Goal (SDG) 4, which emphasises the importance of promoting artificial intelligence in education. However, they raised ethical concerns related to its tendency to provide false information, which can negatively impact SDG. Moreover, a study that analysed the lesson plans generated in the context of primary schools, showed that while ChatGPT can level the playing field by opening access to lesson plans for all teachers, to unleash its full potential a cautious approach is needed, especially towards ethical concerns like bias and wrong information (Van Den Berg & Du Plessis, 2023). A preliminary study conducted in Ireland to understand the use and perception of preservice teachers regarding Generative AI, found that it is used for both personal and academic purposes (Hsu et al., 2024). In addition, it furthered the earlier referred ethical concerns by adding skill diminishment, educational equity and data privacy with overreliance.

A study on foreign language teachers' use of ChatGPT for creation of lesson plans, who do not generally have access to high quality curricula, also highlighted the potential of reducing the professional burden on teachers (Dornburg & Davin, 2024). However, the findings suggest a critical ethical concern related to historical bias e.g. introducing research rejected practices into modern curriculum, is pervasive along with an unknown rate of errors. An example of historical bias is ChatGPT's use of the audio-lingual method, an outdated, behaviorist approach popular in 1970's, that focused on repetition and memorized dialogues in lesson plans. This shows how older teaching methodologies can resurface in generated content due to historical influences in the training data. Moreover, an example of the issue of unknown error rates is ChatGPT's tendency to produce inconsistent or incorrect responses, even at low temperature settings[20]. For instance, it showed over 5% error in simple prompts related to software curriculum, highlighting the need to consider reliability when using the tool in educational contexts.

[20] A temperature setting in ChatGPT controls the randomness of its responses: lower values (e.g., 0) make answers more deterministic and focused, while higher values (e.g., 0.7–1) make outputs more creative but also more variable and prone to errors.

These studies provide valuable insights into recent researchers' identification of ethical issues teachers face across different countries from Asia to Europe. However, the findings are primarily based on a single, most widely known tools i.e. ChatGPT. It is important to understand the ethical alignment of other proprietary general purpose tools i.e. Gemini and Copilot. Therefore, in the following section, we present a detailed analysis of a study that used these three together to generate lesson plans for 8th grade students at scale in Massachusetts to draw a more comprehensive understanding of shared ethical alignment issues (Trust et al., 2025).

To answer the critical question should we trust AI-Generated Lesson Plans, a recent study investigated 310 AI-generated lesson plans, featuring 2,230 learning activities, created by ChatGPT, Gemini and Copilot for the 53 content standards mandated in the Massachusetts eight-grade and Massachusetts Government and Civic Life curriculum (Trust et al., 2025). Findings revealed significant limitations in ethical alignment of the generated content e.g. lack of DEI (Diversity, Equity and Inclusion) content and attention to building higher order thinking skills. This is evident from Table: 5 below indicating a very low alignment score[21] only in the range of 5 **to 11%**. Overall 94% (n=2086 out of 2,230) of the generated activities did not receive any code[22] based on Banks Level of Integration of Multicultural Content Model (Banks, J. A., 1989), as these lesson plans lacked any discernible multicultural content. Activities generated by Copilot were the least likely to incorporate multicultural content, (n=34, 5%) while ChatGPT generated activities were the most likely (n=67, 11%).

[21] Alignment score here means percentage of Generative AI created activities that received a code based on the Banks' Levels of Integration of Multicultural Content Model.

[22] A code here refers to a typical process used by researchers where they systematically label and categorise data. In this case, this meant classifying the lessons based on their adherence to the Banks' Levels of Integration of Multicultural Content Model.

Level	ChatGPT		Copilot		Gemini	
	n	%	n	%	n	%
Contribution	2	<1%	1	<1%	1	<1%
Additive	65	11%	33	5%	39	7%
Transformation	0	0%	0	0%	1	1%
Social Action	0	0%	0	0%	0	0%

Table: 5 Number and Percentage of Activities that Received a Code Based on the Banks' Levels of Integration of Multicultural Content Model

Moreover, the AI generated lesson plans tended to be monocultural in nature. For example, the lessons had in-group views of citizenship by emphasising American symbols and topics while ignoring the past and present-day experiences of historically marginalised and disenfranchised groups. Even when diverse content was included it was nearly at the lowest levels of Banks' model i.e. contribution and additive approach. To elaborate, this model uses a four point scale ranging from Contribution level (acknowledging specific individuals and groups), Additive (adding diverse histories without altering dominant narratives), transformative (featuring histories from the perspective of underrepresented groups) and finally social action (creating opportunities to address social problems whilst advancing goals of racial, gender and socio-economic equity and justice for everyone). Examples of contribution and additive level lesson plans are given below.

8.2.2.2.1 Contribution Approach

A ChatGPT generated lesson plan recommend that teachers:

'present brief profiles of historical Figures who exhibited political courage, such as John Adams defending British soldiers in the Boston Massacre trial, Abraham Lincoln during the Civil War, and Rosa Parks during the Civil Rights Movement'.

This is an illustration of the lesson plan aligning with the contribution level of Banks' model, by offering brief profiles without deeper explorations of the individuals and their lives.

8.2.2.2.2 Additive Approach

Another lesson plan generated by ChatGPT about the role of political protest in democracy, recommended teachers to:

'Divide students into small groups and assign each group a different case study of political protest. Example of case studies: The Civil Rights March on Washington in 1963. The Women's March of 2017. The Hong Kong Protests of 2019. The environmental protests of the Extinction Rebellion'.

It is clear that while the events featuring multiple diverse groups are added to the curriculum, there is no guidance or resources for how to explore the causes and consequences of each event from the standpoints of multiple participants, leaving it firmly at the additive level on Banks' scale.

Interestingly there was only one activity from the entire dataset coded as a transformative approach and none (n=0) of the activities were at the social action level of Banks' Model. The single lesson plan coded against the transformative approach was generated by Gemini about the Civil War, federal government, and civil rights and stated that:

'Teachers should encourage students to consider potential future directions for civil rights activism and policy'.

In this example, the opportunity for students to use historical evidence to envision future activism and policy raised the lesson plan to transformation level.

Through these examples, it appears that the majority of the generated lesson plans failed to promote opportunities for students to explore and examine the experiences of diverse groups and their struggles for political inequality and social justice. Therefore, teachers should be cautious with the use of the AI generated lesson plans and approve them with care before using them in classrooms. This suggests that if general purpose proprietary Generative AI tools are used without a critical lens, they will produce content that is of low to moderate quality regarding inclusivity and intellectual rigour.

8.2.2.3 Evaluation Frameworks for Ensuring Ethical Alignment

In this section, three different frameworks and models are presented that can help to evaluate the alignment of AI-driven curriculum development tools with ethical guidelines. Focus is given to safety (Clark et al., 2025a), bias detection (Clark et al., 2025b) and multicultural content integration (Trust et al., 2025) which map to two of the UNESCO's key ethical principles i.e. Safety and security and Fairness and non-discrimination (*Recommendation on the Ethics of Artificial Intelligence - UNESCO,* 2021).

8.2.2.3.1 Safety

Oak National Academy has built and utilised an AI agent to assess Aila's outputs, called the Independent Asynchronous Content Moderation Agent (IACMA) for safety, as described previously (Clark et al., 2025a). In addition, HarmBench helped them to define the 'toxic' categories (Mazeika et al., 2024). This agent helped to assess the generated content against predefined safety categories, flagging it as toxic, if it encourages highly sensitive or harmful behaviour such as illegal activity or violence (Clark et al., 2025a).

8.2.2.3.2 Bias Detection

Contextual Embedding Association Test (CEAT) is an automated bias assessment approach that was used with a prompt-engineered word extraction method within a Retrieval augmented generation (RAG) framework for automatic bias detection (Peng et al., 2025) in AI generated

texts for tutor training lessons. Through this study, it has been demonstrated to be effective as a scalable and objective tool for bias assessment in AI-generated content. In addition, it has the potential to reduce human subjectivity and enhance fairness in the outputs.

8.2.2.3.3 Multicultural Content Integration

Banks Four Levels of Integration of Multicultural Content model focuses specifically on measuring the incorporation of diverse, multicultural and inclusive content in curriculum and lesson plans (Banks, J. A., 1989). As discussed previously, it was used to evaluate lesson plans generated by general purpose Generative AI for diversity, equity and inclusion. An interesting finding was that the generated lessons rarely introduced diverse perspectives. This is a two sided situation, firstly it is a confirmation of this model's potential to highlight the limitations of generated content from DEI perspective and second, is the identification of the lack of consideration given to ethical issues of comprehensive diversity and equity in curriculum design.

From the analysis of grey and academic literature in this context, it is evident that these tools and frameworks can serve as a starting point to evaluate the ethical alignment of current Gen AI tools to develop curriculum and the associated outputs. While the theoretical foundations of AI ethics in education are well-established, there is a need to have a holistic approach to evaluate the ethical alignment of AI-driven curriculum tools. This should not only cover safety, age appropriateness and cultural bias, but the other key dimensions highlighted by UNESCOs Frameworks e.g. sustainability, responsibility and accountability.

In addressing this research question, the discussion up to this point has focused on the ethical alignment of AI-based tools for curriculum development. However, the next section turns attention to the adoption and use of such tools by Irish school teachers. As indicated earlier, this particular area of research appears to be under-explored, with limited studies available in this context. Therefore, the analysis will draw on one academic study (Hsu et al., 2024) and one newspaper article (Irish Times, 2025) that includes direct quotes from teachers, providing insights into their experiences and perspectives on using AI-based tools.

8.3 Irish Teachers and AI: Early Adoption, Concerns and Training Needs

In general, Irish teachers are optimistic about the use of artificial intelligence in education and appear to be using it for personal and academic purposes (Hsu et al., 2024). They recognise its potential to improve learning and planning activities, but are concerned about its use in student assessment. During the Association of Secondary Teachers in Ireland (ATSI) conference (Irish Times, 2025), teachers discussed the pros and cons of integrating AI in the classroom. In the following discussion, three Irish teachers' views are shared in this space, reported in Irish times in April of 2025.

Special Education Teacher Natalie Doyle Bradley has started to use AI as a powerful education tool. Having limited access to textbooks, she uses AI for planning lessons and teaching interactively. For example, she built a custom app called History Quest, which helps students explore topics like Renaissance by choosing their own learning paths. In this app, it is possible to adjust reading level and audio narration giving students a sense of control over their learning along with reinforcing key facts in engaging ways. However, she thinks extreme care should be taken when assessing students using AI.

Another teacher Maria Markey Greene from Rosmini Community School shared similar ethical concerns i.e. it is hard for her to determine if the student's homework was AI generated. Initially, she could trace it back to ChatGPT, but a few months later, the reference was gone. Widespread presence of AI is making it challenging to verify students' original work. She says that due to the ability of AI to produce essays with critical analysis, it is difficult to judge a student's own understanding.

Riain O'Cianaigh, a teacher from Magh Éne College looks at both sides of the coin. He says that AI helps with personalising learning, accessibility for students with special needs and varied content formats like audio and video. The real time feedback helps students to prepare for important exams. But highlights concerns like digital equity, plagiarism and lack of training

among teachers. He says that without proper training, teachers may either rely completely on AI or avoid it altogether.

While the testimonials presented in this section are drawn from secondary school contexts, the themes they highlight (e.g. challenges in assessment, teacher education) may also hold relevance for primary schools, albeit with appropriate consideration of developmental differences. Ultimately, while recognising the benefits AI can provide, teachers should consider it as a support tool and not a replacement for classroom instruction and student evaluation.

8.4 Conclusion

It is evident from addressing this research question that there are numerous studies emphasising the benefits of AI integration in primary schools along with the related ethical issues and mitigation strategies with special focus on the development of essential skills in teachers. These theoretical underpinnings are helpful to guide the future initiatives in this context, however, there appears to be limited evidence of long term holistic adoption of ethical guidelines and frameworks in the current literature. The five available tools (Eduaide, Drift, Twee, MagicSchool, Genially) discussed in this report, appear to be following relevant data privacy and protection laws and regulations. However, this focus does not carry over to efforts to align with ethical guidelines. Part of the reason for this disparity is the lack of legislative pressure when it comes to ethical guidelines compared to data privacy and data protection. In the absence of legislation requiring vendors to ensure that their products and services are ethically aligned, market pressures from schools and teachers as buyers will be the primary driver towards ensuring that tools move in the right direction when it comes to ethics.

Moreover, some recent studies from 2025 have started to report initial evaluation of ethical alignment of Generative AI tools for curriculum development e.g. special purpose tools like Aila (AI-powered lesson assistant) (Clark et al., 2025a) as well as general purpose Generative AI tools that can be applied to achieve similar outcomes (Trust et al., 2025). However, the

literature is still limited in this respect, the studies identified as part of this research focused on ethical issues such as safety, age appropriateness and multicultural content integration. These three issues represent only a quarter of the ten principles identified by UNESCO (*Recommendation on the Ethics of Artificial Intelligence - UNESCO,* 2021). There is an opportunity to take a more holistic approach by considering the full set of these principles when evaluating AI-driven tools for curriculum development in the context of primary schools.

9. Findings and Conclusion

The following section integrates the findings and conclusions as a discussion addressing the key research question and the four SRQs. The purpose is to highlight the most significant outcomes, discuss their implications and reflect on how they address the research objectives.

9.1 Outline

The key research question underpinning this report is: *How is the use of AI impacting the evolution of primary and special school teachers' curriculum design practices, particularly preparation and planning for learning and teaching?*

Due to the diverse nature of the sub-research questions, major findings and implications will be discussed separately under each individual question. While there are natural areas of overlap and interconnection, presenting the outcomes in this way allows for a more nuanced and context-sensitive analysis of each theme. A final synthesis section will then draw these strands together, highlighting key patterns and integrated implications for policy and practice.

9.2 SRQ1

The first SRQ1 is: *What existing legislation, policy frameworks, and/or guidelines govern AI-based curriculum design in education, and how can these inform and support primary and special school teachers' planning and practice?*

A critical theme emerging from this analysis is the tension between robust rights-based and policy frameworks for AI in education and the practical challenges of implementing these frameworks in diverse school contexts (DEY, 2025; Olurinola, 2025) such as primary, bilingual, and special educational needs settings. While frameworks establish high standards, they require ongoing reflection and adaptation for effective integration in the classroom. Ireland's national guidance exemplifies good legislative and strategic alignment, referencing core standards like the EU AI Act (European Union, 2024), GDPR (European Union, 2016), and UNCRC (United Nations, 1989), and calling for inclusive, context-sensitive differentiation. However, translating

legal and technical mandates into classroom practice remains difficult for many teachers - especially where guidance is generic, resources are uneven, and sustained professional learning is lacking (DEY, 2025; pp.17-21, 24; Olurinola, 2025 Yim, 2024;).

AI-specific documents, such as Ireland's Department of Education and Youth's (DEY, 2025) Guidance (DEY, 2025) and international frameworks (UNESCO, OECD) reinforce the value of human oversight, inclusiveness, and collaboration, yet do not consistently provide operational clarity for teachers working with younger or more diverse learners. Yim (2024) and Yim & Su (2025) echo this point by stating that AI literacy frameworks "are often generic and focus on technical aspects, rarely providing clear, age-appropriate guidelines or resources for primary education" (pp.1-2). In practice, challenges include teachers' capacity and confidence to interpret policy (DEY, 2025; Olurinola, 2025), the uneven distribution of infrastructure and supports (Yim, 2024), and a paucity of age-appropriate, differentiated frameworks (Yim & Su, 2025) for early years, bilingual, and SEN classrooms. Reports and recent surveys reveal a disconnect between policy creation and classroom reality: ambitious national strategies have yet to fully address the granular work of equipping teachers at every level to enact safe, ethical, and meaningful AI integration (Marcus-Quinn, A., & McCoy, S. 2025). This point is echoed internationally as Chiu et al., (2024) and Ugras et al., (2024) note.

Meaningful progress relies on context-sensitive translation of policy, targeted professional learning, and fostering ongoing communities of reflective practice. When frameworks empower teachers as curriculum co-designers, offer practical, age-appropriate models, and make room for local differentiation, the promise of ethical and inclusive AI adoption becomes achievable. In sum, the literature, and legislative experience in Ireland, suggest that the move from policy aspiration to classroom impact depends on operational clarity, teacher agency, and sustained, context-responsive support (DEY, 2025, pp.17-21; Olurinola, 2025). As part of a systematic review, Yim (2024) discusses how frameworks and policies are only effective when teachers are empowered to translate them into practice through agency, citing numerous examples from empirical research. Therefore, the literature points clearly to these prerequisites for turning policy ambition into classroom change.

9.3 SRQ2

The second SRQ is: *What are some current open source and proprietary AI-based tools that support curriculum design for primary and special school teachers and what is their impact (positive or negative) on their teaching and learning practices?*

The aim of SRQ2 was to identify current AI-based tools (open source and proprietary) supporting curriculum design and development for primary and special school teachers and to analyse their impact on teaching and learning practices. The findings revealed a developing landscape where AI acts primarily as an assistive and augmentative tool, rather than a replacement of teachers' expertise, impacting their efficiency, curriculum differentiation and student outcomes (Elkordy & McVey, 2025; Lusi et al., 2025; Nattawuttisit et al., 2025; Zagkotas, 2025).

AI-based tools that support curriculum design were broadly categorised into three areas: Instructional, Analytical, and Administrative (Kwid et al., 2024). Instructional tools appeared to be the most widely available, followed by Analytical and Administrative. These tools present a diverse set of features, including lesson planning, assessment, differentiation, interactive content creation and content adaptation for diverse classrooms. Interestingly, the special purpose tools for curriculum development appear less prominent in academic studies in contrast to the general purpose Generative AI tools.

A key reported benefit is the improvement of teacher efficiency and the reduction of workload. The speed of content creation is notable, as one study reported that AI-based tools helped educators to reduce the time required to create a single Multiple Choice Question (MCQ) by up to 80% (Raskob et al., 2025). This is also the expected role of AI-based tools i.e. to automate time-intensive tasks and enable teachers to focus on pedagogy (Zagkotas, 2025). This efficiency ultimately augments teacher expertise and enhances their agency (Iqbal et al., 2025; Nattawuttisit et al., 2025). More importantly, this collaboration between teachers and AI-based tools can help them to act as decision makers in the development of curriculum (Lusi et al., 2025; Zagkotas,

2025). The use of AI-based tools can also transform pedagogical strategies and efficiency in the second language curriculum, however, Irish language support is yet to be developed.

Another area where some positive impact has been reported is Inclusion. Tools like MagicSchool introduce features such as text levellers, text scaffolders, sentence starters, exemplars and non-exemplars, which support accommodations to a diverse range of students, ensuring equitable access to content. Moreover, the emergence of Generative AI enables real-time content adaptation or hyper personalisation, exceeding the capabilities of traditional adaptive learning systems (Saranya & Sankaradass, 2023). Also, the synergy of AI with gamification is reported to enhance student motivation, engagement and learning outcomes. With all these benefits, it is really important to have human oversight while using AI-based tools. Teachers must act as quality gatekeepers, ensuring the accuracy, language and sensitivity of the outputs, as they retain the moral agency and responsibility for the educational outcomes of students.

Even with such advancements, the integrity of AI-generated curriculum can be questionable. For example, a study reported that ChatGPT alone cannot create a reliable curriculum for mathematics due to difficulties with mathematical reasoning and its tendency to produce inaccurate content, occasionally mismatching the abilities of learners with the content. This suggests that auto pilot use of Generative AI tools could be detrimental.

Another limitation of current AI-based tools is their inability to maintain pedagogical coherence because they are generally not trained on a single, coherent curriculum sequence, which restricts their ability to create lessons that build upon prior learning. This highlights the limits of this technology, because only teachers possess the unique contextual knowledge of what has been taught previously, how knowledge should be built in the future, and the specific outcomes that are required for student progression within a wider curriculum sequence.

To mitigate these risks, several models and frameworks have been suggested in this report e.g. Next Gen, ReKnow AI, TAG, because they can help with maintaining pedagogical coherence and integrity of the curriculum. In addition, teacher education is essential in AI techniques like prompt engineering, which can support them to build short and long term curriculum effectively (Iqbal et al., 2025). To sum up, AI-based tools serve as capable co-pilots for curriculum development through managing repetitive tasks like MCQ generation efficiently, teachers must act as captains via building the curriculum based on their experience, deep knowledge of students and continuous validation that the outputs of copilot are accurate, accessible, safe and meaningful.

9.4 SRQ3

The third SRQ is: *What are some success stories or case studies in the context of AI-supported preparation for learning and teaching for primary and special school teachers from which we can derive learnings and recommendations?*

The rationale for this question is to give a detailed outline of the key factors that can make such applications successful and impactful for teachers. The evidence base demonstrates that multiple studies indicate that the use of AI is gradually reshaping the curriculum development practices of primary and special school teachers, especially in the domains of preparation and planning for learning and teaching. In a large-scale primary school context, Ugras et al., (2024) highlighted teachers' impressions in relation to how ChatGPT helped with planning, proposing lesson materials, and generating creative activities, effectively enriching the curriculum development process. This is echoed in different studies such as Blundell, Mukherjee, & Nykvist (2025); Juahiainen & Guerra (2023) and Walter (2024).

Across diverse case study contexts, including Turkey, Uruguay, Ukraine, the USA, the UK, and Australia, the integration of AI, when implemented thoughtfully, has enabled teachers to personalise learning pathways, streamline the creation of differentiated resources, and reduce administrative burdens. For example, Nezhyva et al. (2024) highlighted AI's function in primary teacher preparation, including developing lessons and resources that support personalised and

adaptive learning experiences for young students through content differentiation and customisation. Notably, AI has been found effective in supporting inclusive practices, such as adapting content for students with special educational needs and language backgrounds (Jauhiainen & Guerra, 2023; Ugras et al., 2024). This can help facilitate teacher responsiveness to student diversity in real time, and enable iterative adjustments to lesson planning.

However, the evolution in teacher practices is not driven by AI technology alone, but is fundamentally shaped by human agency, professional development, and institutional conditions (Blundell, Mukherjee, & Nykvist, 2025; Walter, 2024). The converging findings demonstrate that professional development is foundational to meaningful adoption of AI. Studies highlight that high-impact integration depends on robust, ongoing teacher education (Ugras et al., 2024), with school-based, collaborative professional development shown to build both technical and pedagogical capacities for effective AI use. Teachers remain the primary developers and validators of curriculum materials, with AI tools functioning best when they supplement, rather than supplant, professional judgement. The case studies stress the need for 'human-in-the-loop' approaches, where AI-generated content is critically reviewed and contextualised before classroom use (Jauhiainen & Guerra, 2024; Ugras et al., 2024; Walter, 2024).

In planning and preparation, the literature suggests AI provides significant advantages in automating routine tasks (such as resource generation, assessment item creation, or lesson sequencing), thus freeing teacher time for more complex instructional design and reflection Blundell, Mukherjee & Nykvist, 2025; Clark et al., 2025a; Hoare & Smith Ferguson, 2025, Nezhyva et al., 2024; Ugras et al., 2024; Walter, 2024). Teachers report greater flexibility in experimenting with new pedagogical strategies (Jauhiainen & Guerra, 2023), and an increased ability to address the needs of individual learners, including those in mainstream and special education settings. Walter (2024) highlights the effect of AI on one teacher's pedagogical flexibility by stating that Thomas found value in the instant feedback and diverse ideas generated by LGAI (Language-Generating Artificial Intelligence). He elaborates on its role in enhancing his teaching:

> 'It's like sitting down and talking to somebody who is an expert science teacher already and asking for their advice. I wouldn't necessarily follow every piece of advice they give me, but hearing them give a suggestion makes me think about why I do things the way I do and whether they're based on habit or based on any kind of evidence or experience." (Walter, 2024, p. 44)

This passage illustrates how teachers can feel empowered to experiment with and reflect on new pedagogical approaches, using AI both as inspiration and a professional sounding board. At the same time, the evidence warns against over-reliance: where training, support, or strong safety guardrails are lacking, risks related to pedagogical misalignment, digital inequity, and inappropriate content increase. Jauhiainen & Guerra (2023) cautions that "proficiency in critical thinking, fact checking, and comprehension remains indispensable in the era of Generative AI to take full advantage of it in learning environments and teaching curricula" (p. 3). This underscores the necessity of sustained investment in teacher learning, explicit policy guidance, and rigorous, adaptive evaluation systems[23] that support data-driven feedback and adjust questions to match skill level and understanding (Walter, 2024). This improves accuracy, motivation and learning outcomes.

In summation, AI is not simply an efficient tool; it is prompting a cultural and strategic shift in how curriculum is planned and enacted. For Ireland, the international lessons are clear. Policy and practice must prioritise teacher leadership, teacher agency, equity, and continuous learning, in order for AI to realise its potential in advancing inclusive, high-quality education, while safeguarding against fragmentation and unintended harm (Blundell, Mukherjee & Nykvist, 2025; Walter, 2024; Ugras et al. 2024). The significant concerns around ethical alignment merit in-depth discussion in all contexts but especially in primary and special schools, as is reflected in the dedicated SRQ 4 of this report. The future effectiveness of AI in Irish primary and special school curriculum design will depend on building participatory, well-resourced systems -

[23] An adaptive evaluation system is a form of artificial intelligence that learns, adapts, and improves as it encounters changes, both in data and the environment.

systems that embrace innovation but remain anchored in evidence, professionalism, and the lived reality of local classrooms.

9.5 SRQ4

The fourth SRQ is: *How is AI currently being used by primary and special school teachers in Ireland and internationally and to what extent does this align with ethical practices?*

The aim of SRQ4 was to understand how AI-based tools are currently being used by primary and special school teachers in Ireland and internationally and to what extent they align with ethical practices. This is an emerging area, currently driven by the technology's benefits, however, challenged by demonstrable ethical misalignment.

It is recognised across the globe that ethical adoption of AI-based tools can provide personalised learning, automate administrative tasks and offer intelligent tutoring (Adams et al., 2023; Alawneh et al., 2024; Berson et al., 2025; Crompton et al., 2024; Gouseti et al., 2025; Tagare et al., 2025; Wieczorek et al., 2025). In Ireland, studies of experienced teachers are limited, with evidence drawn from pre-service teachers (a sample that cannot be generalised), indicating recognition of the potential of AI-based tools to improve learning and planning activities. A special education teacher reported using AI-based tools for planning lessons and interactive content creation; however, they raised ethical concerns such as the challenge of assessment and academic integrity (e.g. determining if a student's homework was AI-generated or not) (Irish Times, 2025).

AI in primary schools needs to be guided by four key ethical principles: pedagogical appropriateness, children's rights, AI literacy, and teacher well-being (Adams et al., 2023). However, the implementation of these principles faces systemic challenges, including the complexity of conceptualising AI ethics, geo-political influences, and the speed of technological advancement outpacing regulation. Alongside this, current guidelines appear to exhibit a Western-centric bias. Moreover, the core ethical challenges synthesised from academic literature include data privacy, algorithmic bias and the potential for AI to narrow learning experiences by guiding students towards predetermined paths. Algorithmic bias is a notable concern, as one

study reported AI-based tools defaulting the response to a male doctor when prompted by a female student (Tagare et al., 2025). From the perspective of Ireland, the lack of Irish language support by AI-based tools poses a risk towards cultural preservation.

An initial exploratory evaluation suggested an average ethical alignment of 27% in a set of selected tools, as indicated on Edtech Index platform. In addition, recent research studies revealed major ethical concerns upon analysis of lesson plans generated by general purpose AI-tools (ChatGPT, Gemini, Copilot), namely lack of Diversity, Equity and Inclusion (DEI) and failure to promote higher-order thinking skills. It has also been reported that the generated content was monocultural, with most of the lesson plans and activities reaching the lowest levels of Banks Level of Integration of Multicultural Content Model (contribution and additive approach) (Trust et al., 2025). In addition, other studies have highlighted the risks of historical bias and elevated error rates (Dornburg & Davin, 2024). This suggests that teachers must exercise caution and vet AI-generated curriculum before using it in classrooms.

Beyond caution, teachers require a comprehensive ethical foundation encompassing knowledge, skills, and dispositional competencies. Essential skills for ethical integration include AI transparency and explainability, critical analysis of AI and culturally responsive and inclusive pedagogy. Pedagogically, techniques such as the glass box approach, where teachers help students understand how AI-based tools work e.g. how data is processed can increase transparency. Alongside this, a constructivist approach where students are placed in the role of AI developers e.g. developing an ethical chatbot can help demystify ethical issues (Gouseti et al., 2025). Moreover, it is really important for teachers to develop a critical attitude and willingness to question AI-generated outputs and engage students in ethical conversations. In Ireland, teacher testimonials highlight the need for professional training, which is necessary to prevent teachers from either relying completely on AI or avoiding it altogether.

Furthermore, to support teachers and related stakeholders in critical analysis, frameworks have started to emerge in academic literature that map to UNESCO's ethical principles e.g. safety and security, fairness and non-discrimination. These include the Independent Asynchronous Content Moderation Agent (IACMA) for safety (Clark et al., 2025a), the Contextual Embedding Association Test (CEAT) for automated bias detection (Peng et al., 2025), and the Banks Four Levels of Integration of Multicultural Content model (Banks, J. A., 1989) for evaluating DEI in curriculum. Utilising such frameworks is key for developing a holistic approach to evaluating the ethical alignment of AI-driven curriculum tools.

9.5 Synthesis

In drawing these strands together, it is clear that successful integration of AI in primary education hinges on the interplay between robust legislative frameworks, effective AI tool adoption, practical case study insights, and unwavering ethical alignments. National and EU-level legislation, such as the EU AI Act (European Union, 2024) and GDPR (European Union, 2016), have established crucial safeguards and expectations for how AI can be harnessed in schools, especially regarding privacy, transparency, and the management of risk associated with AI application in teaching and learning. These legislative parameters provide a foundation upon which schools can explore the use of diverse AI tools, from lesson planning assistants to adaptive learning platforms. Oak National Academy's Aila (Clark et al., 2025a) is one such example among other international case studies (Jauhiainen & Guerra, 2023; Ugras et al., 2024) where differentiation, facilitation of inclusion and the reduction of teacher workload are apparent common themes. In addition, other AI-based tools can be effective for curriculum development, if they are adapted in conjunction with the relevant models like ReKnow AI, TAG to ensure pedagogical coherence and integrity of generated content. However, case study evidence consistently underscores that the impact of AI tools depends on high-quality professional development, collaborative peer support, and clear, up-to-date institutional guidance, ensuring that teachers have the confidence and competence to supervise and adapt AI-driven solutions for diverse primary classrooms (Granström and Oppi, 2025). Critically, these developments must be underpinned by a strong ethical commitment, operationalised in

'human-in-the-loop' approaches (Clark et al., 2025a; Walter, 2024), open guidelines, and ongoing review practices that prioritise child safety, teacher agency, and inclusive pedagogical aims. Policymakers and schools should embrace AI as a means to advance educational equity and efficiency only when accompanied by ongoing vigilance, deep ethical reflection, and a shared sense of professional responsibility for all learners.

10. Conclusion and Recommendations

In conclusion, this research demonstrates that AI is impacting the evolution of teachers' curriculum design and development practices and, in turn, impacting the teaching and learning of students. No new initiative yields exclusively positive outcomes. Potential drawbacks inevitably accompany any innovation. Key tensions for teachers using AI in primary schools include loss of professional autonomy, risk of over-reliance on AI-generated resources, diminished creativity, uncertainty around data privacy and equity, and increased burden and lack of training; balancing efficiency with ethical oversight and pedagogical freedom remains essential.

The literature indicates a multitude of ways in which AI is driving notable change, common themes of which are represented in Appendix E. It can reduce cognitive load, enhance curriculum development, and support personalised learning, while also empowering teachers to bridge the gap from curriculum delivery to being local curriculum makers.

Case studies have endorsed how AI-based tools supplement teachers' lesson preparation by giving them the time, space and opportunity to explore and innovate with lesson materials and pedagogical approaches. These have been discussed in detail in section 7.3. However, challenges of equity, data privacy, training, and lack of (Irish) language support need to be addressed. For Ireland, adoption should be guided by strong policy and ethical safeguards, cultural alignment, and teacher involvement. Two key international case studies, profiled in sections 7.2.5 and 7.2.6, highlight the scale of investment directed toward enhancing equitable access and fostering teacher engagement in Communities of Practice and/or further, ongoing professional

development for teachers. Interestingly, few other case studies explicitly discussed the high cost of AI implementation. This may indicate a potential positivity bias in the studies undertaken and/or funded. Further research, particularly at primary level, is recommended to evaluate long-term impacts, ensure ethical alignment and inclusivity, and explore how AI can best unite curriculum policy with local, teacher-led innovation. The literature at the primary school level consistently reflects the presence of this research gap.

This report also offers recommendations derived from the key themes emerging in the literature for the research questions. These are illustrated in Figure: 24 and listed in Appendix F. For developers, this means focusing on analytical and administrative tools along with instructional tools. In addition, it is recommended to adapt content for the Irish language, enhance inclusion through features like text levellers and increase engagement through embedding gamification in AI-based tools. Additionally, it is recommended to use frameworks like IACMA, CEAT for automated evaluation of the ethical alignment of the generated curriculum material such as lesson plans. For teachers, the focus needs to be on integration strategies that augment classroom practice rather than replace professional judgement, while ensuring adequate training and ongoing support is provided. Teachers need to build necessary ethical AI skills and competencies like prompt engineering and AI explainability, so that they become competent gatekeepers who can approve content before use in classrooms. Furthermore, the use of appropriate pedagogical techniques like constructive pedagogy and glass box approach[24] is more important in this evolving nature of their role. Students require equitable access to AI-driven resources that respect diversity, uphold privacy, and adapt to individual learning needs. Students should also be placed in the role of AI developers to achieve constructivist pedagogy e.g. developing an ethical chatbot can help demystify ethical issues. Policy makers, in turn, bear responsibility for strengthening and developing contextual legislation, widening access, and establishing oversight mechanisms to ensure equitable and responsible adoption of AI across schools.

[24] A glass box approach is where teachers support students to understand the inner workings of AI (e.g. how input data is processed) for increased transparency (Gouseti et al., 2025).

Ultimately, the transformation of education through AI will succeed only if all stakeholders embrace a shared commitment to upholding personal agency, ethical accountability and collaborative innovation. The future of AI in schools is not about replacing teachers but about empowering every teacher and learner to thrive in a dynamic, just, and compassionate society where the power of AI technology amplifies, rather than diminishes, the richness of teachers' potential. This research report highlights the ultimate potential for teachers to thrive as curriculum developers, harnessing creativity and augmenting and extending the possibilities for the students in the planning and preparation of learning.

Taken together, the evidence indicates that AI is progressively transforming curriculum planning into a more informed, flexible, and reflective process. Through rigorous inquiry, strategic design, and thoughtful implementation of carefully calibrated pathways, teachers and students in primary and special school settings can navigate emerging innovations with discernment and agency. This involves responding, not reactively but purposefully, in ways that deepen the quality and intentionality of planning and practice. This also demands recognition of context, acknowledgement of complexity, and commitment to continuous reflection. It rejects both technological resistance and the implementation of innovations without rigorous piloting. Instead, it cultivates a culture of informed, evidence-based, and human-centred decision-making that honours the professional expertise of teachers and the diverse learning profiles of every student.

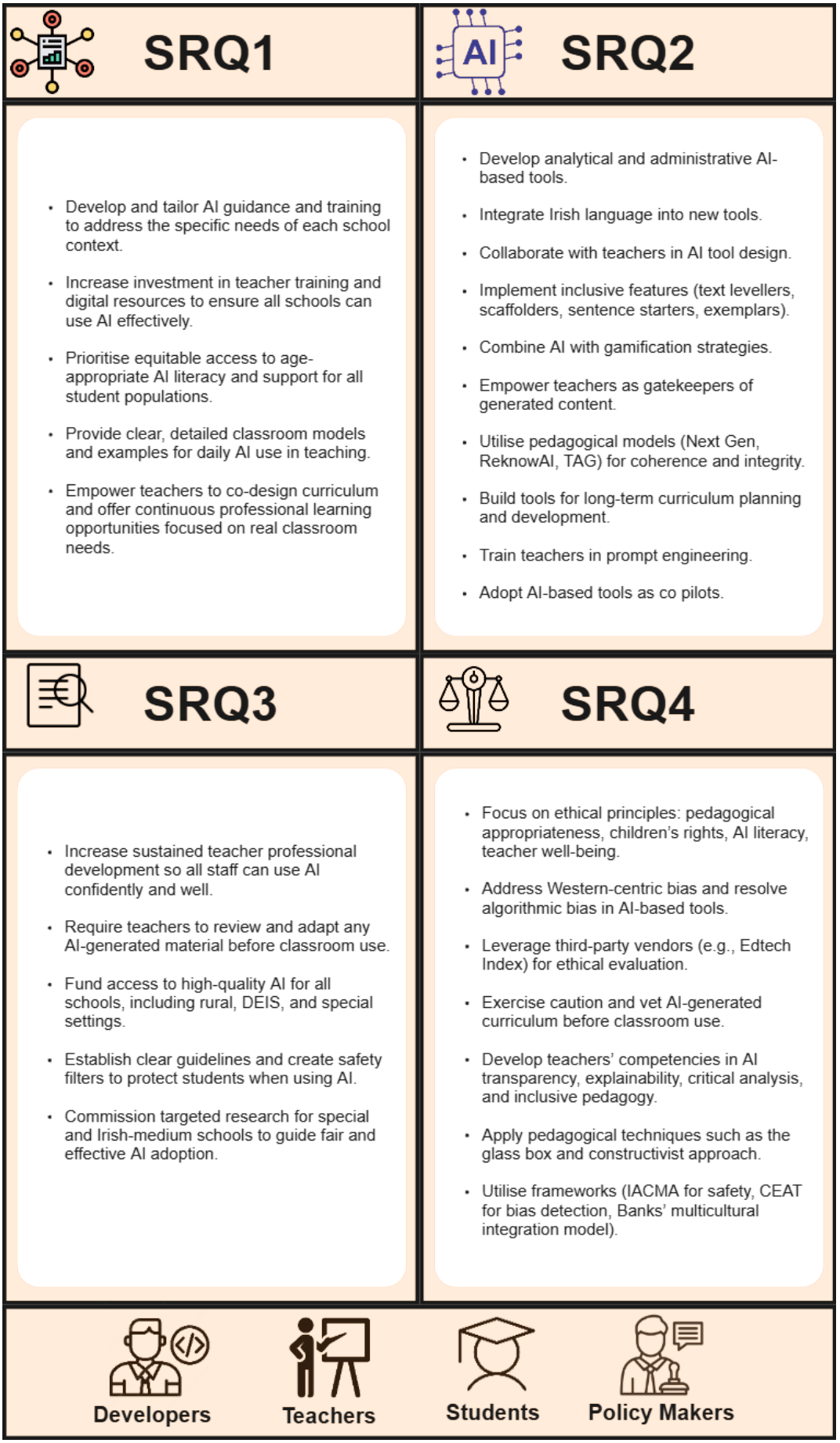


Figure: 24 Recommendations for Key Stakeholders based on Research

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12. Appendices

12.1 Appendix A: 17 Selected Seed Studies.

4 prioritised for snowballing were SS1, SS7, SS12, and SS16.

No.	Title	Year	Source	SRQ1	SRQ2	SRQ3	SRQ4
SS1	**A critical review of teaching and learning artificial intelligence (AI) literacy: Developing an intelligence-based AI literacy framework for primary school education**	2024	Science Direct	☑			
SS2	UNESCO's AI Competency Framework: Challenges and Opportunities in Educational Settings	2025	IGI Global Scientific Publishing	☑			
SS3	Artificial intelligence literacy education in primary schools: a review	2025	International Journal of Technology and Design Education	☑			
SS4	Engaging Teachers to Co-Design Integrated AI Curriculum for K-12 Classrooms	2021	Proceedings of the 2021 CHI conference on human factors in computing systems		☑		
SS5	Artificial Intelligence for Enhancing Special Education for K-12: A Decade of	2024	International Journal of Artificial		☑		

	Trends, Themes, and Global Insights (2013–2023)		Intelligence in Education				
SS6	The use of Artificial intelligence in school science: a systematic literature review	2023	Educational Media International		☑		
SS7	**Reshaping curriculum adaptation in the age of artificial intelligence: Mapping teachers' AI-driven curriculum adaptation patterns.**	2024	British Educational Resource Journal		☑		
SS8	Attitudes towards and expectations on the role of artificial intelligence in the classroom among digitally skilled Finnish K-12 mathematics teachers	2024	LUMAT: International Journal on Math, Science and Technology Education		☑		
SS9	Educational Approaches with AI in Primary School Settings: A Systematic Review of the Literature Available in Scopus	2024	Education Sciences		☑		
SS10	Collaborative construction of artificial intelligence curriculum in primary schools					☑	
SS11	Use of Artificial Intelligence (AI) Technologies in Education According to Primary School Teachers: Opportunities and Challenges	2024	Sakarya University Journal of Education			☑	
SS12	**Generative AI and ChatGPT in school**					☑	

	children's education: Evidence from a school lesson						
SS13	Reshaping curriculum adaptation in the age of artificial intelligence: Mapping teachers' AI-driven curriculum adaptation patterns	2024	BERJ			☑	
SS14	Education for AI, not AI for Education: The Role of Education and Ethics in National AI Policy Strategies	2021	International Journal of Artificial Intelligence in Education				☑
SS15	Ethical principles for artificial intelligence in K-12 education	2023	Computers and Education: Artificial Intelligence				☑
SS16	**The ethics of using AI in K-12 education: a systematic literature review**	2024	Technology, Pedagogy and Education				☑
SS17	Unpacking the ethics of using AI in primary and secondary education: a systematic literature review	2025	AI and Ethics				☑

12.2 Appendix B: A Comparative Table: AI Frameworks, Guidelines and Legislation in Education

To make the landscape clear and comparative, the following table sets out the key frameworks mentioned and some not explicitly mentioned in RQ1 section (notably the US AI Bill of Rights (2022) and the Council of Europe's Convention in AI, Human Rights, Democracy and the Rule of Law (2024) since these are globally relevant benchmarks. All sources can be found in the Reference section.

Category	Framework /Policy	Year	Binding/Advisory	Scope & Relevance to Education	Focus Area
Binding Legislative & Regulatory Frameworks	**EU Artificial Intelligence Act** (European Union, 2024)	2024-2027 rollout	Binding (EU law)	Applies across EU; high-risk categorisation for AI in student profiling, assessments, admissions	Transparency, explainability, human oversight; AI literacy for educators (Art. 4); risk management & penalties; rights of teachers to understand and contest AI-driven decisions
	General Data Protection Regulation (GDPR) (European Union, 2016)	2016/ enforceable from 2018	Binding (EU law)	All AI tools processing student data	Strict data governance, consent, privacy, algorithmic transparency; data minimisation; student data rights
	UN Convention on the Rights of the Child (CRC) (United Nations, 1989)	1989 (Ireland ratified in 1992)	Binding (UN Treaty)	Child-centred digital protections	Protects privacy & participation rights; equitable, child-first AI designs

	Council of Europe Convention on AI, Human Rights, Democracy & Rule of Law (Council of Europe, 2024)	2024	Binding (on ratifying states)[25]	General AI uses, but includes education	First international AI treaty; mandates safeguards for human rights in AI use, including children's contexts
	US AI BIll of RIghts (The White House, 2022)	2022	Non-binding (soft law, but influential)	US context; increasingly used as global benchmark	Rights to notice, explanation, protection from algorithmic bias; safe data use; human alternatives
Curriculum & Skills Frameworks	**UNESCO AI Competency Framework (Teachers & Students)** (UNESCO, 2021a)	2024-2025	Advisory	Curriculum integration globally	AI literacy competencies: ethics, critical thinking, environmental impacts, human-centeredness
	EU DigCompEdu & DigComp 2.2 (European Commission, 2022a; European Commission, 2022b)	2017-2022 updates	Advisory	Digital skills for educators & citizens	Competences in data, content creation, emerging tech, responsible AI

[25] Ireland has not yet ratified the Council of Europe Convention on AI, Human Rights, Democracy & Rule of Law (2024), but the treaty is open for signature and awaits ratification by member states. As of late 2024, the European Commission signed on behalf of the EU, while individual member countries, including Ireland, are expected to complete ratification in the coming period. No public records show Ireland's formal ratification as of November 2025

	AILit Framework (OECD + EC) (European Commission & OECD, 2025)	2025	Advisory	AI literacy for primary/secondary schools	Four domains: engaging, creating, managing, designing AI; practical classroom integration; ethics
National & EU Policy Guidelines	**Ireland's Digital Strategy for Schools to 2027** (Department of Education, 2022)	2022-2027	Policy non-binding	National education system	Emphasis on AI literacy, digital infrastructure, equity, and safe use
	Ireland's National AI Strategy: "AI Here for Good" Refresh (Government of Ireland, 2024)	2024	Policy	Cross-sector;includes education	Values-based AI, focus on trust, student/teacher education, ethical implementation
	AI Advisory Council - Ireland (AI Advisory Council, 2024)	2025	Advisory	Education society	Practical recommendations, up-to-date guidelines for schools, teacher AI literacy support
	Department of Education and Youth Guidance on use of AI in Schools (Ireland) (DEY, 2025)	2025	Advisory, evolving to formal	AI in schools	Privacy, inclusivity, school-level policies; alignment with EU AI Act
	(Australian Framework for Generative	2023	Advisory	All school sectors/states/territories	Offers 25 guiding statements in its framework spanning 6 core principles: teaching

	AI in Schools (Australian Department of Education, 2023)			Focuses on Generative AI tools rather than all forms of AI and their use in schools	and learning, human and social wellbeing, transparency, fairness, accountability, privacy, security and safety
	Policy for the Responsible Use of AI in Government (Australian Government, 2024)	2024 (effective 1st September, 2024)	Mandatory requirements for agencies	Policy that applies across non-corporate Commonwealth entities in Australia	It is structured on 3 key pillars: Enable & Prepare, Engage Responsibly, and Evolve & Integrate.
	UNICEF Policy Guidance on AI for Children (UNICEF, 2021)	2021	Advisory (global policy guidance)	AI design and deployment affecting children	Equity, participation, bias testing, child-centred impact assessments
International Ethical Guidelines & Principles	**EU Ethics Guidelines for Trustworthy AI** (High Level Expert Group on AI, 2019)	2019	Advisory	AI design & use, including education	7 principles: human agency, accountability, transparency, robustness, diversity, non-maleficence
	UNESCO Guidance on Generative AI in Education (UNESCO, 2023b)	2023	Advisory	Global ed-sector orientation	Practical recommendations on equitable, safe generative AI adoption
	OECD AI Principles (OECD, 2019)	2019	Advisory (endorsed by 42+ states)	Global	Principles for responsible AI innovation; students/teacher inclusion; good governance

12.3 Appendix C: Additional Case Studies from Grey Literature (Brazil, US/Spain)

12.3.1 Case Study 7 Overview: Brazil

Letrus (Letrus, n.d.) is a pioneering educational technology programme in Brazil that combines artificial intelligence with pedagogical strategies to improve reading and writing skills among students in the final years of elementary school and throughout high school (UNESCO, 2023a). It was awarded the UNESCO Prize for using AI to improve writing skills (Velez Reyes, n.d.). It is widely recognised for its innovative use of AI-driven feedback and data to personalise learning, streamline corrections, and magnify the impact of teachers in the classroom.

Successes

After the adoption of Letrus throughout the state educational network in Espírito Santo, the state soared from 11th to 1st place in Brazil's national Exame Nacional do Ensino Médio (ENEM) rankings, demonstrating a significant improvement in student performance. These school rankings may influence perceptions of quality and effectiveness, and often contribute to how education policy and public opinion are shaped in Brazil (Government of Alberta, n.d.). Letrus is implemented as public policy in the state school systems of Mato Grosso, Goiás, and Espírito Santo, and is present in over 5,900 public and private schools. More than 1 million students have benefited and over 4 million texts have been written through the platform (ICTworks, 2022). Letrus was named the best educational technology in the world by UNESCO, highlighting its international impact and recognition. The platform boasts an 81% satisfaction rate among educators, reflecting its effectiveness and alignment with classroom needs.

Features

AI platforms provide instant automated feedback and grading based on set criteria, allowing for quick assessment while supporting deeper learning. They automatically flag and reject work for plagiarism, short length, or straying from assigned topics. Teachers and school leaders get detailed reports and dashboards to track student progress and target interventions as needed.

The tools ensure all materials align with national curriculum standards. Teachers retain the flexibility to personalise feedback and refine their assessment approaches, supported by ongoing professional development and expert guidance.

Learnings

Letrus demonstrates that AI-driven, personalised feedback and data-informed instruction can significantly boost literacy outcomes when used at scale. Key factors for success include combining automation with strong teacher oversight, supporting educators through ongoing training, and ensuring system-wide adoption for equity. The platform's experience shows that technology, when thoughtfully implemented, can make teaching more efficient and responsive to diverse student needs.

Recommendations

It is recommended to combine AI-driven tools with strong teacher oversight, provide ongoing professional development for educators, and implement such solutions system-wide to ensure broad and equitable impact. Prioritising personalised feedback, data-informed instruction, and curriculum alignment will enhance learning outcomes while maintaining teaching quality and efficiency.

12.3.2 Case Study 5 Overview: US/Spain

The Amira Learning case study (Amira Learning, n.d.) demonstrates the use of an AI-powered reading tutor designed to support literacy in both English and Spanish, particularly benefiting early learners and minority language speakers

There are multiple reputable sources supporting the positive impact and success of Amira Learning's AI-based reading tutor, particularly in delivering effective feedback for literacy and minority language learners. For example, for multilingual learners, Studies have confirmed Amira's efficacy in bilingual (Spanish/English) settings by accelerating fluency and grade-level mastery, with valuable pronunciation and comprehension support for English Language Learners.

Successes

The system provides real-time pronunciation and comprehension feedback to students as they read aloud, addressing common gaps in literacy and language acquisition. It supports both English and Spanish, making it especially useful for bilingual education and learners of minority or second languages. Teachers receive actionable reports on student progress, enabling targeted instruction and timely intervention, while students gain confidence through individualised feedback. This also supports differentiated teaching strategies. The approach is scalable and adaptable, showcasing that AI can effectively supplement teacher capacity and address linguistic diversity in classrooms. Impact stories offer detailed insights into how these successes have impacted teachers and students in primary school settings.

Recommendations

Consider the importance of culturally responsive content. An AI tutor trained specifically on Gaeilge speech patterns and dialectal variations could accelerate fluency, support teachers with fewer resources, and help standardise best practices for minority language acquisition. Pilot the approach in early primary or immersion schools, gathering evidence on impact before a broader rollout. By adapting features like curriculum mapping, local content integrations, Socratic dialogue and dual language scaffolding, Amira's model could influence Ireland further with its dual language literacy goals and make high-quality language planning and preparation ever more accessible to every teacher and to every student.

12.4 Appendix D: Additional Examples of Countries using AI Tools.

(As mentioned in RQ3)

Country	Name of Tool/Initiative	Key Features
United States	Eduaide.ai, Kuraplan (US), MagicSchool, Brisk	AI creates lesson/unit plans, personalised differentiation, aligned to standards (Common Core), wide export/formatting options (Eduaide, Ai, n.d.; Brisk Teaching, n.d.; Kuraplan, n.d)
China	17ZuoYe, AI Education Framework (Beijing), Squirrel AI	Mandatory AI literacy in Beijing; platforms offer AI-personalised homework, instant feedback, curriculum alignment; Squirrel AI adapts lessons by student need (Business insider, 2025; Ecommerce to China, n.d.).
South Korea	AI Digital Textbooks, Adaptive Learning Tools	Nationwide rollout of AI textbooks (from 2025); AI adapts course content/pace to student progress and collects real-time analytics; strong focus on teacher support and equity (TestWe, n.d.; World Bank, n.d.)
Finland	Council for Creative Education (CCE) Finland AI Enabled School Programme, ITS	AI-powered lesson planning, adaptive platforms, real-time analytics; intelligent tutoring systems for 24/7 support; reduces admin workloads, preps students for AI future (CCE Finland, n.d.)
India	Byju's, Embibe, Toppr, Vidyalaya Lesson Plan Generator	AI-driven adaptive learning, smart content creation, automated lesson plans, virtual teaching assistants, grading, and analytics for Indian curricula (Vidyalaya School Software, n.d.; Lovely Professional University (LPU), n.d.)

Singapore	Authoring Copilot, MOE EdTech Masterplan	AI lesson planner (Authoring Copilot), learning feedback assistants in multiple subjects; adaptive learning system, integrated nationwide via Student Learning Space (Nanyang Technological University (NTU), n.d.; AI Expert Network, n.d.)
Greece	AI4edu (Study Buddy, Teacher Mate), Digital Tutor	National AI-powered digital assistant for lesson planning; Teacher Mate offers lesson/curriculum design, progress tracking, test generation (Digital Watch, n.d.; Greek Reporter, 2024)
Armenia	(No prominent tool specifically named)	Education reforms include AI lesson planning pilots and EdTech partnerships (Armenpress, n.d.)
Switzerland	(EdTech / Local Tools; ETH Zurich, eduAI)	Swiss schools and institutions piloting AI for lesson planning, adaptive learning, automated feedback (Swiss Innovators Club, n.d.; The Swiss Quality, n.d.)

*All sources can be found in the Reference section.

12.5 Appendix E: Table illustrating themes from case studies

The following table illustrates the notable themes derived from the peer-reviewed case studies selected for analysis in this report, including the six specific case studies extracted for specific analysis in SRQ3:

Theme	Case Study
1. Personalisation of Learning Pathways and Content	Ugras et al., 2024 Jauhiainen-Guerra, 2023 Nezhyva et al., 2024 Blundell, Mukherjee & Nykvist, 2025 Gattupalli, Maloy Edwards, 2023 Hoare & Smith-Ferguson, 2025 Clark et al., 2025a
2. Differentiation for Diverse Learners (Multilingual, SEN, Reading/Language Levels)	Ugras et al., 2024 Jauhiainen-Guerra, 2023 Nezhyva et al., 2024 Blundell, Mukherjee & Nykvist, 2025 Hoare & Smith-Ferguson, 2025 Clark et al., 2025a
3. Motivation and Learner Engagement	Ugras et al., 2024 Jauhiainen-Guerra, 2023 Nezhyva et al., 2024 Hoare & Smith-Ferguson, 2025
4. Real-Time Formative Assessment and Scaffolding	Jauhiainen-Guerra, 2023 Gattupalli, Maloy Edwards, 2023 Blundell, Mukherjee & Nykvist, 2025 Hoare & Smith-Ferguson, 2025
5. Teacher Efficiency and Reduced Workload	Ugras et al., 2024 Blundell, Mukherjee & Nykvist, 2025 Nezhyva et al., 2024 Walter, 2024 Hoare & Smith-Ferguson, 2025 Clark et al., 2025a

6. Enhancement of Creativity, Critical Thinking and Digital Skills	Nezhyva et al., 2024 Ugras et al., 2024 Blundell, Mukherjee & Nykvist, 2025 Hoare & Smith-Ferguson, 2025
7. Teacher Professional Development and Need for ongoing Training	Blundell, Mukherjee & Nykvist, 2025 Ugras et al., 2024 Walter, 2024 Hoare & Smith-Ferguson, 2025 Clark et al., 2025a
8. Necessity of Teacher Mediation and Oversight	Ugras et al., 2024 Walter, 2024 Pyzalski, 2024 Hoare & Smith-Ferguson, 2025 Clark et al., 2025a
9. Risk of Over-Reliance, Loss of Pedagogical Sequence	Ugras et al., 2024 Nezhyva et al., 2024 Pyzalski, 2024 Walter, 2024
10. Issues of Equity, Access, Infrastructure Gaps, Digital Divide	Kotsiovos-Doyle-Chicone, 2024 Ugras et al., 2024 Blundell, Mukherjee & Nykvist, 2025
11. Ethical Concerns (Misinformation, Bias, Privacy, Academic Integrity)	Ugras et al., 2024 Pyzalski, 2024 Hoare & Smith-Ferguson, 2025 Clark et al., 2025a
12. High Costs of Implementation	Kotsiovos-Doyle-Chicone, 2024 Hoare & Smith-Ferguson, 2025
13. Student Agency and Critical Interaction	Ugras et al., 2024 Nezhyva et al., 2024 Hoare & Smith-Ferguson, 2025
14. Need for Context- Appropriate Integration /Localised Practice	Ugras et al., 2024 Pyzalski, 2024 Walter, 2024 Hoare & Smith-Ferguson, 2025

	Clark et al., 2025a
15. Evidence-Based Teaching and Alignment with Science of Learning	Hoare & Smith-Ferguson, 2025 Clark et al., 2025a
16. Communities of Practice (Professional Learning Communities)	Hoare & Smith-Ferguson, 2025

12.6 Appendix F: Recommendations for Key Stakeholders

Recommendations from SRQ1

- Develop and tailor AI guidance and training to address the specific needs of each school context.
- Increase investment in teacher education and digital resources to ensure all schools can use AI effectively.
- Prioritise equitable access to age-appropriate AI literacy and support for all student populations.
- Provide clear, detailed classroom models and examples for daily AI use in teaching.
- Empower teachers to co-design curriculum and offer continuous professional learning opportunities focused on real classroom needs.

Recommendations from SRQ2

- Develop analytical and administrative AI-based tools.
- Integrate Irish language into new tools.
- Collaborate with teachers in AI tool design.
- Implement inclusive features (text levellers, scaffolders, sentence starters, exemplars).
- Combine AI with gamification strategies.
- Empower teachers as gatekeepers of generated content.
- Utilise pedagogical models (Next Gen, ReknowAI, TAG) for coherence and integrity.
- Build tools for long-term curriculum planning and development.
- Train teachers in prompt engineering.
- Adopt AI-based tools as co pilots.

Recommendations from SRQ3

- Increase sustained teacher professional development so all staff can use AI confidently and well.
- Require teachers to review and adapt any AI-generated material before classroom use.

- Fund access to high-quality AI for all schools, including rural, DEIS, and special settings.
- Establish clear guidelines and create safety filters to protect students when using AI.
- Commission targeted research for special and Irish-medium schools to guide fair and effective AI adoption.

Recommendations from SRQ4

- Focus on ethical principles: pedagogical appropriateness, children's rights, AI literacy, teacher well-being.
- Address Western-centric bias and resolve algorithmic bias in AI-based tools.
- Leverage third-party vendors (e.g., Edtech Index) for ethical evaluation.
- Exercise caution and vet AI-generated curriculum before classroom use.
- Develop teachers' competencies in AI transparency, explainability, critical analysis, and inclusive pedagogy.
- Apply pedagogical techniques such as the glass box and constructivist approach.
- Utilise frameworks (IACMA for safety, CEAT for bias detection, Banks' multicultural integration model).

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