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Reframing school leadership for the digital age

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ABSTRACT

The role of school leadership in digital transformation is increasingly recognised as central to creating inclusive, adaptive, and future-proof schools and education systems. However, the complexity of this task is often underestimated in policy, research, practice, and professional development. This article explores school leaders' roles as key agents in co-designing inclusive and adaptive digital learning cultures within diverse sociocultural, technological, and educational contexts. Building on contributions from Thematic Working Group 2 (TWG2) at EDUsummIT 2025, this paper introduces a leadership framework comprising six inter-related parts: transformative and strategic leadership; capacity building; equity and inclusivity; policy and governance; leading change; and future-proofing. This framework reflects the evolving demands placed on leaders in digitally enhanced, constantly changing educational environments. Contributions include reflections on theoretical approaches, empirical studies, conceptual analyses, policy-focused pieces, and international cases. Together, they provide a synthesis of current challenges and innovative responses to leadership in the digital age, with a focus on practical tools, inclusive and adaptive strategies, and contextual variations in reframing schooling for the digital age.

Introduction

Across the globe, education systems are navigating unprecedented complexity. Rapid technological innovations, shifting social dynamics, and increasingly diverse cultural landscapes have transformed the expectations placed on school leaders. Within this evolving ecosystem, school leaders play a pivotal role in shaping digital learning environments, cultivating adaptive cultures, and orchestrating the collective efforts of stakeholders, including teachers, learners, policymakers, and researchers, to co-design the future of learning equitably, inclusively, and sustainably. Schools are complex contexts, and school leaders may be evident across a variety of roles, including, but not limited to, principalship, middle leadership, classroom teachers, or system leaders, with each making an influential contribution. Throughout this paper, the term "school leaders" refers to this broader collective. References to principals specifically may be due to this cohort being specifically identified in research or policy.

Various conceptions of leadership for technology-enhanced education have been proposed. For example, Information and Communication (ICT) leadership [1] is associated with techno-centric efforts for building infrastructure, providing equitable access to resources, and motivating and facilitating ICT use in teaching and learning [2]; whereas Technology Leadership [2] emphasises instructional quality and related professional development, with visionary guidance, strategic planning and instructional alignment. Contemporary conceptions converge on the term Digital Leadership [3], which reorients leadership toward a multi-dimensional approach that encompasses technology leadership, cultural transformation for pedagogical innovation, and the building of an inclusive and adaptive learning culture. For this reason, the term digital leadership is adopted in this paper.

Digital leadership needs to respond to the rapid proliferation of emerging digital technologies, including artificial intelligence (AI).

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These technologies promise enhanced opportunities for personalisation and innovation, yet also introduce risks. School leaders may be susceptible to persuasive marketing claims and untested trendy strategies or pressured into actions disconnected from pedagogical purpose. For leaders to navigate this environment with confidence and integrity, they require both robust technical knowledge and a sense of agency. They must understand their role within larger educational networks, recognise the perspectives and influence they bring to collaborative design processes, and leverage these to empower staff and engage communities. This agency is essential for ensuring alignment of technology integration with broader goals of equity, well-being, and cultural responsiveness.

In sum, to create impact, digital leadership requires agentic actions to address complex, multi-dimensional and interrelated issues. Thus, this paper introduces a leadership framework that includes six interrelated dimensions: transformative and strategic leadership, capacity building, equity and inclusion, policy and governance, leading change, and future proofing. Each aspect offers a lens for understanding how leaders can co-create the conditions for inclusive and adaptive learning cultures. Collectively, they provide a scaffold for conceptualising leadership as an evolving set of practices situated within a rapidly shifting ecosystem.

The research question guiding this paper was "What leadership capabilities are required for school leaders to effectively navigate digital transformation and promote sustainable innovation in learning cultures?"

Methods

The authors adopted a polylogue approach [4–6] to include voices from six countries and cultures (see authors and other members in the Acknowledgement). It incorporates multiple concurrent conversations and perspectives from a diverse range of participants, with varying degrees and modes of engagement. The polylogue was enriched by the related expertise and experience of members' respective communities, for example, the 5-component competency framework developed in the Netherlands [7] was introduced by a Dutch member. The discussion and collaborative work started via email and Google shared workspace in Feb 2025 across TWG 2 members. The members engaged in three phases of activities—identifying relevant topics, identifying relevant literature, and co-constructing a preliminary working document—before meeting at EDUsummIT 2025 held at Dublin City University (DCU) Institute of Education in June 2025. We continuously documented and revisited our discussion points across the duration of the EDUsummIT, culminating in elaboration of the six-dimension leadership framework. Two of the authors applied these six dimensions of leadership to the context of their countries as a review of the framework as a whole. Rather than elaborating on each country's profile, these two cases, one from Europe and one from the Australasian region, serve as illustrative examples to demonstrate the relevance of the dimensions.

Six aspects of school leadership for the digital age

Fig. 1 conceptualises the interrelatedness of the elements that collectively comprise the six aspects of school leadership. We start with a discussion of the distinct goals of transformative and strategic leadership as the central focus, followed by an explanation of five related elements.

Transformative and strategic leadership

In the context of rapid technological advancement and changes, school leaders face the challenge of creating a shared vision in an unpredictable environment, often with limited resources such as time, staff, and finances, while facing increasing expectations. Also, emerging technologies like generative AI bring new possibilities but also risks, including ethical concerns, potential psychological harms to users, non-transparent decision-making, and unfair treatment of certain user



Fig. 1. Six aspects of school leadership for the digital age.

groups. In this context, transformative leadership [8] aims to reshape educational environments to be more responsive to diverse learner needs. It entails a commitment to visionary change through democratic engagement and the use of technology to enhance inclusivity.

Transformative leadership works in tandem with strategic leadership [9], which involves long-term planning, vision alignment, and adaptive decision-making to manage organisational change and innovation, including guiding institutions through digital transformation. Together, transformative and strategic leadership emphasises a shared vision that aligns with both local needs and broader educational goals. It encourages leaders to integrate various forms of leadership, including instructional, distributed, and transformational leadership [10], to navigate complex environments. Transformative leadership aims to advance equity, inclusion, and social justice across diverse contexts. It can be used in tandem with, but should be distinguished from transformational leadership [11], which focuses on inspiring followers to exceed expectations by articulating a vision, stimulating intellectual thinking, attending to individual needs, and modelling ethical behaviours.

Beyond the discussion of the leadership model, it is critical to focus on actions and impacts. According to Zhang et al. [12], the coherence of strategic leadership practices across stakeholder groups is more critical than strict adherence to any single leadership model. School leaders should avoid abstract frameworks that lack translation into actionable leadership behaviours. Leaders should have a sophisticated understanding of how to activate different transformation mechanisms based on organisational roles and contexts, creating multiple pathways for participation in inclusive cultural change processes. For example, in the context of generative AI, Ghamrawi et al. [13] proposed concrete leadership roles, including catalysing innovation, curating relevant technologies and resources, championing the benefits and potential of digital teaching and learning practices, cultivating an experimentation culture, and connecting stakeholders for meaningful collaboration.

Transformative leaders need to focus on creating conditions for collaborative innovation accessible to all learners. Connolly et al. [14] proposed developing organisational permeability, enabling learning to penetrate into and out of diverse communities through efficient knowledge-sharing mechanisms rather than resource-intensive formal structures. Their conceptual model positions strategic leaders who enable a multi-level approach that connects individuals, institutions,

and other organisations. It emphasises a culture of transformative dialogue among students, teachers, and the wider community to support the digital transformation in the organisation and to develop digital competencies among all stakeholders. It thus involves aligning micro-level (classroom), meso-level (school), and macro-level (system) priorities to foster shared understanding and coordinated action. Empirically, research (e.g., [15]) has shown the complex interactions between organisational culture and student achievement. Principal's leadership and school organisation culture (innovation and change) have a direct impact on students' achievement in both language and mathematics; principal's leadership also has an indirect effect on student achievement through the mediating factor of classroom culture (e.g., goal orientation). These multi-level interactions suggest that strategic leadership must simultaneously address organisational culture transformation and classroom learning culture development to ensure inclusive outcomes.

The structural and cultural dimensions of change are interwoven, as illustrated in Banoglu et al.'s [16] study: principals demonstrating high levels of both dimensions achieved superior outcomes for diverse learners, while those emphasising only one dimension produced limited transformation. Path analysis reveals that learning organisation culture serves as a critical mediating variable between leadership actions and inclusive integration success, with cultural factors explaining more variance than technical infrastructure or individual competencies. Evidence from COVID 19-related research [17] provides unique insights into how crisis conditions accelerate certain aspects of inclusive digital transformation while exposing systemic vulnerabilities. Schools with established inclusive digital learning cultures adapted more successfully, while those lacking cultural foundations struggled despite access to technological tools, highlighting the primacy of inclusive culture. To build an inclusive and adaptive learning culture, it is critical to shift from a deficit mindset focusing on identifying problems to a collective success culture [18] with deliberate attempts to learn from successful practices, fostering a learning culture through collaborative inquiry in an open and trusting environment. It involves encoding individual pedagogical practices into a collective memory that integrates interrelated activities, processes, and methods of multiple organisational members. It could enhance confidence and persistence, stimulating coordinated pursuit toward reaching common goals.

Capacity building

Building the transformative leadership capacity of school leaders and teachers is crucial for fostering and sustaining a digital learning culture. This empowerment enables them to become digital leaders who can influence the integration of technology in classrooms [19]. However, capacity building requires consideration of the complexities of the school ecosystem, contemporary digital competency frameworks, effective leadership development, and the contexts in which capacity building might occur. The school ecosystems encompass the complex relationships between constituents and contexts, the interconnected network of actors and factors (actants), each with distinct features, connections and behaviours that mutually influence one another [20,21]. Leading change requires comprehension of the relational dynamics and organisational configurations that shape digital transformation and the capacity to establish congruency in the system.

Capacity building requires ongoing attention, guidance through models and competency frameworks, and an iterative process for professional learning, such as the 5-component competency framework proposed by Van Zanten et al. [7], developed in collaboration with the Dutch National Digitalization Impuls (NPuls) (see Fig. 2). It requires the leader to empower staff to enable participation [19,22]. Transformative leadership needs to involve internal and external stakeholders in developing the vision to build support and ownership for the digital transformation [23], while collaborating with staff to develop and enact the processes and decisions through complementary top-down and bottom-up approaches [19]. It also involves cultivating a safe and innovative learning culture that fosters students' digital literacy and innovative use of technology [7,24].

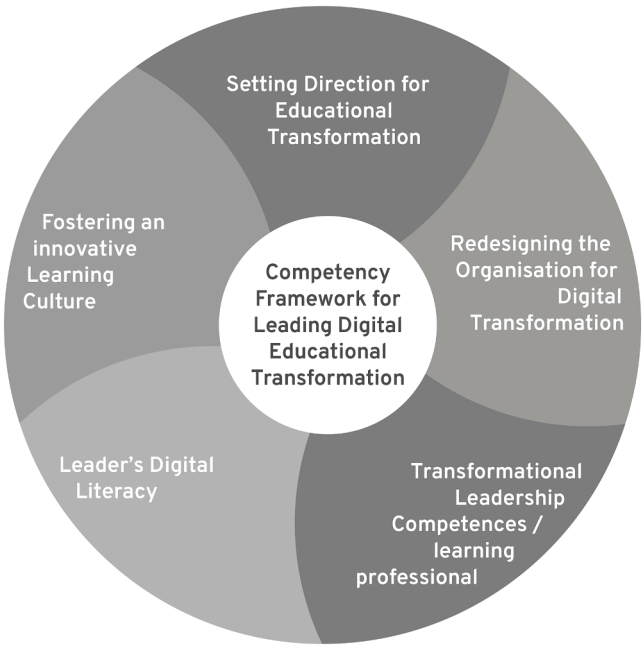


Fig. 2. Competency framework for leading digital educational transformation (This figure is adapted from the Competency Framework diagram supplied under a CC BY-NC 4.0 Licence @ [[7]/iXperium]).

Digital transformation requires leaders to be digitally literate and adept at navigating uncertainty, and also to develop teachers' digital agency by creating positive influence on teachers' attitudes towards, and professional development for, using technology. Digital agency refers to digital competence, confidence and accountability combined to inform how the individual controls and adapts to the digital environment [25,26].

Effective transformative leaders employ so-called 'both/and', rather than 'either/or' leadership [27] to manage paradoxes, such as balancing bottom-up and top-down approaches, small-scale interventions with large-scale transformations, and free experimentation with safe boundaries [7,27].

Equity and inclusivity

Digital equity and inclusion are central concerns in transformative leadership for digital learning cultures. Leaders play important roles in recognising and dismantling barriers that hinder access to technology and resources, ensuring all learners, regardless of their socio-demographic background, can benefit from digital education. Leaders need to pay attention to all aspects of the digital divide [28], encompassing not just access but engagement, support, and digital literacy. Leadership, then, entails advocacy, resource allocation, and community partnership in addition to ensuring the development of digital competencies.

Equity and inclusivity are especially critical in the current world infused with pervasive AI technologies. While AI and adaptive technologies hold promise for personalised and accessible education [29], they also risk exacerbating existing inequalities through biased algorithms and uncritical implementation [30]. Selwyn [31] reminds us that technologies are never neutral; they reflect and reinforce the values of those who design and deploy them. Leaders must interrogate the assumptions behind educational technologies and demand transparency and accountability in their use [32]. For example, underrepresented groups are often rendered invisible in AI training datasets, such as those

in the Global South, and bias in AI algorithms could lead to both allocative and representational harms that have long-lasting effects on individuals and communities, perpetuating inequities. Policymakers must ensure that AI adoption in education is governed by equity-focused regulation and that marginalised voices are central to the design of digital strategies.

Underrepresented groups include indigenous and rural communities, which often face infrastructural and cultural barriers that require more than device distribution. Culturally responsive digital leadership involves not only inclusive content but also co-designing digital educational plans with communities, multilingual resources, and diverse epistemologies [33]. This aligns with Ladson-Billings' [34] theory of culturally relevant pedagogy, which positions student identity as central to learning and underpins the theory of culturally sustaining pedagogies [35].

Additionally, leaders must attend to how digital technologies enable students with disabilities to access quality education. Assistive technologies enable student access through modifications, mediating devices or adjustments to mainstream devices; however, they are expensive and may make the disability visible. The Universal Design for Learning (UDL) principles provide a complementary framework that supports teachers to make curricular adjustments and, when paired with appropriate assistive technologies, may serve to benefit all learners [36,37]. However, as with any pedagogical approach, it is necessary for teachers to have access to appropriate professional development in how to implement this confidently and effectively [38]. Software applications, platforms, and devices are beginning to incorporate accessibility features that reduce the need for expensive assistive devices, reduce stigma by mainstreaming these features, and enable greater access and ease of use [37].

Innovative practices, such as heterogeneous grouping, assistive technologies and AI-supported models, present opportunities to contextualise education and to explore and create inclusive learning environments that accommodate diverse learning needs, preferences and backgrounds. Innovative approaches can help remove existing barriers.

Policy and governance

School leaders play a critical role in navigating regulatory environments, aligning school-level decisions with system-wide priorities, interfacing with broader government policymakers, advocating for supportive policies, and developing school-level policies. Effective governance structures help prevent fragmented or reactive technology adoption, enabling coherent planning and accountability. Wolfenden et al.'s [39] study illustrated how, through Networked Improvement Communities, school leaders in the Global South acted as change agents, analysed school inclusion policies, shared knowledge artefacts and strategies, and enacted actions to enhance equity and inclusion.

However, policies need to be adaptable to the rapidly changing technological landscape. Governance structures that allow for flexibility and responsiveness to emerging trends can empower leaders and teachers to implement innovative practices. This requires a shift from top-down, rigid policy-making approaches to collaborative and participatory models that involve stakeholders such as teachers, students, and community members. Such an approach promotes transparency and accountability, which are also vital for building trust among stakeholders.

Butler et al. [40] explain approaches to making digital education policies adaptable, through multi-level alignment across national, institutional, and classroom contexts to ensure coherence while responding to crises (e.g., COVID 19 pandemic) and technological disruptions. Mitigating measures should be put in place to address systemic inequities, such as the digital divide, and policy implementation should also consider context-sensitive enactment through engaging stakeholders in inclusive governance.

Also, policymakers need to develop flexible, living documents that adapt to the rapidly changing educational landscape. It means fostering reflective, context-sensitive strategic thinking and a holistic approach to leadership and transformation of education [41]. By shifting from rigid regulations to more agile guidance, educational policies can better support the integration of digital technologies into learning environments.

In the context of the proliferation of AI and data science, Gulson and Webb [42] discussed the concept of "computational education policy" (p. 15) that foregrounds policymaking based on data-driven prediction that amplifies instrumental rationality to complement human judgment. This emerging approach, however, requires leaders' capacity in understanding AI algorithms and associated ethical issues, with a deep understanding of data policy, interpretable machine learning and explainable AI, to mitigate issues of power, ethics and potential harms to underrepresented groups.

Leading change

The integration of technology into education has often not led to fundamental new teaching and learning processes, but to the substitution of existing teaching practices [43]. The Covid-19 Pandemic and related full-scale distance education offered a glimmer of hope for disruptive and transformative change in educational processes, but many schools and teachers reverted to the old routines, with only minor technological advancement [44]. The recent rapid development in AI seems to offer possibilities for the transformation of teaching and learning processes, as AI lowers the technical barrier to cater to the growing need for differentiated and personalised learning pathways and flexible and inclusive learning environments, as well as a solution to teacher shortage [44]. The critical question is: how can school leaders effectively shape digital transformation and what strategies are needed for successful change leadership?

Change leadership is critical for navigating the complexities of digital transformation within schools. Effective leaders need to develop a comprehensive change strategy to help build ownership across the organisation [23]. Frameworks like DigCompEdu [45] and HeDiCom (Higher Education teachers' digital competencies for the future [46]) should not be adopted as rigid templates but flexible guides adaptable to local needs. They can serve as tools for discussions and reflections within school teams about the competences needed to realise the school vision, as a means to develop a shared language and perspective, and as a guide for continual professional development. Successful change emerges from fostering relationships, trust, and internal coherence within the school community. In short, create safe spaces for trial-and-error without the fear of failure.

Collaboration, agility, innovation, and creative work are necessary to (re)design technology-enhanced educational processes. Interdisciplinary collaboration, with contributions from staff with diverse perspectives, can lead to transformative learning [47]. Effective communication within the school community and across various organisational silos, coupled with fostering a sense of ownership among staff, can help leaders mitigate resistance to change and promote a shared vision for digital initiatives [10].

Furthermore, leaders should leverage their teams' strengths to enhance their capacity for change and ensure the entire organisation is aligned in fostering a progressive digital learning culture. Digital transformation calls for "leadership from the middle", where there is shared responsibility across levels and people within the organisation [27]. Education will not transform if responsibility is limited only to a few formal leaders; it requires a learning and innovative culture in which members take ownership for educational innovation [7,23].

Future-proofing

Leading schools amid rapid disruptive changes requires future-proofing strategies that sustain innovation, adaptability, and agility

[48]. It involves adaptive learning spaces that enhance students' experiences, such as hybrid and online spaces as digital learning and teaching environments, rather than mere alternatives [49]. Rather than fixed solutions, such leaders create conditions for continuous adaptation [50]. They balance ongoing educational delivery requirements with future-oriented, inclusive transformation initiatives, preserving stability for vulnerable learners and promoting equity and cultural diversity.

Future-proofing involves data-informed decisions and a culture of innovation embedded with agility [51,52]. Ethical responsibility is critical: future-proof leaders act as ethical filters, ensuring technology meets diverse students' needs without compromising quality. Aziz et al. [53] emphasize multidisciplinary collaboration and ethical awareness in data-driven leadership, ensuring fairness, transparency, and accountability over algorithmic decision-making [32]. Supported by an analytical culture [54], they encourage teachers to use data to guide student success.

Future-proofing demands adaptability and reflexivity. Adaptive leaders respond flexibly to complex, unpredictable situations [55], making leadership development an iterative, inquiry-driven process [56]. Moreover, reflexive leaders [57] help to probe underlying beliefs and explore systemic contexts before taking action and inclusive leadership focuses on inclusivity and human-centric values.

Overall, future-proofing is a continuous cycle of rethinking, innovation, and change. School leaders need to create a forward-looking vision, develop a digital mindset, ethical AI practices, and an analytical culture.

The preceding section explicates the six-part leadership framework aiming at reframing school leadership for the digital age to build inclusive and adaptive learning cultures. Case examples of digital leadership in Germany and Australia are presented below, and evaluated against the leadership framework.

Case 1: School leadership in the digital age in Germany

In Germany, measures to promote digitisation and digital skills among students were first consolidated in 2016 through a cross-state strategy developed by the KMK (The Standing Conference of the Ministers of Education and Cultural Affairs [58]. In this approach, due to the need to improve, which has also become apparent in international studies (e.g. [59,60]), the initial focus was on school IT infrastructure, the further development of teacher training and, above all, the digital skills of students. This seemed necessary because, despite numerous waves of innovation, including the introduction of the internet for learning in the 1990s and the expansion of the use of mobile devices in schools in the 2000s, [61] not all schools in Germany had yet begun to exploit the digital potential for teaching and learning.

The growing awareness that school leaders are central to the success and sustainability of school innovation processes was clear, however, this awareness was only gradually transferred to the aspect of digitisation. In 2021, an addition was made to the aforementioned 2016 strategy, finally anchoring the key role of school leaders in the digital age in Germany. This addition clarified the role of school leaders in transforming teaching and learning in the digital world [62]. This included developing a clear vision for teaching and learning in a digital world, supporting teachers in developing their digital competence, and encouraging ICT-related teacher collaboration. Several federal states, responsible for school education in Germany's federal structure, took this up by developing digitisation-related school leadership programmes in the context of digital leadership. These programmes are through partnerships with educational foundations and NGOs and focus as well on attitudes, beliefs, visions, transformation as on the improvement of students' learning and co-constructive learning communities within and beyond schools [63].

While during the pandemic, the majority of school leaders in Germany placed a high priority on supporting and managing digitisation-related school development processes [64], studies conducted subsequently show a decline in the relevance of the topic. This is evident from the latest Schulbarometer surveys (e.g. Robert Bosch [65]) and the international comparative ICILS 2023 study [66,67]. ICILS 2023 shows that school leaders in Germany rate the importance of development processes for improving the use of digital media in teaching and learning in their schools as being relatively low [66]. Furthermore, it is evident that school leaders in Germany often have very limited scope for decision-making about the technical and personnel resources available to schools.

Regarding recent developments and challenges in the context of digital leadership, the topic of how to deal with AI is also relevant in Germany, as it is worldwide. Initially, discussions on this topic often focused on the risks and challenges of AI use by students. Clarity was provided by a cross-state guideline adopted by the Standing Conference of the Ministers of Education and Cultural Affairs in 2024, which reflects on the use of AI in schools in the context of the challenges and potential for teaching and learning ([68]; as a section of the KMK, responsible for school education). The guidelines provide recommendations for education policy also refer to avoiding the widening of the digital divide. There are numerous schools in Germany that are addressing the issue of AI management processes and breaking new ground which can be seen in school awards such as the AI school award program (https://ki-schulpreis.land-der-ideen.de). Again, the topic of AI is initially being discussed at the level of teaching and learning and not comprehensively in terms of school transformation processes. Initial studies point to the need to reflect on the mindset with regard to digital leadership and to take a new look at schools and their basic structures [51].

Against the backdrop of the six-part leadership framework, Germany needs to take further action in all areas of digital leadership, including strategic and transformative leadership, capacity building, equity and inclusion, policy and governance, leading change, and future-proofing. Although the needs and goals outlined in the German strategy papers should focus more on transformation and the role of school leaders, the main issue must be capacity building. Many aspects of equity and inclusion are already being considered in relation to school leadership, however, action is still greatly needed in this area. The constructive evolution of the relationship between school leaders and the school administration in recent years will continue to play a crucial role for Germany in the future, with policy and governance taking on a more transformative and supportive role. The issue of future-proofing is particularly evident in Germany in the context of AI developments. However, the broader picture of sustainable school transformation is often left out of focus. This requires continuous and sustainable financing structures for the resource-intensive transformation and cooperation across the different levels of school administration and as well as greater scope for action that distinguishes more clearly between centrally controlled necessities and requirements that can only be managed decentralised within existing accountability and responsibility structures.

Case 2: School leadership in the digital age in Australia

In Australia, attention to digital learning and student digital capability has evolved over several decades through national policy and curriculum reforms. The *Melbourne Declaration on Educational Goals for Young Australians* [69] recognised that rapid technological change was reshaping how people access, use and create information, and emphasised the need for young Australians to be highly skilled users of ICT. This set the foundation for subsequent government initiatives, including the Digital Education Revolution, which invested in one-to-one devices for secondary students, as well as infrastructure and teacher capability, with the aim of preparing learners to participate confidently in a digital society [70]; 2010).

During the 2010s, digital learning became further embedded through the Australian Curriculum. The Technologies learning area, including Digital Technologies from Foundation to Year 10, was endorsed in 2015 [71]. States and territories complemented this national agenda through their own digital strategies aimed at modernising infrastructure and strengthening professional learning, as reflected in initiatives such as the NSW Schools Digital Strategy [72].

In 2019, the *Alice Springs Mparntwe Education Declaration* updated national goals for education, reaffirming excellence and equity and emphasising digital capability as essential for young Australians to become confident, creative individuals and lifelong learners [73]. Despite this policy direction, national assessments and research continue to highlight inequities in device access, connectivity and digital skill development, particularly for students from low socioeconomic and remote communities [74].

School leadership plays a central role in responding to these challenges. The Australian Professional Standard for Principals [75] provides a national framework describing high impact leadership practices. Although it does not explicitly isolate digital leadership, it positions principals as leaders of teaching, learning and improvement, which increasingly involves guiding digital transformation. Sector reports illustrate that school leaders are expected to use digital technologies strategically, yet considerable variation exists in schools' digital maturity and planning processes [76].

The COVID 19 pandemic intensified the need for digital leadership. Rapid transitions to remote learning required leaders to mobilise digital platforms, support staff, and address emerging concerns about equity, wellbeing and access [77,78]. Studies such as Growing Up Digital Australia show growing concerns about digital engagement, uneven access and the need for more purposeful approaches to technology in teaching and learning [79,80]. As a result, school leadership is now understood as critical to shaping how digital transformation influences inclusion, engagement and adaptive learning cultures.

Recent developments further connect leadership with digital futures. The *Australian Framework for Generative Artificial Intelligence in Schools* [81,82] provides national guidance for the ethical and equitable use of AI in education, including principles related to privacy, safety and avoiding the amplification of digital divides. School leaders are explicitly identified as key actors in ensuring responsible adoption. The release of Australian Curriculum Version 9.0 also introduced a specific curriculum connection for artificial intelligence, encouraging whole school approaches that build students' understanding of AI and its applications [74].

Against this policy landscape, the six-part leadership framework offers a useful lens for understanding Australian developments. Strategic and transformative leadership is reflected in national declarations and curriculum reforms that position digital capability as essential for learning and participation [69,75]. Capacity building is evident in leadership standards, professional learning resources and platforms such as the Digital Technologies Hub, which support planning and implementation.

Equity and inclusion remain central as research consistently identifies digital access disparities, making leadership essential in ensuring that technology supports participation for all learners [74,83]. Policy and governance also play strong roles in setting direction, with national AI frameworks and system level reviews offering guidance, while state strategies respond to infrastructure needs and workforce development [84,85]. Yet gaps remain between policy aspirations and the operational realities leaders face, particularly in relation to democratic participation, digital citizenship and the everyday work of navigating technology rich environments [86].

The leadership dimensions of leading change and future proofing are evident in how principals manage the complexities of digital adoption. Reviews of pandemic responses and subsequent technology studies show leaders shaping local digital strategies, pacing innovation and fostering collaborative cultures that support experimentation and continuous improvement [76,78]. At the same time, public debates about AI, screen time and wellbeing highlight the need for leaders to manage digital growth responsibly while maintaining core educational values and relationships.

Looking forward, Australia's strong policy foundation offers significant opportunities for digital leadership. However, further development is required across all six dimensions of the TWG 2 leadership framework. Strategic and transformative leadership must continue to guide coherent, inclusive digital visions; capacity building remains essential to support leaders and teachers in understanding emerging technologies; equity and inclusion demand ongoing commitment to bridging the digital divide; and policy and governance structures must provide clearer operational guidance and greater flexibility. Leading change and future-proofing are increasingly important as schools confront new technological and societal shifts. To co-design adaptive, inclusive learning cultures, school leaders will require sustained support, expanded professional networks and policy environments that enable innovation while safeguarding equity and educational purpose.

Conclusion

School leaders play pivotal roles in navigating unprecedented complexity driven by rapid technological innovations, changing social dynamics, and diverse cultural landscapes. This paper introduces a six-part leadership framework for digital transformation, essential for creating inclusive, adaptive, and future-ready schools and education systems. Albeit a small slice of the cultural diversity of TWG2, the two case examples from different socio-political-cultural contexts illustrate the global nature of the digital leadership challenges faced by school leaders, and the utility of this framework in evaluating leadership and identifying gaps. The difference in government and education system support has, and will continue to, influence the way in which those challenges will be addressed. Fig. 3 summarises the differences highlighted by the framework, presenting distinct digital leadership strategies and profiles in two different contexts.

Transformative and strategic leadership provides a long-term vision for digital transformation grounded in pedagogy, aligned with community aspirations, and responsive to emerging trends. Leaders filter technological possibilities through educational values, ensuring innovation serves learning. This involved shared decision-making and creating spaces for experimentation, reflection, and collective ownership. Capacity building supports teachers to purposefully reshape digitally enhanced teaching and learning modes. Leaders must enable coaching, mentoring, and collaborative inquiry to build competence and confidence, especially as emerging technologies reshape pedagogy, assessment, and student agency. Building digital leadership capacity at all organisation levels is crucial. Equity and inclusion must anchor future-focused leadership. Leaders must ensure innovation amplifies opportunities rather than deepening existing inequalities through strategies that support learners with diverse linguistic, cultural, cognitive needs, and investments in accessible and culturally responsive technologies, as well as partnerships with families and communities. Inclusive leadership requires vigilance on data ethics, privacy, and algorithmic bias in the age of AI.

Policy and governance highlight leaders' roles in aligning school decisions with system priorities and advocating for supportive policies. Effective governance prevents fragmented or reactive adoption of technology, enabling coherent planning and accountability. Leaders must interpret policy, mediate expectations, and influence decisions shaping the educational ecosystem. Leading change emphasises the relational and iterative nature of transformation through cycles of sensemaking, negotiation, and adaptation. Leaders must communicate purpose, manage resistance, and model continuous learning, balancing urgency with care to maintain well-being, preserve professional autonomy, and cultural integrity. Future-proofing builds organisational resilience amid demographic shifts, evolving educational demands, and accelerating technological advancement. Leaders must anticipate emerging trends, build flexible infrastructure, foster digital literacy across all stakeholder groups, and embed review processes that support long-term sustainability.

Together, these six dimensions frame digital transformation as human-centric efforts shaping environments where every learner and educator can thrive. By reframing leadership as collaborative,

Dimension	Case 1 (Germany)		Case 2 (Australia)	
Transformative and strategic leadership	The importance of school leadership was introduced later (2021)	*Leaders have limited decision-making power. Post-pandemic survey shows leaders' low ranking of the importance of digital development*	A national framework describing high-impact leadership practices was developed earlier (2015)	Framework critical to shaping how digital transformation influences inclusion, engagement, and adaptive learning cultures
Capacity building	An attempt was made through partnerships with educational foundations and NGOs	*A critical area of need*	A National Standard (The Australian Professional Standard for Principals) backed with professional learning resources	Platforms such as the Digital Technologies Hub were built
Equity and inclusion	Guidelines on the use of AI aim to avoid widening digital divides	*Further action is still needed*	Alice Springs *Mparntwe Education* Declaration highlighted equity	*Inequities in device access, connectivity and digital skill development are still reported*
Policy and Governance	Cross-state guidelines exist (e.g., KMK) established	*School leaders lack decision-making power over technical and personnel resources.*	Strong national frameworks, complemented by state strategies	*Gaps between policy aspirations and the operational realities exist*
Leading change	Sustained change was a high priority in digitalisation during COVID-19	*Priority declined afterwards*	Post-pandemic review shows leaders shaping local digital strategies and pacing innovation	Leaders also foster collaborative cultures that support experimentation and continuous improvement
Future-proofing	The topic of AI was discussed in classroom teaching and learning	*It lacks a broader picture of sustainable school transformation*	The national AI framework provides guidance on the ethical and equitable use of AI in education	National curriculum encourages a whole-school approach to AI and its applications

Fig. 3. Comparative summary of two case examples across the 6 digital leadership dimensions.

networked, and equity-driven, this framework can guide leaders in co-designing innovative, just education ecosystems.

Limitations and recommendations

The case studies represent only two of the six countries present in TWG2 and come from well-developed countries. Comprehensive presentation of an analysis using the framework, in addition to a full exploration of the framework elements, meant that limits needed to be imposed. Pragmatics in relation to timeframes and access to necessary data and knowledge also influenced the selection of the countries. It is recommended that future research use the framework's six dimensions as a basis for case study analysis in developing countries.

During the preparation of this work the authors used Co-pilot and Grammarly in order to check for grammar and phrasing. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

CRediT authorship contribution statement

Janet Cochrane: Conceptualization, Formal analysis, Methodology, Resources, Writing – original draft, Writing – review & editing. **Seng Chee Tan:** Writing – review & editing, Writing – original draft, Conceptualization. **Michael Phillips:** Conceptualization, Resources, Supervision, Writing – original draft, Writing – review & editing. **Birgit Eickelmann:** Conceptualization, Resources, Writing – original draft, Writing – review & editing. **Marijke Kral:** Conceptualization, Software, Writing – original draft, Writing – review & editing. **Jacob Chammon:** Conceptualization, Writing – original draft, Writing – review & editing. **Shesha Kanta Pangeni:** Conceptualization, Resources, Writing – original draft, Writing – review & editing.

Declaration of competing interest

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

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