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K-12 teachers' perspectives on AI use in education through the lens of activity theory

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Abstract

The rapid proliferation of AI systems in the past several years has pointed to a potential revolution in education. However, there is currently a lack of theoretical framework to explain how educators understand and view AI and its impact on education. The present study draws on qualitative data from Australian teachers at K–12 levels to explore their perceptions on using AI in school settings. Data were collected in April/May of 2023, approximately six months into the sudden global recognition of AI's potential impact on society, including education. Our thematic analysis suggested six major themes representing in-service teachers' views that AI is unsuitable, impersonal, imperfect, uncertain, assisting, and inevitable. This study also presents theorizing of the activity theory in an AI world, highlighting the complex and nuanced nature of teachers' sentiments regarding the use of AI in school settings.

Keywords: artificial intelligence, K-12, teacher, activity theory, sentiments

Introduction

Few events in recent years have sparked as much controversy and optimism as the affordances presented by Artificial Intelligence (AI). Defined as "machine-based systems that can, given a set of human-defined objectives, make predictions, recommendations, or decisions that influence real or virtual environments" (UNICEF, 2021, p. 16), AI has ushered in a transformative era. This new phase, often referred to as Generative AI, is characterized by its generative capabilities, anthropomorphic features, and advanced functionalities, suggesting the potential for significant improvements in work efficiency—though not necessarily in the quality—of various practices. Educational communities worldwide have taken note of its potential impact on the teaching workforce (e.g., OECD, 2023).

In response to the increasing presence of AI applications in education, the field of "Artificial Intelligence in Education" (AIED) has emerged and witnessed rapid growth in recent years (Kim & Kim, 2022). To date, investigations in AIED have primarily focused on development and validation of AI systems, AI curriculum development, mapping AI skills, and approaches to leveraging in-school resources and infrastructure (UNESCO, 2022). Despite these developments, there has been a relative lack of empirical research aimed at understanding K–12 *teachers' perceptions* of AI and the potential of its use in school settings (Gašević et al., 2023; UNESCO, 2022). In light of this, the current study aims to examine teachers' perspectives on the use or rejection of AI technologies.

Many empirical studies that examined perceptions of AI have tended to rely on a range of theories, particularly the theory of planned behavior (TPB; Ajzen, 1985), the technology acceptance model (TAM; Davis, 1989), and the technological, pedagogical and content knowledge framework (TPACK; Mishra & Koehler, 2006). While these theoretical approaches were utilized to explore the mechanisms of teaching and learning of AI (e.g., Al Darayseh, 2023; Chai et al., 2021), they were developed in the broader context of behavioral science or digital technology (not specific to AI). Perhaps more importantly, these well-established theories emphasize individuals' knowledge base and psychological dispositions, giving little attention to the classroom or system-level contexts in which each teacher operates. Although some studies incorporate contextual variables (e.g., teacher training and school support in Khong et al., 2023; professional development and collegial support in Lee, 2023), these are often treated as "external" variables predicting individuals' tendency to adopt new technologies, rather than being incorporated into comprehensive theorizing of AI use within educational settings. Hence, we argue that there is a need to establish a theoretical framework that addresses teachers' perceptions (a) specific to AI uses and (b) recognises classroom and system-level contexts as integral to teachers' perceptions in AI use in education.

Activity theory as a theoretical framework

We propose *Activity Theory* (AT) (Engeström, 2015; Leontiev, 1978**)** as a theoretical lens to examine teachers' perceptions on using AI technologies in school-based education. AT was developed by Leontiev (1978), who expanded upon Vygotsky's sociocultural triangle—comprising the learner, the social environment, and cultural artifacts—and integrated it into a broader theoretical framework. He emphasized activity as the central element of this framework, delineating six core components that structure and explain human actions within a sociocultural context: (a) human agent/subject/individual, (b) tools, resources, and instruments, (c) object/objectives, (d) rules and regulation, (e) community, and (f) division of labor. Subsequently, the Finnish educationalist Engeström (2015) reduced the complex written theorization of Leontiev and Vygostky into a compact visual

representation by placing the six elements within multiple, interconnected triangles (see Figure 1; the external and internal triangle shapes). The theory positions digital technologies, alongside other tools and resources, as mediators of human activity; coordination and collaboration between human and machine are facilitated by effective utilization and understanding of tools and resources in achieving the objectives of the individual and communities involved (Blayone, 2019). AT's emphasis on individuals' active engagement in goal-oriented and tool-mediated activities presents itself as a useful framework to examine teachers' pedagogical practices involving various contexts encompassing both physical and virtual environments (Barczak et al., 2023; Daniels, 2004).

In recent years, the theory has been welcomed by researchers in the field of digital technology education as it is seen as allowing specific analysis of a range of tool-medicated activities that aim to enable effective teaching and learning (Daniels, 2004). Applications of AT have been seen in studies on computer artifacts and log files (Park & Jo, 2017), the utilization of online tools within virtual learning environments (Adams et al., 2019), and the teaching and learning of programming courses (Barczak et al., 2023). For example, Barczak et al. (2023) utilized the AT's six elements for evaluating an automated assessment system for programming courses: (a) subject (instructor of the course), (b) tool (e.g., automatic assessment system/marker), (c) objectives (algorithmic reasoning and programming skills as the course objectives), (d) learning community (comprising instructor and students), (e) rules and regulations (prescribed in the coursework syllabus), and (f) division of labor (spanning teacher and learners).

Activity Theory (AT) is increasingly recognized as a valuable framework for understanding the integration and usefulness of AI in teaching contexts. For instance, Guo et al. (2024) applied AT in the investigation of the effectiveness of AI-powered chatbots in learning English as a foreign language. They found that students' learning communities were formed around AI as a mediating tool in collaborative writing processes, with AI-student interaction guided by rules, task requirements, and writing conventions. Furthermore, the authors found that activities that were not supported by AI posed challenges to student collaboration, highlighting AI's critical role as a mediating tool between humans and objectives (Guo et al., 2024). Similarly, Zapata et al. (2024) utilized Activity Theory (AT) to investigate the role of Generative AI (GenAI) in providing formative feedback during undergraduate students' writing processes. Their study revealed that the integration of AI feedback led to a restructuring of the community of practice and the division of labor. Students perceived AI-generated feedback as a productive component within their learning community, indicating a significant shift in traditional educational dynamics. Another AT application is seen in Woo et al. (2025) where Hong Kong secondary school students developed their own GenAI tools and used them to write short stories. The study focused on prompt engineering activities in human-AI collaborative

story writing. Activity Theory (AT) was applied to analyze the students' use of tools as mediating elements, their writing as the object, and their school information and academic achievement levels as components of the community. The findings demonstrate that AT elements are effective in understanding human-AI collaborative activities.

Collectively, these studies have demonstrated that Activity Theory (AT) provides a valuable lens for exploring the complex interplay among AI-powered systems, learners and pedagogical approaches. However, existing research on AT applications in AI has predominantly focused on higher education contexts, particularly in areas such as language acquisition, writing practices and feedback, and computer science programming. Notably, there has been limited application of AT to investigate in-service teachers' perspectives and sentiments toward AI use—a gap the current study seeks to address. Our theoretical approach in this study aligns with that of Barczak et al. (2023), which included all six core elements of AT. However, instead of concentrating on a particular course curriculum, we broaden our scope to encompass the wider teaching contexts of K–12 teachers who face the challenge of understanding potential benefits and risk of emerging technology.

Activity theory for teaching and learning in the era of artificial intelligence

We propose each of the six elements of activity theory be expanded in the context of K–12 teachers' AI use in school settings (see Figure 1 for a visual summary).

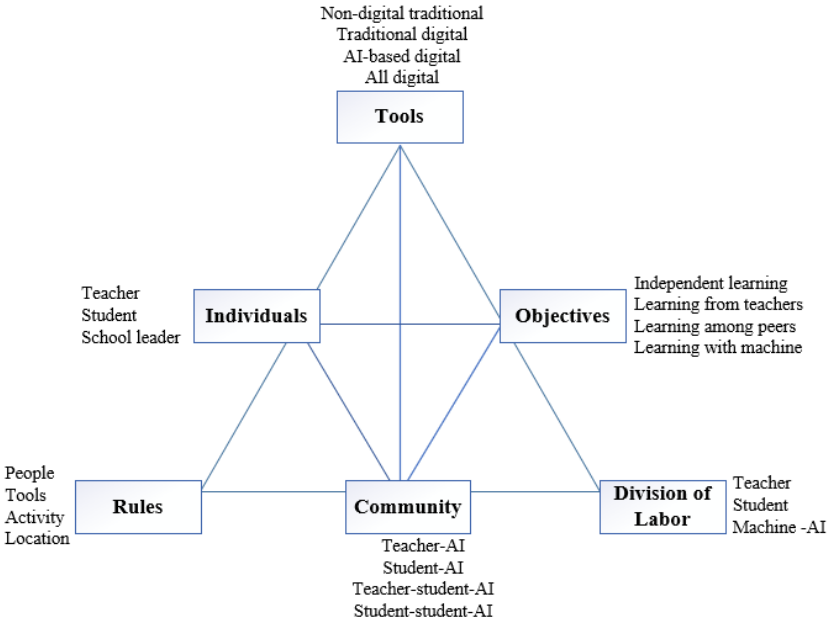
(a) *Individual* actors will include (i) teachers and (ii) students as well as (iii) school leaders setting rules for technology use in the school. AT sees individuals (not tools) as having agency—digital tools do not force individuals to act in certain ways; The tools remain as mechanisms for conveying socially and culturally constructed meanings of action (Koschmann et al., 1998).

(b) *Tools and resources* will need to consider learning environments that utilize: (i) non-digital traditional (e.g., books, experimental devices of science classrooms, under the guidance of human teacher), (ii) traditional-digital (e.g., computer and internet, under the guidance of human teacher), (iii) AI-based digital (under the guidance of human teacher), and (iv) all-digital (with little or no guidance of human teacher). Before the era of generative AI, Engeström (2015) envisioned learning environments based on all digital or non-digital technologies.

(c) *Learning communities* will be formed not only by human–human relationships but also human–machine partnerships (Lee & See, 2004). In addition, three types of interaction may also need to be considered: "learner–content, learner–instructor and learner–learner interaction" (Moore, 1989). We further argue that a learning community will be created not only by (i) human–human relationships (such as teacher–student, student–student) but also by collaborative partnerships (ii) between teacher and AI (e.g., during lesson preparation), (iii) between student and AI (e.g., for learning support), (iv) among teacher–

student–AI (e.g., via AI-empowered instruction), and (v) among student–student–AI (e.g., during group projects and utilizing AI).

Figure 1
A Framework for K-12 Teachers' Perceptions of AI Technology Use, based on Activity Theory



Note. Engeström's triangle (Engeström, 2015) with six elements are presented, along with the extended elements (in the branches) proposed in this study to incorporate AI-integrated school-based education.

(d) *Division of labor* (i.e., how labor will be divided between human and technology) may be the cornerstone of re-conceptualization of learning design in the new AI era. Articulation of the roles of teachers, students, and AI's assistance and generative functions will need to be explicitly established to set an acceptable boundary for AI use. The extent of people's use of AI's assistance and generative functions has brought both deep concerns and optimisms (OECD, 2023; UNICEF, 2021), along with a growing expectation about AI's potential to alleviate teachers' workload and enhance their professional practice by reducing time spent on routine tasks. While teachers' AI use tends to bring out positive sentiments, student use of AI in the context of division of labor tend to be associated with deep concerns due to an ambiguous boundary regarding the authenticity and ownership of the work created by student–AI collaboration (Gašević et al., 2023; Wang et al., 2023).

(e) *Rules and regulations* will need to be established in response to the growing expectations for clear guidance at the international, national, and local levels (OECD, 2023; UNICEF, 2021). International organizations have been working towards the establishment of AI principles, such as "policy guidance on AI for children" (UNICEF, 2021) or "guidance for generative AI in education and research" (UNESCO, 2023). However, high-

level lofty educational principles such as "ensuring inclusion of and for children" are not sufficient to guide AI implementation in the schools. Rules and regulations governing the use of AI in classrooms will need to specify (i) who is using it (teachers vs. students), (ii) which types of tools (e.g., mobile phones, AI devices) and (iii) in which activities and for what purposes, (e.g., brainstorming ideas versus submitting assessments), as well as (iv) the premises and platforms where these activities occur (e.g., online, in-school, or at home).

(f) *Objectives/goals* are perceived as catalysts for facilitating and implementing specific tool-mediated and goal-directed activities (Leontiev, 2006). According to AT, digital technology lacks inherent meaning if it does not contribute to the pursuit of goals and values acknowledged and set by individuals and communities (Blayone, 2019). From this perspective, it is anticipated that traditional educational objectives, such as the acquisition of basic skills and knowledge in reading, writing, and arithmetic, as well as the cultivation of attitudes and dispositions for lifelong learning and personal well-being, may remain significant regardless of the presence of AI. While these fundamental educational objectives may not undergo substantial modification with the introduction of AI into classrooms, there could be a noticeable shift in the community emphasis on students' self-regulated and independent learning in the AI era, facilitated by the proliferation of AI tools and resources designed to support personalized learning experiences (Gašević et al., 2023). In this regard, there may be a growing need for gaining theoretical and practical insights to articulate a set of learning outcomes in (i) learners' independent learning, (ii) learning from human teachers, (iii) learning among peers, and (iv) learning with machines.

The present study

Drawing upon qualitative data from Australian teachers, this study has two primary foci: (a) to investigate K–12 teachers' perceptions of AI technology use in school settings, and (b) to assess the relevance of our conceptualization of activity theory as a theoretical framework for understanding the diverse views held by teachers. In late November 2022, generative AI technologies gained substantial media attention and subsequent "sudden public interest" globally (Gašević et al., 2023, p. 3). The data collection of the present study took place in April/May 2023, approximately six months after generative AI's broad public recognition. This timing aimed to capture a snapshot of teachers' perceptions amid the early but heightened global awareness of AI' potential impact on education.

Following AT, our initial conceptualization of teachers' perceptions of AI were examined based on the core six elements, along with the following questions that guided our data analysis:

(a) *Individual*: Who is using AI programs, tools, and resources? How do teachers differentiate between teacher use and student use of AI? What do teachers see as key considerations for teacher use and student use of AI?

(b) *Tools and resources*: How do teachers view AI programs, tools, and resources? Are these tools and resources seen as beneficial (e.g., potential to increase efficiency, providing new pedagogic opportunities) or detrimental (e.g., source of additional workload or disruption to student learning)?
(c) *Learning community*: Do teachers perceive AI as enhancing (e.g., more efficient communication, more tailored support for individual students with diverse needs) or threatening the learning community (e.g., AI as disrupting traditional pedagogy or threatening the teaching profession)?
(d) *Division of labor*: How do teachers divide labor with AI? What tasks are they willing to delegate to AI, and what tasks do they believe must completely remain as tasks of human teachers?
(e) *Rules and regulations*: How do teachers perceive the current (or lack of) rules and regulations surrounding AI use in education?
(f) *Objectives*: How have teachers shifted, or are they open to shift, their understanding of the fundamental objectives of education in anticipation of the AI era?

We argue that excluding teacher perspectives would significantly limit the understanding of how AI might be integrated into schools. Our hope is that the findings of this study will unveil teachers' concerns, preferences, and needs, shedding light on their future use of AI technologies in classrooms. Such insights could prove invaluable for school leaders and policymakers as they navigate the intricate landscape of formulating guiding principles and essential policies and regulations pertaining to AI use in school settings. For AI product developers, teacher perspectives may be crucial in crafting and tailoring AI programs that are more likely to be embraced by the teaching workforce. Additionally, we envision that the extension of activity theory developed in this study will offer empirical researchers a pathway to operationalize the pedagogical utilization of digital technologies and to envision learning design of future-focused classrooms.

Methods

Participants

The data were collected from in-service teachers in Australia via an online survey using the Qualtrics platform. The survey link was available for approximately eight weeks, from April 5 to May 22, 2023. The online survey had both Likert scale items (i.e., generating quantitative data) and open-ended questions (i.e., generating qualitative data). The data analyzed for the current paper are based on the respondents' qualitative data to the open-ended questions only; quantitative data were analyzed separately and reported elsewhere (Author, manuscript submitted for publication). A total of 206 teachers provided a set of

complete responses to the whole survey. Among these, 66 teachers also provided qualitative responses to three questions placed at the end of the survey. Out of a possible 198 responses (66 participants answering 3 questions), 31 responses were left "empty," resulting in a missing response rate of approximately 15.7%.

The participants had a mean age of M = 36 (S.D. = 10), with a higher percentage of females (65%). According to the Australian government data (cf. Australian Institute for Teaching and School Leadership [AITSL], Australian Teacher Workforce Data portal, 2025; https://atwd.aitsl.edu.au/data), the female teacher proportion within the Australian teaching workforce at the secondary level is 67%. The average age of the Australian teaching workforce is 46 years old. Thus, the participants of our study reflect the gender disparity present in the Australian teaching workforce, but they were somewhat younger than the average Australian teacher.

Ethics approval for this study was obtained through the university affiliated with the first author. Within the ethical guidelines, each participant was coded with a system-generated identification number before the data analysis was conducted.

Measures

We have employed three questions, broadly focusing on: what participants want to use AI for, what they do not want to use AI for, and an open-ended question inviting additional thoughts or comments. These questions essentially capture perspectives of "for," "against," and "what else". The three open-ended questions were intended to capture teachers' personal reflections on AI uses in school settings by allowing them to express their opinion in broad terms. The exact wording of the open-ended questions were: (a) please provide any comments about the areas of your work that you are willing to use AI-powered programs for; (b) please provide any comments about the areas of your work that you would never use AI-powered programs for; and (c) please provide any comments about the use of AI in Education that were not covered in this survey. The survey also had various questions pertaining to participants' demographics (e.g., age, gender), teaching context (e.g., school leadership roles), and school setting (e.g., location). Table 1 provides a summary of the participants' information, which is also included alongside direct quotes to offer contextual details about each contributor (note: not all respondents provided answers to all questions, so there is some missing information).

Data analytic approach

We employed a qualitative data-analytic approach aimed at generating nuanced, rich, and contextual insights into how teachers perceive and engage with AI in school contexts. A qualitative methodology was chosen for several reasons: (a) the concept of AI was relatively novel to most teachers during the data collection period, and (b) participant

teachers were unlikely to have received formal training or professional development in AI. Consequently, it was anticipated that (c) they would exhibit varying degrees of familiarity with AI, leading to a broad spectrum of concepts, emphases, and primary concerns. Therefore, an open-ended approach, inviting participants to articulate their own perspectives, facilitates a thorough and in-depth exploration of their main concerns regarding AI use in school settings.

Table 1
Study participants' demographic, teaching, and school contexts (N = 62)

Variable	Category	Frequency	Percentage
Gender	Male	21	34
	Female	39	63
	Non-binary	2	3
Age	20s	18	29
	30s	21	34
	40s	14	23
	50s	8	13
	60s	1	2
Years in Teaching	5 years or fewer	10	16
	6 to 10 years	10	16
	11 to 15 years	10	16
	16 years or more	14	23
	No response	18	29
Education Level	Secondary school	2	3
	Technical institution	1	2
	Bachelor's degree	27	44
	Master's degree	31	50
	PhD degree	1	2
Teaching Level	Primary	7	11
	Secondary	36	58
	Other/No response	19	31
Teacher Training	Technical institution	1	2
	Bachelor's degree	24	39
	Master's degree	15	24
	Other/ No response	22	35
School Leader	No	43	69
	Yes	19	31
School Location	Non-Urban	33	53
	Urban	11	18
	No response	18	29
School's Socio-Economic Index	Below/About 25 percentiles	1	2
	About 50 percentiles	6	10

About 75 percentiles	16	26
Above 75 percentiles	21	34

The two authors coded the data using thematic analysis, taking a constant comparison approach (Butler-Kisber, 2018). Both authors independently used open coding to categorise teacher perspectives of AI. After several deliberations, an initial code list was created, and themes were consolidated. The second author categorised the data according to the initial codes and themes that were agreed upon; the first author reviewed and revised for consistency between the data and codes/themes. This process again involved several discussions and re-negotiations between the authors. Once both authors agreed, selective coding was developed to synthesise the insights arising from the sub-codes into main themes. The final code list, along with descriptions, are provided in Table 2.

Results

Table 2 provides a summary of the major codes (i.e., themes), sub-codes, and the frequency of each code identified in the data. Our analysis suggests six major codes to represent participants' responses: AI is *unsuitable, impersonal, imperfect, uncertain, assisting,* and *inevitable*. AI as an assistant (Theme 5; n = 67) emerged as the most common theme, with a significant number of responses (n = 31) reflecting teachers' willingness to incorporate AI into their teaching practices. Despite this openness to integration, concerns about AI use were evident across other themes (Themes 1–4). The primary concern revolved around AI being impersonal (Theme 2; n = 37), with teachers emphasizing its inability to replicate the uniquely human elements of teaching. Other concerns, though less prevalent, included the unsuitability of AI to support teaching (Theme 1; n = 22), limitations and potential for bias in AI (Theme 3; n = 14), and uncertainty regarding AI's roles, particularly in relation to originality and plagiarism in student work (Theme 4; n = 6). Additionally, AI as Inevitable (Theme 6; n = 17) captured a neutral stance, where participants acknowledged AI's likely integration into daily teaching practices without expressing strong positive or negative sentiments. Overall, the themes indicate that teachers are keenly aware of both the affordances and limitations of AI. Many practitioners are actively considering where AI might be beneficial or unsuitable for their teaching practices, reflecting a nuanced and thoughtful engagement with AI integration. Detailed descriptions of each of the major codes, along with examples of teacher voices, are presented below.

AI is unsuitable

Some participants expressed a complete refusal to engage with AI for teaching and learning. There was a sense that overreliance on AI would prevent students from acquiring key skills, rendering assessments meaningless, and making a poor substitute for highly skilled

teachers. They were particularly concerned about AI as a potential threat to educational integrity in student learning process.

> *Students are becoming too dependent on using AI for assessment tasks which means assessments may lack validity or purpose. Students are not learning when using AI for assessment tasks.*
> [Male, Age 28, Years in teaching = 6, No leadership position, Urban]

> *My primary concern is that students will not learn the skills to collect and synthesis information themselves and this will be detrimental to acquiring knowledge and being able to use it.*
> [Female, Age 27, Years in teaching = 1, No leadership position, Non-urban]

Table 2
Major codes, sub-codes, and summary description

Major code	Sub-code	Summary description
1. *AI is unsuitable*: Teachers refuse to use AI for all tasks. (*n* = 22)	1a. Disruption to learning (*n* = 5)	Students may not acquire skills if they rely too heavily on AI.
	1b. Not suitable to assist teachers (*n* = 17)	AI is not able to generate a range of teaching-preparation tasks.
2. *AI is impersonal*: Teachers believe AI does not have the essence of humans. (*n* = 37)	2a. Human interaction (*n* = 15)	AI is not capable of understanding of student–teacher relationships, empathy, emotions, and mental health issues.
	2b. Spoken communication & physical supervision (*n* = 22)	Teachers need to interact with parents, give pastoral support, and provide supervision and playground safety.
3. *AI is imperfect*: Teachers believe AI has serious limitations, so they will only use it with careful oversight. (*n* = 14)	3a. Bias and inaccuracy (*n* = 8)	Caution is needed against AI's bias and inaccuracy. There is a need for careful oversight and fact-checking by human teachers.
	3b. Decision-making (*n* = 6)	AI should not perform tasks requiring moral judgement, ethical engagement, and high-stakes decisions.
4. *AI is uncertain*: Teachers feel unsure about AI's abilities, and somewhat fearful about AI's roles in student work. (*n* = 6)	4a. Plagiarism & intellectual property (*n* = 4)	There is uncertainty surrounding students plagiarizing and intellectual property issues.
	4b. Boundaries of permissible actions (*n* = 2)	There is a need for negotiating and agreeing upon a set of rules about permissible actions when using AI technologies.
5. *AI is assistant*: Teachers feel comfortable delegating some of their responsibilities to AI. (*n* = 67)	5a. Administration & planning (*n* = 22)	AI can perform low-level administrative tasks like timetabling or data entry
	5b. Written communication (*n* = 12)	AI can generate draft text, edit and proofread
	5c. Data analysis and research (*n* = 7)	AI can analyze large data sets (e.g., student performance) and summarize research

	5d. Teaching: Pedagogic benefits, assessment & differentiation (*n* = 31)	AI can assist developing lesson plans, creating differentiated materials, developing assessment materials, marking, and providing feedback
6. *AI is inevitable*: Teachers accept AI as inevitable and are ready to embrace AI's potential. (*n* = 17)	6a. Need for policy, regulation, & government oversight (*n* = 4)	Teachers call for policies, regulations, and government oversight
	6b. Accept and recognize need to learn (*n* = 13)	Teachers accept AI while recognizing that both teachers and students must learn how to use AI ethically and effectively

The other set of concerns related to the refusal to use AI for various teaching preparation tasks. Some participants expressed a desire to retain complete control over their pedagogical approaches in a range of tasks across planning lessons, developing assessments, and providing feedback. Overall, there was a perception that AI would not effectively reduce teachers' workload and that AI could not replicate the human teacher in the classroom.

> *Although I know about and have played with some applications of AI, I have discovered that I neither need them in my life, nor see benefits of them in education. Using AI to write lesson plans and gather resources is ridiculous, since AI cannot distinguish between best practice and sensationalism. It is not the way to reduce teacher workload.*
> [Female, Age 32, Years in teaching = 12, No leadership position, Urban]

> *I would never use AI-powered programs for generating anything directly involved in the teaching and learning process. This includes lesson plans, unit plans, worksheets or scaffolding resources, differentiated activities, student feedback, reports or communications with parents.*
> [Female, Age 34, Years in teaching = 12, No leadership position, School location = Urban]

AI is impersonal

Participants also highlighted to the importance of human interaction, both in terms of teacher–student and teacher–parent relationships. Many of them referred to the socializing role of education, the importance of empathy, and the need for understanding emotions and mental health. While a few participants saw AI as a tool to support these processes, the prevailing sentiment was that AI could not replicate distinctly human interaction.

> *The overdependence on technology in education has been an issue already, and AI is only increasing that. Education is about humans interaction with genuine real presence. This will never be replaced effectively.*
> [Male, Age 36, Years in teaching = 13, School leader, Non-urban]

> *Unique human abilities and experiences are crucial in these areas, and human interaction and communication are irreplaceable.*
> [Male, Age 35, Years in teaching = 5, No leadership position, Urban]

> *I think when it [comes] to interaction with students, their families/carers, our colleagues, providing feedback, ensuring the differentiation of our units/lessons*

> *are going [to meet] the needs our individual learners, supervision etc... anything that involves an empathetic/compassionate/humanistic skillset, AI can help to augment the experience, but shouldn't be offloaded to.*
> [Female, Age 37, Years in teaching = 1, No leadership position, Urban]

Participants frequently suggested that a machine could not understand how to communicate with parents, a task requiring deep understanding of individual students and their behavior and learning engagement. Effective communication was seen as particularly important when it is related to student safety.

> *I'm very uneasy about using AI for human interaction, such as communicating with parents about individual students.*
> [Female, Age 46, Years in teaching = 10, School leader, non-urban]

> *[I will never use AI for] … communicating with parents, giving g feedback to students and supervising the playground or students working in class.*
> [Female, Age 33, Years in teaching = 11, No leadership position, Non-urban]

AI is imperfect

Many participants also acknowledged that AI, while useful, is not perfect. They suggested that AI be used only as a starting point or with close human oversight. Some participants pointed out AI's inherent bias and inaccuracy, highlighting the danger of blind application and the importance of human teachers exercising professional judgement.

> *… … myself and those that I know who also create with it, use it as a base which then needs to be modified and fact-checked. AI is great at suggesting ideas that can then be used and created by humans.*
> [Female, Age 40, Years in teaching = 14, School leader, Non-urban]

> *… … because of the inherent biases and inaccuracies that are generated with the large language models expert review is required rather than just the blind application. Thus I think teachers still have a big part to play in the education system.*
> [Male, Age 35, Years in teaching = 8, No leadership position, Non-urban]

> *No matter how I would use AI in my teaching, I intend to always use it as a base then edit accordingly.*
> [Female, Age 33, Years in teaching = 8, School leader, Non-urban]

One particularly salient term was "decision making". Frequently, participants suggested that high-stakes decisions always required human oversight. It seems that while low-stakes tasks like data entry or scheduling can be relegated to AI, teachers believe that the ultimate responsibility for key decisions must lie with humans.

> *I would not use AI to make a decision of any kind, without reviewing all considerations for myself.*
> [Female, Age 33]

> *I would always want the final say on what's delivered [by AI] to them.*
> [Male, Age 33]

> *… …, it is important to note that while AI can be incredibly powerful and useful, there are certain tasks that require a level of human judgment and decision-making that cannot currently be replicated by machines.*
> [Non-binary, Age 23]

> *In addition, some professions need to emphasize human moral judgment and ethical decision-making, such as legal and ethical advice. These tasks involve complex ethical issues and human values, requiring human moral thinking and professional judgment.*
> [Male, Age 35, Years in teaching = 5, No leadership position, Urban]

AI is uncertain

One key theme emerging from the participants' reflections was a sense of uncertainty about the role of AI in education. Perspectives were divided along two main lines: some participants were more neutral, simply noting that it was difficult to predict how schooling may change with increasing AI use; other participants responded with more negatively charged commentary, expressing serious concern about the state of future of education. Their serious concerns mainly centered on protecting intellectual property and detecting plagiarism.

> *The use of AI to engage in academic dishonesty is the primary concern among teachers at the moment.*
> [Male, Age 33, Years in teaching = 1, No leadership position, Non-urban]

> *Plagiarism detectors should be developed far more advanced than the AI techs. Students are more inclined to resort to inputting their school tasks into AI rather than doing them on their own.*
> [Female, Age 44, Years in teaching =21, No leadership position, Non-urban]

> *There is still a fear of AI in schools, particularly in relation to Intellectual Property.*
> [Male, Age 47, Years in teaching =25, No leadership position, Non-urban]

Some teachers also demonstrated uncertainty regarding the boundaries of permissible actions. They deliberated on existing practices that mirror potential functions of AI, noting that educators are already engaged in similar activities (e.g., offering sample responses). They questioned the distinction between providing example responses to students as a scaffolding exercise and utilizing AI for such purposes.

> *Co-developing acceptable use agreements... e.g. is it OK for AI produced content to be used as 'sample responses'? Isn't this similar to when we provide work samples from a previous cohort to guide current student work.*
> [Female, Age 50, Years in teaching = 24, No leadership position, Non-urban]
> *AI poses many benefits and downsides based on how it is used. … … I am less concerned about teachers using AI than i am of students using this technology.*
> [Female, Age 31, Years in teaching = 10, No leadership position, Urban]

AI as assistant

Many teachers expressed a desire to use AI for completing administrative and repetitive tasks, such data entry and scheduling. Some teachers also expressed surprise that these

processes were not already automated. There was a sense of optimism in that these routine tasks could free teachers' time for more useful tasks, as well as avoiding the drudgery of work that does not require professional expertise. However, one participant, an assistant principal, did note the potential risk of completely disconnecting from routine tasks and missing subtle cues necessary to identify issues if relying exclusively on AI.

> *General admin stuff, digital assistants are already so good, having better ones would be great*
> [Male, Age 21]

> *[I would use AI] to handle some of the more mundane aspects of work like basic admin and data entry which should not exist in this day and age. For example, I have to use a platform where I still need to manually adjust a calendar date for different things 22 times - AI should be able to handle this for me.*
> [Male, Age 33]

> *If AI could clean out my inbox and provide responses to low level queries that would be good - but even in low level queries I identify gaps or problems so I would be concerned if as an Assistant Principal [I] disengaged from sections of my work.*
> [Female, Age 51, Years in teaching = 28, School leader, Non-urban]

Along these lines, participants described using AI to assist with writing. In general, they believed that AI could increase their efficiency (e.g., when completing multiple reports with similar content), accuracy (e.g., editing and proofreading), or facility (e.g., when responding to sensitive emails) when communicating in written modes.

> *Come up with a range of alternative phrases to use in reports each year to basically say the same thing, but in a new way.*
> [Female, Age 50, Years in teaching = 24, No leadership position, Non-urban]

> *[I would use AI for] Articulating replies to tricky emails.*
> [Female, Age 51, Years in teaching = 28, School leader, Non-urban]

The perspective of AI as assistant, rather than replacement, was also commonly expressed in discussions about AI assisting with research and data analysis. In contrast to administration and planning tasks, where some participants hoped for complete delegation to AI, most teachers saw AI as an assistant "partner" for research and analysis.

> *I have found benefit in using AI-powered programs for searching literature databases with conversationally-framed questions rather than, for example, Google scholar, which requires attention to keywords and Boolean operators. I may use an AI-powered program to collate and analyse student data, for example, to determine the effect of my draft feedback on assignment quality, or to identify students who are not making a year's growth.*
> [Female, Age 34, Years in teaching = 12, No leadership position, Urban]

With respect to activities related directly to teaching, three distinct categories emerged. The first category represents a group of participants who expressed overall excitement of the potential of new approaches to augment their teaching role and purposeful pedagogy.

> *I have been enthralled in the used of AI in my teaching role. I use it for creating teaching programs, lesson plans and assessment.*
> [Female, Age 40, Years in teaching = 14, School leader, Non-urban]

> *I use this also for my HSC classes. Give the AI an HSC question and then analyse the results. What mark would it have achieved? What happens if we change the keyword, how does the answer change? Since this form of AI is relative new to these students, it can be very engaging.*
> [Female, Age 40, Years in teaching = 14, School leader, Non-urban]

> *AI is helpful let's embrace it to maximize its potential.*
> [Male, Age 36]

The second category related to using AI for assessment and feedback; this typically involved developing test items, identifying patterns of student error, marking, and providing feedback to students.

> *I'm keen to use a well-trained model to assess & grade student responses. Being able to process handwritten work accurately will be very useful. … If the AI can reliably give valid feedback to students regarding improvements that will be valuable.*
> [Male, Age 60, Years in teaching = 16, No leadership position, Urban]

> *AI could be helpful for generating responses for student feedback.… AI application could produce a comment for where the student made an error.*
> [Male, Age 23]

The third category of pedagogic concerns centered on resource creation tailored to students' diverse needs and purposes, as well as enhancing learning opportunities through enrichment and differentiation and supporting students with disabilities.

> *I like the idea of implementing AI for lesson planning, unit design, even embedding into classroom activities and learning opportunities.*
> [Female, Age 37, Years in teaching = 1, No leadership position, Urban]

> *I work in learning enrichment and lead a team of teachers that work with students with learning difficulties. We already use a range of assistive technology such as Office365 Dictate and Immersive reader. The plethora of AI software holds great potential to help students with difficulties have greater access to the curriculum and also allows teachers easier development of tasks that are accessible for a range of students.*
> [Female, Age 50, Years in teaching = 25, School leader, Non-urban]

AI is inevitable

The final major theme emerging from the data was teachers' belief that AI-integration in classrooms is inevitable. Participant perspectives clustered around two main emotional responses: some participants were relatively neutral, accepting that AI would become part of their everyday reality, regardless of their personal views; others were more optimistic, expressing a desire to embrace the efficiencies offered by AI. Many participants also noted that the inevitability of AI signaled a necessity for government regulation, policy, and oversight.

> *It's a whole new world - I hope government regulations and policies catch up.*
> [Female, Age 24]

> *The exponential growth and development of AI and other advanced technologies is going to be inevitable…. I do definitely think that humans are far more capable of regulating what AI can do—it is just a matter of implementing limitations in relation to how AI should be used in Education*.
> [Non-binary, Age 20]

Other participants noted that there was a need to teach students how to use AI effectively, including the need to make students aware of AI's limitations. This was seen particularly important because young teachers and students are already engaged with AI. There was a general sense that both teachers and students could benefit from AI, as long as it was carefully deployed.

> *Kids having been cutting and pasting from google for a long time! …Young teachers and students are already using it.*
> [Female, Age 50, Years in teaching = 25, School leader, Non-urban]

> *We [teachers] are not keeping up. Students know more about it than teachers and no policies are being put in place.*
> [Female, Age 45, Years in teaching = 22, No leadership position, Non-urban]

> *It's really important to expose students to AI and discuss with them how it already exists in their lives. This will be their future so we can't ignore it. Also, if we can reduce our work load as teachers, this is amazing.*
> [Female, Age 33, Years in teaching = 11, No leadership position, Non-urban]

Below, we discuss how this diversity of views can be theorized based on activity theory, considering implications for teachers, school leaders, policymakers, AI developers, and researchers.

Discussion

Overall, our data revealed that teachers held complex and nuanced understanding of AI's potential impact on education. Some were anxious about disruption of student development of fundamental skills, believing that AI use must be carefully regulated; others were more neutral, seeing AI as a partner that could improve efficiency as long as they provided human oversight; others were ready to embrace AI, believing its affordances for new and exciting opportunities for teaching and learning. Furthermore, many teachers seem to have embraced the notion that *AI is inevitable*, acknowledging that younger-generation teachers and students are already using this technology, while there was also a broad consensus that *AI is imperfect* and *AI is impersonal*. These perceptions led to a general feeling that AI is unlikely to replace the teaching profession as a whole. Collectively, these prevailing views of AI, coupled with the absence of comprehensive government regulations, seemed to play a role in participants' perception that AI is not universally beneficial to all stakeholder groups within educational communities.

We also found that our theoretical framework, activity theory, was a useful mechanism for making sense of the diverse views held by teachers regarding AI use. Overall, activity theory seems to offer insights into how individuals may navigate the distribution of labor between machine automation and human control to optimize workflow and outcomes while considering system-level regulations (or lack thereof) and striving to adhere to a set of objectives acknowledged and valued by the learning community. The first generation of activity theory focused on *individual* activity mediated by tools (Leontiev, 1978). Our data also evidenced that the "first" triangle—formed by individuals, tools, and objectives—centers on achieving goals through individual tool use. The second generation expanded to collective activity systems by incorporating rules, community, and division of labor (Engeström, 1987, 2015). Our findings showed that connectivity among AI users (individuals), AI's potential to enhance efficiency (division of labor), and key members of a given activity (learning community) highlights AI's affordances and its impact on teaching communities, providing support for the second generation of the theory. The third generation (Engeström, 2001) recognizes multiple interacting activity systems and the coordination across them. Recent research has integrated Bronfenbrenner's ecological framework, situating AI integration at micro-, meso-, and macro-levels (e.g., Satvati et al., 2025). Participants of the present study expressed a desire for broader support and structured guidance from the macro-level to facilitate meso- and micro-level development within educational communities. In the context of AI, the third generation's emphasis on system coordination may be particularly relevant, as micro-level actors (teachers) acknowledge the influence of macro-level factors (e.g., government policies, national regulations, international communities establishing norms) and meso-level professional networks in shaping AI integration and the development of teachers' AI competencies. We now turn to a more in-depth illustration of how each element of activity theory is manifested in our data and how we interpreted them within the framework of activity theory.

Reflections upon activity theory

Individual & division of labor

Overall, our participants perceived the potential of *AI as an assistant* to support their work and improve efficiency. However, there were notable differences in participants' perceptions of AI use by teachers themselves, compared to AI use by students. In discussions of teacher tasks suited for AI, there appears to be a more optimistic and clearer yet nuanced understanding of its advantages and limitations, which was contrasted to their discussion of student use of AI. Therefore, it appears that (at least for our participants) the concept of *AI as assistant* is mainly reserved for teaching tasks, rather than student use of AI.

The everyday practice of teachers involves a variety of tasks, ranging from those simply requiring time to those requiring highly specialized professional judgement. In general, teachers were willing to use AI for tasks that do not require teacher expertise (e.g., manual data entry, administrative work). This finding is unsurprising, given that time spent on such tasks is a common frustration for teachers and an often-cited reason for those leaving the profession (Cuervo & Vera-Toscano, 2025). On the other hand, many teachers wished to maintain partial or complete oversight of tasks related to pedagogic labor or mentoring roles, spanning across creating engaging and differentiated lessons, developing good assessments, writing report cards, providing meaningful feedback, building rapport with students and colleagues, and communicating with parents. Participants viewed these tasks more central to the teaching profession, consistently referring to the elements of pedagogical practices in quality teaching and emphasized the importance of truly "knowing" students and their personalities, habits, and behaviors—nuances that AI cannot grasp due to its inherent inability to experience human understanding and connection (*AI is impersonal*). Teachers were also cautious of AI's limitations (*AI is imperfect*), believing that AI should not be fully trusted and that there would always be a need for human oversight and control, regardless of how AI was being used.

While teachers described the potential use of AI for their own work with a mix of optimism and caution, their perceptions of students' AI use were more wary and guarded, with the overall sentiments leaning more towards the negative than the positive. Concerns ranged from outright rejection (*AI is unsuitable*) to worries about plagiarism and ethical issues and potential interference on student development of fundamental skills. Within the prevailing view of skepticism towards students' use of AI (*AI is uncertain*), there was also a notable lack of teachers identifying specific benefits to student learning experience and well-being that could be garnered from AI.

There might be two possible reasons for this relative lack of attention to student use of AI and its possible benefits. One reason is that it is likely that most teachers may not have had the opportunity for professional development for AI use in school settings, or they may lack sufficient hands-on experience to develop a well-defined outlook on AI-integrated learning design. The other reason may be related to teachers' dichotomous thinking in how AI might be used. Teachers seem to focus on the *process* in their thinking of *AI as assistant* for their own work, while AI's impact primarily shifted to learning *outcomes* when teachers discussed student use of AI. Given the school accountability policies and culture in the past two decades that measure teacher effectiveness through student achievement (Lingard et al., 2017), teachers' orientation towards student outcomes is understandable. However, the focus on student outcomes could stifle opportunities to consider AI's potential for improving student experiences and learning processes. Much of the empirical studies in the field of digital technology have claimed the benefits in making students' learning

experience more interactive and engaging, thus enriching their motivation and engagement. Examples range from interactive content creation and delivery by synchronous virtual collaboration (Porumb et al., 2013), 3D virtual reality learning environments (e.g., Dalgarno & Lee, 2010), and active collaboration with AI (Gašević et al., 2023). Yet, in the early phase of AI adoption in education, the negative sentiments (*AI is unsuitable*; *AI is uncertain*) may have played a role for teachers not fully considering AI's impact on student experiences and motivation beyond outcomes.

Tools & resources

Overall, there was a broad consensus that teachers do not perceive AI as a threat to human educators. Some teachers perceived AI as a mere extension of the digital tools and resources they had already used in the past. Others expressed an intention to learn more about sophisticated AI-based digital tools in the near future. However, we also noted that teachers generally referred to AI in its generic form, without drawing upon particular distinctions between different AI applications or other digital tools that are commonly used in the school. While it was clear that many participants were referring to generative AI, specific tools were not mentioned (aside from a few incidental mentions of ChatGPT). It seems that participants conceptualized "AI" as a broad category of general digital applications, rather than seeing discrete tools with unique functions.

There was also limited mention in participants' responses about specific pedagogical benefits or approaches to using AI in the classroom. Furthermore, no teachers referred to how AI tools and resources may be utilized along with traditional (e.g., books) or other digital learning tools (e.g., videos, games). Previous research suggests that teachers who are proficient in various types of digital tools are more likely to adopt emerging technology more readily (Lee, 2023). In this regard, digital literacy is often measured by how many tools people have explored and used regularly and comfortably without major setbacks or frustration (Blayone, 2019). Hence, a range of digital tools that teachers currently use may suggest their inclination of more advanced digital tools such as AI. While teachers' transferable capabilities from digital technology to AI technology remains to be seen, participants' relative lack of detailed descriptions of pedagogical benefits in using AI may also simply due to their current (and insufficient) levels of AI literacy. Taking these views all together, a pedagogical paradigm shift necessitated in AI-integrated classrooms may call for strengthening teachers AI literacy while also monitoring their technological, pedagogical and content knowledge (TPACK; Mishra & Koehler, 2006).

Rules & regulations

Participants expressed a strong desire for a clear set of rules and regulations regarding AI use in education, emphasizing the urgency of such guidelines due to the shared belief that

AI is inevitable. They particularly emphasized the need for rules to govern and advise students on appropriate and ethical interactions with AI. Furthermore, they attributed the sense of uncertainty surrounding AI (*AI is uncertain*) to a lack of system-level guidance and advising schools and teachers on integrating AI to enhance student learning without negative impacts. Given that teaching is already a highly regulated profession in Australia, where our participants are drawn from, their urgent need and expectations for government-led AI guidelines are unsurprising. Australian teachers must navigate both state and federal requirements, curricula, and assessment programs, including student use of technology such as access to mobile phones and the internet (Brown, 2021). Without guidance from the system level, the integration of AI into educational practices may encounter significant challenges, as teachers may continue to feel uncertain and hesitant to update or modify pedagogical strategies to adapt to the integration of innovative technologies such as AI.

Learning community

Some participants saw AI as a benefit to the learning community, believing it could open opportunities to reduce teacher workload. Others emphasized its potential as a threat to the integrity of student learning processes. However, there were four broad views that seem to be consistent amongst responses: (a) the sense that AI would have some sort of influence on the ways that teaching and learning are conducted (*AI is inevitable*); (b) the feeling that AI cannot possibly replace human teachers and teaching profession as a whole because machines cannot replicate human–human relationships (*AI is impersonal*); (c) the perception that the ever-changing nature of AI technology makes it hard to judge whether AI is another technological fad that would fade away into obscurity despite promises to revolutionize education or if it would become an everyday application in teachers' repertoire (*AI is uncertain*); and (d) a sense that the current status of AI technology cannot be trusted (*AI is imperfect*).

On the other hand, our participants' voices did not capture a broader range of learning communities. Detailed comments on diverse student groups—such as neurodivergent students, English language learners, and students from immigrant backgrounds—were largely absent, even though AI tools are likely to affect these groups differently. Furthermore, the diverse range of teachers' professional learning communities, which often extend beyond the classroom or school context, were not represented in our data. These communities take various forms, including models aligned with communities of practice, practical tasks, and research-oriented activities. Participation in AI-focused networks and professional learning events likely shapes both technology integration in schools and teachers' AI competency development (Fakhar et al., 2024). As teachers prepare to be AI-ready for future classrooms, professional communities are likely to form an integral part of the emerging AI learning ecosystem.

Learning objectives

Teachers' visions of educational objectives and how AI may support such visions are associated with their overall perception of AI as ethical and beneficial to the learning communities (Gašević et al., 2023; Wang et al., 2023). According to our data, there was a prevailing belief that the overall objectives of education will largely remain unchanged in AI-empowered classrooms. While AI could function as a partner or short-term disruptor, teachers generally did not foresee AI altering or removing their overarching educational objectives, aimed at preparing young generations to succeed in the real world. Participants perceived AI's primary function as a tool (*AI is assistant*), believing that AI's impersonal nature (*AI is impersonal*) prevents it from realizing several important aspects of school-based education—developing students' soft skills, modelling empathy, supporting personal well-being, and building relationships. Therefore, despite the increasing presence of AI-social robots in daily life (Smakman et al., 2021), there is a broad consensus among teachers that AI cannot effectively support students' social-emotional development and cannot foster student growth in this critical aspect of schooling. Notably, there was an omission in teacher discussions regarding whether and how the educational objectives related to student development in cognitive-academic aspects might change, as well as how potential modifications might occur with respect to learning objectives in specific domains or skills (e.g., mathematics, reading, critical thinking). From both research and practice, there is a need to "design models for human-AI interactions … that provide guidance on how AI supports, augments, and directs learning" (Gašević et al., 2023, p. 2).

Practical recommendations

Several practical recommendations for teachers, school-leaders, policymakers, AI developers, and researchers arise from this study. They are:

- *Teachers* should reflect on their own digital competency as well as their preferred pedagogical approaches; consider a range of possibilities and technical affordances in students' self-study, learning from teachers, learning among peers, and learning with AI; develop procedures for the division of labor with AI, both for their own work and for student development; and consider which areas of student learning domains will be more beneficial from technological innovation and which domains will be more vulnerable to technological threats; and develop AI literacy to understand the limitations of AI.
- *School leaders* should develop school-wide expectations for learning objectives with and without AI; establish rules and regulations about the division of labor for staff and student use of AI; envision a paradigm shift in who constitutes learning community; and facilitate teacher professional development to enhance AI literacy.

- *Policy makers* should develop national- and state-level policies to regulate AI use in schools; set clear boundaries for the division of labor; and develop national- and state-level strategies for teachers' professional development in AI literacy.
- *AI developers* should expect consumer demand for AI applications that can increase efficiency of administrative tasks; and consider AI impact on potential short- and long-term outcomes of student learning and well-being when designing AI applications.
- *Researchers* should examine teachers' needs, preferences, perspectives, dispositions, and AI literacy across sectors (primary vs. secondary vs. tertiary) and across subject domains (e.g., science vs. writing); provide empirical evidence for best practices of learning design and pedagogical approaches using AI; develop a range of components of AI literacy for teachers and students in specific local contexts; and develop an evidence-based theoretical framework and learning design principles of AI-integrated teaching and learning.

Limitations and future studies

We acknowledge several limitations of this study that future research could address. Firstly, participants were Australian teachers; the data may not reflect teacher sentiments in other parts of the world. Secondly, participants were recruited via convenience sampling, primarily through the authors' institutions. They do not represent the broader population of Australian teachers, and their perspectives could reflect the characteristics of this specific group. Thirdly, the data were collected based on voluntary participation, contributing to a potential bias towards certain viewpoints over the "average" perspective drawn from a nationally representative sample. Our participants were slightly younger than the average Australian teacher, with a mean age of 36 compared to 46, which may have influenced the perspectives shared. Fourthly, teacher voices outlined in this study represent their views in a specific time point in AI development history, approximately six months after the sudden public interest in AI technologies. Fifthly, while the survey's three broad questions allowed participants to express their thoughts freely, more structured questions considering specific elements of activity theory might provide deeper insights into further conceptual improvisation of activity theory (e.g., "How do you envision the future of teaching and learning in terms of labor division?"). Furthermore, various theoretical constructs (e.g., meta-functional competence) advocated within activity theory could also be explored. Sixthly, future studies could offer deeper insights by employing a more structured sampling approach to ensure balanced subgroup sizes, facilitating subgroup analyses across key demographic factors (e.g., gender, age, teaching subject, and years of teaching). Lastly, given the rapid evolution of generative AI, a longitudinal or follow-up

study may be warranted to capture shifting perspectives on AI use among teachers over time.

Conclusion

The present study demonstrated varied, yet nuanced and complex views held by in-service teachers regarding the use of AI technology in school settings. They were expressed as AI being *unsuitable*, *impersonal*, *imperfect*, *uncertain*, *assisting*, and *inevitable*. The majority of teachers reported feeling comfortable with using AI to *assist* them for some low-level tasks such as administration, data analysis, and written communication. However, some teachers expressed that AI was *unsuitable* for use in school settings due to its *impersonal* and *imperfect* nature. For this reason, they wished to maintain partial or complete oversight of teacher tasks relating to pedagogy or those requiring empathy, human interaction, and student safety. We also found that some participants expressed contrasting views, noting that the future of AI applications is *uncertain* but simultaneously acknowledging that its introduction to classrooms would be *inevitable*. These findings underscore the importance of balancing the integration of AI in schools with the preservation of human-centered elements, such as empathy and interaction, while reflecting teachers' desire to be assisted by advanced technology and their recognition of its inevitable role in the future of education.

Activity theorists have long emphasized that a critical aspect of human–machine partnerships is trust in machine automation (Lee & See, 2004). While too much trust would lead to system failure, lack of trust would damage system inefficiency and sustainability. Blayone (2019) argues for "defensible levels of trust based on available knowledge and algorithmic transparency" (p. 455), suggesting that trust in AI automation relies on people's knowledge and sufficient explorations about its capabilities—in other words, AI literacy. Therefore, the future acceptance of AI as an essential and trustworthy component of the learning community may largely hinge upon the system-level decision and investments in fostering AI literacy of educational community.

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Availability of data and materials
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Declarations

Competing interests

The authors declare that they have no competing interests.

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References

Adam, I. O., Efah, J., & Boateng, R. (2019). Activity theory analysis of the virtualisation of teaching and teaching environment in a developing country university. *Education and Information Technologies, 24*(1), 251–276. https://doi.org/10.1007/s10639-018-9774-7

Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckman (Eds.), *Action-control: From cognition to behavior* (pp. 11–39). Heidelberg, Germany: Springer.

Al Darayseh, A. (2023). Acceptance of artificial intelligence in teaching science: Science teachers' perspective. *Computers and Education*: *Artificial Intelligence, 4*, 100132. https://doi.org/10.1016/j.caeai.2023.100132

Australian Institute for Teaching and School Leadership [AITSL]. (2025). Australian Teacher Workforce Data portal. https://atwd.aitsl.edu.au/data

Barczak, A. L., Mathrani, A., Han, B., & Reyes, N. H. (2023). Automated assessment system for programming courses: A case study for teaching data structures and algorithms. *Educational Technology Research and Development*, *71*, 2365–2388. https://doi.org/10.1007/s11423-023-10277-2

Blayone, T. J. (2019). Theorising effective uses of digital technology with activity theory. *Technology, Pedagogy and Education*, *28*(4), 447–462. https://doi.org/10.1080/1475939X.2019.1645728

Brown, B. (2021). 'Steering at a distance', Australian school principals' understandings of digital technologies policies during the Digital Education Revolution. *Journal of Educational Administration and History*, *53*(1), 50–66. https://doi.org/10.1080/00220620.2020.1856796

Butler-Kisber, L. (2018). *Qualitative inquiry: Thematic, narrative, and arts-based perspectives*. SAGE Publications. https://doi.org/10.4135/9781526417978

Chai, C. S., Lin, P. Y., Jong, M. S. Y., Dai, Y., Chiu, T. K., & Qin, J. (2021). Perceptions of and behavioral intentions towards learning artificial intelligence in primary school students. *Educational Technology & Society*, *24*(3), 89–101.

Cuervo, H., & Vera-Toscano, E. (2025). Teacher retention and attrition: Understanding why teachers leave and their post-teaching pathways in Australia. *Asia Pacific Journal of Education*, 1–18. https://doi.org/10.1080/02188791.2025.2473356

Dalgarno, B., & Lee, M. J. (2010). What are the learning affordances of 3-D virtual environments? *British Journal of Educational Technology*, *41*(1), 10–32. https://doi.org/10.1111/j.1467-8535.2009.01038.x

Daniels, H. (2004). Activity theory, discourse and Bernstein. *Educational Review*, *56*(2), 121–132. https://doi.org/10.1080/0031910410001693218

Davis, F.D. (1989). Perceived usefulness, perceived ease of use and user acceptance of information technology. *MIS Quarterly*, *13*(3), 319–339. https://doi.org/10.2307/249008

Engeström, Y. (1987). Learning by expanding: An activity-theoretical approach to developmental research. Orienta-Konsultit.

Engeström, Y. (2001). Expansive learning at work: Toward an activity theoretical reconceptualization. *Journal of Education and Work*, *14*(1), 133–156. https://doi.org/10.1080/13639080020028747

Engeström, Y. (2015). *Learning by expanding*. Cambridge University Press.

Fakhar, H., Lamrabet, M., Echantoufi, N., & Ajana, L. (2024). Towards a new Artificial Intelligence-based framework for teachers' online continuous professional development programs: Systematic review. *International Journal of Advanced Computer Science & Applications*, *15*(4), 480. https://doi.org/10.14569/ijacsa.2024.0150450

Gašević, D., Siemens, G., & Sadiq, S. (2023). Empowering learners for the age of artificial intelligence. *Computers and Education: Artificial Intelligence*, *4*, Article 100130. https://doi.org/10.1016/j.caeai.2023.100130

Guo, K., Li, Y., Li, Y., & Chu, S. K. W. (2024). Understanding EFL students' chatbot-assisted argumentative writing: An activity theory perspective. *Education and Information Technologies*, *29*(1), 1–20. https://doi.org/10.1007/s10639-023-12230-5

Kim, N. J., & Kim, M. K. (2022). Teacher's perceptions of using an artificial intelligence-based educational tool for scientific writing. *Frontiers in Education, 7,* Article 755914. https://doi.org/10.3389/feduc.2022.755914

Khong, H., Celik, I., Le, T. T., Lai, V. T. T., Nguyen, A., & Bui, H. (2023). Examining teachers' behavioural intention for online teaching after COVID-19 pandemic: A large-scale survey. *Education and Information Technologies*, *28*(5), 5999–6026. https://doi.org/10.1007/s10639-022-11417-6

Koschmann, T., Kuutti, K., & Hickman, L. (1998). The concept of breakdown in Heidegger, Leontiev, and Dewey and its implications for education. *Mind, Culture, and Activity, 5*, 25–41. https://doi.org/10.1207/s15327884mca0501_3

Lee, J. (2023). Latent class profiles of teacher use of digital tools in PISA 2018 data. *Education and Information Technologies*, *29*(10), 12229–12261. https://doi.org/10.1007/s10639-023-12305-3

Lee, J. D., & See, K. A. (2004). Trust in automation: Designing for appropriate reliance. *Human Factors*, *46*, 50–80. https://doi.org/10.1518/hfes.46.1.50_30392

Leontiev, A. N. (1978). *Activity, consciousness and personality*. (M. J. Hall, Trans.). Prentice-Hall.

Leontiev, A. A. (2006). " Units" and Levels of Activity. *Journal of Russian & East European Psychology*, *44*(3), 30–46. https://doi.org/10.2753/RPO10610405440303

Lingard, B., Sellar, S., & Lewis, S. (2017). Accountabilities in schools and school systems. *Oxford Research Encyclopedia of Education*. https://doi.org/10.1093/acrefore/9780190264093.013.74

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Moore, M. G. (1989). Editorial: Three types of interaction. *American Journal of Distance Education*, 3, 1–7. https://doi.org/10.1080/08923648909526659

OECD (2023). *Shaping digital education: Enabling factors for quality, equity and efficiency*. OECD Publishing. https://doi.org/10.1787/bac4dc9f-en

Park, Y., & Jo, I.-H. (2017). Using log variables in a learning management system to evaluate learning activity using the lens of activity theory. *Assessment & Evaluation in Higher Education*, *42*(4), 531–547. https://doi.org/10.1080/02602938.2016.1158236

Porumb, S., Porumb, C., Vlaicu, A., & Orza, B. (2013, October). Advanced learning tools for (non) formal education. *Advanced Engineering Forum, 8*, 65–74. https://doi:10.4028/www.scientific.net/AEF.8-9.65

Satvati, N., Kamali, J., Safian Boldaji, F., Khodadadi, M., & Akhondi, S. (2025). AI Integration into language education and teacher identity: An ecological perspective. *Language Teaching Research Quarterly, 47*, 1–19. https://doi.org/10.32038/ltrq.2025.47.01

Smakman, M., Vogt, P., & Konijn, E. A. (2021). Moral considerations on social robots in education: A multi-stakeholder perspective. *Computers & Education*, *174*, 104317. https://doi.org/10.1016/j.compedu.2021.104317

UNESCO (2022). *K-12 AI curricula: A mapping of government-endorsed AI curricula.* UNESCO Publishing. https://unesdoc.unesco.org/ark:/48223/pf0000380602

UNESCO (2023). *Guidance for generative AI in education and research*. UNESCO Publishing. https://unesdoc.unesco.org/ark:/48223/pf0000386693

UNICEF (2021). *Policy guidance on AI for children 2.0*. UNICEF Publishing. https://www.unicef.org/globalinsight/media/2356/file/UNICEF-Global-Insight-policy-guidance-AI-children-2.0-2021.pdf

Wang, X., Li, L., Tan, S. C., Yang, L., & Lei, J. (2023). Preparing for AI-enhanced education: Conceptualizing and empirically examining teachers' AI readiness. *Computers in Human Behavior*, *146*, Article 107798. https://doi.org/10.1016/j.chb.2023.107798

Woo, D. J., Guo, K., & Susanto, H. (2025). Exploring EFL students' prompt engineering in human–AI story writing: An activity theory perspective. *Interactive Learning Environments*, *33*(1), 863–882. https://doi.org/10.1080/10494820.2024.2361381

Zapata, G. C., Saini, A., Tzirides, A. O. O., Cope, W., & Kalantzis, M. (2024). The role of AI feedback in university students' learning experiences: An exploration grounded in activity theory. *Ubiquitous Learning: An International Journal*, *18*(2). 1–30. https://doi.org/10.18848/1835-9795/CGP/v18i02/1-30

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