The Paradox of Progress: AI and the Challenge of Teaching Sustainability in Singapore

Chua Yan Yun

Temasek Secondary School (Singapore)

Abstract

The rise of AI tools has transformed the educational landscape in Singapore, offering unprecedented efficiency and access to information. This study examines the integration of AI in Geography classrooms, a subject where inquiry-based learning and sustainability education form the core. Interviews with four Geography teachers revealed that while AI supports content mastery, information retrieval, and initial ideation, it is less effective in fostering empathy, ethical reasoning, and emotional connections to sustainability topics. The reliance on AI to process data and present information as statistics can deprive students of opportunities to engage with the moral and affective dimensions of sustainability education, which are essential for fostering empathy and ethical reasoning. The findings underscore the importance of intentional, critical use of AI, guided by educators, to ensure that technological affordances complement rather than compromise learner-centered, context-rich sustainability education.

Introduction

The rise of AI tools has begun to reshape the educational landscape in Singapore. In the *Transforming Education through Technology* Masterplan 2030, the Ministry of Education (MOE) positions Artificial Intelligence (AI) as an enabler of deeper student learning and more effective teaching, signaling the norming of AI-enabled education (MOE, 2023). AI-enabled features are also introduced in the Student Learning Space - Singapore's core digital platform for teaching and learning. These technologies hold promise for increasing productivity and access to knowledge but they have also introduced new challenges, especially for educators who were not trained in an AI-native era but are now tasked with guiding students who are. This article focuses on the teaching of Geography in Singapore, a subject where learning is primarily driven by inquiry and students learn about real-world phenomena. The Geography syllabus prescribed centrally by the Curriculum Planning and Development Division identifies inquiry as the discipline's "signature pedagogy," with teaching and learning organised around an inquiry process that defines the roles of teachers and students (MOE, 2024). However, AI is largely absent from the curriculum document. It does not specify where AI fits within the inquiry process or how it can be used to support teaching and learning.

Beyond content knowledge, the syllabus is aligned with the Ministry of Education's framework for Emerging 21st Century Competencies. In the 2023 Upper Secondary Geography Teaching and

Learning Guide (MOE, 2023), it was articulated that Geography aims to nurture "critical and inventive thinking", "communication, collaboration skills and information skills", "civic literacy, global awareness and cross-cultural skills" as the key competencies. These competencies, embedded and designed to be developed within the content curriculum, then raise a critical question: Can AI truly support the development of these key competencies?

Singapore's education system is underpinned by a strong sense of national mission and social responsibility, and driven by policy initiatives such as the Singapore Green Plan 2030 and the Education Technology Masterplan 2030. Alongside this, the Ministry of Education's narrative increasingly positions AI as a key enabler of deeper learning and future readiness. However, there is still a notable absence of explicit guidance on the positioning of AI within the prescribed Geography curriculum. While the Ministry of Education articulates the desired outcome of students becoming "concerned citizens", teachers must first develop the underlying skills—such as information literacy, perspective taking, and ethical reasoning—that enable students to enact this disposition. Yet how these aims should be reconciled with AI-mediated learning remains largely unarticulated. Left unconnected, these parallel narratives place Geography teachers in a complex position of trying to make pedagogical sense of policy aspirations.

The Promise and Limits of ChatGPT in Sustainability Education

AI tools offer powerful advantages for learning, in particular tools that can break down complex content into digestible segments, allowing students to summarise, organise, and compartmentalise knowledge efficiently. In the early stages of inquiry, AI can spark curiosity by supporting background research and ideation by offering broad overviews of unfamiliar topics or generating guiding questions. In gathering data for inquiry, AI can present multiple perspectives, including stakeholder viewpoints and policy arguments that may lie beyond the students' immediate experience. As Xu (2024) discusses, AI presents itself as a useful aid in presenting reasoning evidence for students to derive at conclusions and provide feedback to guide students in the entire inquiry process.

However, these affordances come with limitations in the context of sustainability education. AI relies solely on patterns within the data it has been trained on to generate a position or stand, without the capacity for ethical judgment or nuanced reasoning. Studies by Kurian (2024) revealed that generative AI often exhibit an "empathy gap," as they lack genuine emotional understanding and can produce inappropriate or superficial responses. As a result, students gain shallow understanding of issues as they are deprived of the moral depth and values-based reasoning that are central to effective sustainability education. AI systems often lack sensitivity to culturally specific contexts, resulting in over-generalised representations that may misrepresent local realities and mute the emotional dimensions of human experiences. When students accept such outputs uncritically, they may engage with sustainability issues at a superficial level, limiting emotional connection and empathetic understanding (Macasawang, 2025). While AI may enhance productivity and streamline aspects of the learning process, its limitations risk undermining the deeper intent of subjects like Geography. Sustainability education meant to evoke empathy, ethical reflection, and a personal sense of responsibility toward environmental phenomena and real-world

issues as emphasised in the 2023 Upper Secondary Geography Teaching and Learning Guide (MOE, 2023) would potentially be diminished.

Methodology

This study examines how Geography teachers in Singapore perceive the affordances and limitations of AI in sustainability education. The primary motivation for this research arises from the absence of explicit positioning of AI within the prescribed Geography curriculum, as well as the broad and largely optimistic narratives surrounding AI in national policy messaging. Existing research tends to be situated in non-Singaporean contexts, leaving a gap in understanding how local educators navigate chatbots within a centrally prescribed curriculum. This study therefore seeks to address this gap by foregrounding teachers' lived experiences and professional judgments, as they are key mediators between AI technologies and classroom practice.

This study is framed as a small-scale action research study aimed at addressing a gap in practice. It seeks to explore the disconnect between the national AI rhetoric and the everyday realities of Geography teachers implementing sustainability education within a centrally prescribed curriculum. Qualitative interviews were carried out to examine 4 Geography teachers' perceptions of the impact of AI on students' sustainability learning, guided by the research question: *How do Geography teachers in Singapore perceive the impact of AI on students' learning in sustainability education across dimensions aligned with 21st Century Competencies?* Participants were selected from mainstream secondary schools to include teachers who were teaching the centrally prescribed Geography curriculum and who represented a range of teaching experience

(2, 5, 13 and 14 years of teaching Geography) in order to examine whether perceptions differed according to years of service. Interview questions were deliberately crafted to align with the curriculum's 21st Century Competencies outcomes, eliciting teachers' views on whether ChatGPT supported students' content mastery, information retrieval, perspective taking, and emotional engagement with sustainability issues. Data was analysed using a mixed approach: teachers' responses to each dimension were aggregated quantitatively to identify overall trends, while qualitative analysis of teachers' classroom examples provided deeper insight into how these impacts were observed in practice.

From the Educators: Geography Teacher's perspectives

The interview conducted with teachers from Singapore revealed varied perspectives on the integration of AI in education. While all four participants rated AI highly for supporting certain aspects of learning—such as content mastery, information retrieval and exposure to multiple perspectives—they also highlighted significant limitations. Respondent 1 noted how students can benefit from "a plethora of stakeholder's perspectives as well as being able to customise which aspect of sustainability they are researching on", which aided their understanding of differing viewpoints.

Notably, AI was perceived as less effective in fostering the development of empathy and ethical reasoning related to sustainability issues. Respondent 3 observed that AI's automation of data analysis allowed students to arrive at conclusions prematurely, resulting in "knowledge gaps" where empathetical or human-centred dimensions of the information might otherwise have emerged.

Results also revealed teachers' neutrality in students' emotional engagement with environmental topics. Respondent 2 cited students not knowing "the gravity of sustainability issues", suggesting uncertainty arising from the absence of reliable indicators or measures to assess students' affective response. Other findings include concerns of potential over-reliance on AI which impedes students' learning. The results are summarised in Table 1.

Teacher responses also highlighted potential reasons for the observed limitations of AI in fostering empathy among students. Teachers noted that AI undermined opportunities for deeper engagement, as it largely supersedes students' own analysis of data. Respondent 1 highlighted that "students over rely on the how of things which impedes the emotional aspect of what they are searching for". The presentation of information as statistical figures without accompanying ethical or contextual discussion deprived students' capacity to relate personally to the content. These factors suggest that while AI can efficiently manage and present data, the overriding role denies the opportunity for students to develop empathy particularly when ethical reasoning and human-centered interpretation are absent from the learning process.

Table 1

Aspect	Interview questions	Respondents who agreed / largely agreed
Content mastery	AI tools help students grasp complex sustainability concepts more quickly than before.	2, 4
	Students are able to use AI tools to develop a deeper understanding of Singapore's unique environmental challenges.	1, 3, 4
	AI helps students kickstart inquiry by providing useful background information and guiding questions.	2, 3, 4
Information retrieval	Students' research and reasoning skills have improved through the use of AI tools.	None
Information retrieval	The use of AI in my classroom has increased student productivity (e.g. notes generation, completing written assignments) in sustainability-related tasks.	1, 3, 4
Exposure to multiple perspectives	Using AI has improved my students' ability to explore multiple perspectives in sustainability debates.	1, 3, 4
	Students using AI are more likely to rely on pre-	1, 2, 3

	generated answers than critically evaluate the information provided.	
Emotional engagement	AI tools support students in developing empathy and ethical reasoning around sustainability issues.	None
	When students use AI, they remain emotionally connected to the environmental topics being discussed.	4

The findings indicate a largely uniform pattern across participants, with no notable differences in perceptions based on years of teaching experience. Notably, even the teacher with the fewest years of experience had not undergone formal education in a context where AI was integrated as part of learning, suggesting that familiarity with AI use cannot be assumed based on recency of training. These findings suggest that although AI can enhance knowledge acquisition, its capacity to cultivate the affective and moral dimensions remains uncertain.

Teachers as Pedagogical Gatekeepers in AI-Mediated Learning

Many concerns surrounding the integration of AI in education have been raised in existing research. Uygun (2024), for instance, found that 50% of teachers in her sample believed that AI "may create an ethical gap in the educational setting." Similarly, Chen, Lee, and Lee (2025) highlighted that both teachers and students expressed trust issues with information presented by AI, given its potential inaccuracy and lack of factual reliability.

The absence of clear pedagogical guidelines for the ethical use of AI in schools is another pressing issue. Singapore's Ministry of Education (MOE) has introduced the EdTech Masterplan 2030, which outlines how schools can better leverage technology to enhance teaching and learning (Ministry of Education Singapore, 2024). However, specific strategies addressing the ethical integration of AI into teaching practices remain unspecified, leaving educators without comprehensive guidance on responsible AI use. Based on the findings of this study, the following recommendations are offered for guiding the purposeful and responsible use of AI in the classroom.

Planning for Explicit Affective Checkpoints Within the Inquiry Process

Teachers play a critical role in safeguarding the affective and moral dimensions of sustainability education by intentionally embedding affective checkpoints within the inquiry process. This includes crafting inquiry questions that foreground ethical dilemmas and human concerns, rather than focusing solely on technical or informational aspects of sustainability issues. During the data collection and analysis stages, teachers can scaffold learning by assigning students stakeholder roles, enabling them to interpret evidence through the perspectives of different social groups and to recognise competing interests and values. By explicitly analysing data in relation to its human and societal implications, teachers help students move beyond statistical reasoning to develop empathy, ethical awareness, and a deeper understanding of sustainability as a lived human issue.

Making the Systemic Limitations of AI Explicit to Students

Teachers also need to make visible the systemic nature of how AI generates and presents information, particularly its lack of moral judgment, emotional awareness, and values-based reasoning. Students should be guided to understand that AI is designed to process and reproduce patterns in data, rather than to teach, evaluate ethics, or cultivate empathy. Explicitly teaching these limitations can shape how students approach AI use, encouraging them to engage more critically, exercise greater discernment, and conduct counter-checking rather than uncritically accepting AI-generated outputs. Such transparency supports the development of informed and responsible AI use, aligned with the goals of 21st Century Competencies and sustainability education.

Strengthening Professional Conversations Around AI's Pedagogical Risks

At the school and departmental levels, professional conversations among teachers should deliberately include discussions on anticipating and mitigating the pedagogical limitations of AI. Beyond sharing technical strategies, these conversations should surface observations of how AI use may interfere with learning processes, particularly when students become overly reliant on generative tools. This includes collaborative exploration of AI-resilient or "AI-proof" task design, as well as shared counterstrategies for supporting students whose learning is compromised by excessive dependence on AI. Such professional dialogue positions teachers as reflective practitioners who actively shape AI integration in ways that preserve the integrity of inquiry-based and values-driven education.

Taken together, these recommendations reassert the teacher's role as a pedagogical gatekeeper, ensuring that the integration of AI enhances learning without eroding the affective, ethical, and civic purposes of sustainability education.

Conclusion

The use of AI in education presents significant potential if employed critically and intentionally. The role of educators is therefore important in guiding students to interrogate bias, accuracy, and ethical implications, thereby cultivating higher-order critical evaluative thinking and digital literacy. Ultimately, sustainability education must remain learner-centered and context-rich, with teachers playing a pivotal role in facilitating discussions that connect abstract information to lived realities and nurturing the emotional connections necessary for responsible, empathetic citizenship.

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