

Review Article

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Teacher-AI-Student Relationships in Student-Centered Learning: A Systematic Review

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Abstract

Background/purpose. Artificial intelligence (AI) offers transformative potential for advancing student-centred learning (SCL) through the Teacher–AI–Student relationship, where AI acts as a mediator to personalise, adapt, and enhance learning experiences. However, AI bias, limited teacher preparedness, ethical concerns, and infrastructure gaps hinder equitable adoption, particularly in resource-constrained contexts such as Africa. This study systematically reviews global and local literature to explore strategies for leveraging AI within this triadic model to strengthen SCL while ensuring cultural and linguistic inclusivity.

Materials/methods. A systematic literature review was conducted, examining studies published between 2000 and 2025 from academic databases, policy reports, and case studies. Inclusion criteria focused on AI-enabled SCL models, teacher–AI collaboration, and context-sensitive implementation. Thematic synthesis identified recurring challenges, success factors, and best practices, with an emphasis on co-design approaches, ethical use of AI, and teacher professional development.

Results. Effective AI integration in SCL requires a phased approach that incorporates diverse, locally relevant datasets, culturally responsive AI tools, sustained educator capacity-building, and collaborative learning communities. The Teacher–AI–Student relationship, when optimised, enhances learner autonomy, facilitates real-time feedback, and supports differentiated instruction aligned with individual learner needs.

Conclusion. Context-sensitive, ethically grounded, and culturally aligned AI adoption is essential to maximise SCL benefits. By embedding AI into the Teacher–AI–Student relationship through co-design, inclusive datasets, and targeted professional development, education systems can address systemic inequities and create personalised, meaningful learning experiences. This study contributes a practical roadmap for policymakers, educators, and technology developers.



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1. Introduction

Artificial intelligence (AI) is increasingly shaping the future of education, offering tools and capabilities to enhance personalised learning, support adaptive instruction, and generate actionable data-driven insights (Chaudhry & Kazim, 2022; Talan, 2021). Within the framework of student-centred learning (SCL), AI can serve as a mediating and augmenting agent in the Teacher–AI–Student relationship, enabling more tailored and dynamic learning pathways (Jamal et al., 2023). Technologies such as natural language processing (NLP), machine learning algorithms, and generative AI (genAI) allow for instructional materials to be adapted in real time to match individual learner needs, preferences, and progress (Baker & Hawn, 2022; Baradziej, 2023). For example, NLP-driven platforms can provide immediate, language-sensitive feedback, while predictive analytics can identify at-risk learners early, allowing educators to intervene with targeted support.

Despite these benefits, the effective integration of AI into SCL is not guaranteed solely by technological availability. The success of AI implementation depends heavily on thoughtful pedagogical design, high-quality and representative training datasets, and ethical deployment (Shiohira, 2021). Without such safeguards, AI systems risk reinforcing inequities, particularly in contexts marked by socio-economic disparities, linguistic diversity, and historical inequalities (Holmes & Porayska-Pomsta, 2022; Holstein & Doroudi, 2021). Biases embedded in AI models, insufficient teacher AI literacy, and infrastructure constraints can undermine inclusivity, potentially disadvantaging students from underrepresented groups (Kizilcec & Lee, 2022).

Existing research has explored AI's potential to transform education; yet, a critical gap remains in understanding how the Teacher–AI–Student relationship can be optimised to strengthen SCL while addressing issues of bias, cultural relevance, and accessibility. In particular, few studies address how this relationship can be structured to mitigate bias, ensure cultural relevance, and improve accessibility across diverse educational contexts (Kizilcec & Lee, 2022). This lack of clarity represents a critical gap in current scholarship, leaving educators and policymakers without sufficient evidence to guide equitable and context-sensitive AI adoption.

This study responds to that gap by systematically reviewing global and local literature to identify strategies for context-sensitive AI integration that support equity, inclusivity, and personalised learning outcomes. By synthesising findings across contexts, the goal is to promote responsible, culturally aligned, and pedagogically sound AI adoption that empowers teachers, enriches learner experiences, and bridges rather than widens existing educational divides. The study seeks to answer the following questions:

1. How are the teacher-AI-Student relationships conceptualised in SCL?
2. What roles do teachers, AI and students play in shaping SCL?

2. Literature Review

Bias mitigation in AI-supported education is a pressing concern, as AI models often inherit biases from the data on which they are trained, potentially reinforcing historical inequities (Baker & Hawn, 2022; Kizilcec & Lee, 2022). In student-centred learning (SCL) contexts, biased recommendations can skew personalised learning pathways, disadvantaging certain groups (Nguyen et al., 2024). To address these risks, scholars highlight several strategies, including fairness-aware algorithms (Kizilcec & Lee, 2022), representative datasets (Holstein & Doroudi, 2021), and continuous bias audits during system deployment (De Martino et al., 2025). Yet bias mitigation extends beyond technical fixes; it requires the active involvement of educators and communities to identify context-specific risks and ensure AI-generated outputs align with equitable pedagogical goals.

Central to these efforts is the role of teachers, whose capacity to engage with AI critically and ethically determines how effectively such technologies are integrated into the classroom. Many teachers still lack the knowledge to assess AI recommendations or adapt AI-driven insights to their specific contexts (Mhlanga, 2023). Professional development, therefore, becomes essential, with research emphasising that sustained, hands-on training is far more effective than isolated workshops. Building teachers' capacity in areas such as ethical AI use, data interpretation, and adaptive pedagogy not only strengthens their confidence but also enhances learner engagement, making teacher AI literacy a cornerstone of successful SCL integration (Kizilcec & Lee, 2022).

Strengthening teacher capacity also closely aligns with co-design practices, in which educators, students, and developers collaborate to shape AI tools that are both pedagogically relevant and culturally responsive. Unlike top-down implementations, co-design encourages iterative refinement of AI features based on classroom realities, while embedding ethical considerations from the outset (Chaudhry & Kazim, 2022; Holmes & Porayska-Pomsta, 2023; Sadewa & Alif Sabilla Rustam Sutoto, 2024). This participatory approach not only aligns AI with curriculum standards but also enhances trust, adoption, and sustainability in educational settings (Larusdottir et al., 2021).

The success of co-design further underscores the importance of localisation, particularly in culturally and linguistically diverse contexts. For example, in South Africa, where multilingualism is the norm, AI systems that fail to reflect local languages or cultural practices risk marginalising learners (Mabena, 2025; Mhlanga, 2023). Incorporating indigenous languages into natural language processing systems, developing localised datasets, and embedding culturally relevant examples within adaptive learning platforms have proven effective in making AI tools more inclusive and engaging (Mhlanga, 2023). By grounding AI in local realities, such approaches not only improve accessibility but also foster learner identity and belonging, which are central to SCL principles.

Bringing these strands together, the literature suggests that optimising the Teacher–AI–Student relationship requires an integrated approach. Technical solutions to bias must be coupled with teacher empowerment, participatory design practices, and localisation strategies that reflect cultural and linguistic diversity. While global frameworks provide useful foundations, meaningful impact depends on adapting AI to the unique needs of local communities. Only through such holistic and context-sensitive approaches can AI genuinely enhance equity and effectiveness in student-centred learning.

3. Methodology

This study employs a systematic literature review (SLR) to examine how artificial intelligence (AI) can support student-centred learning (SCL) within the Teacher–AI–Student relationship. The review specifically focuses on strategies for bias mitigation, teacher AI literacy, co-design practices, and localised AI solutions, covering publications from 2000 to 2025.

3.1. Quality Assessment

To ensure the rigour of the review, each study was evaluated for methodological quality using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). The quality assessment considered factors such as the clarity of the research objectives, the suitability of the research design, the reliability of the data, and the relevance to SCL and AI integration. Only studies that met these minimum quality standards were included in the final synthesis, ensuring the credibility and validity of the review's findings.

3.2. Data Collection Procedures

A comprehensive search was conducted across multiple academic databases, Scopus, Web of Science, ERIC, IEEE Xplore, and Google Scholar. Keywords and Boolean operators were carefully

selected to capture the breadth of relevant literature, such as “student-centred learning” OR “personalised learning” AND “artificial intelligence” OR “AI” AND “teacher-student-AI relationship” OR “educational technology” AND “bias mitigation” OR “ethics” OR “professional development” OR “co-design” OR “localised AI.” To ensure completeness, the reference lists of included studies were manually screened to identify additional sources that aligned with the study’s focus.

3.3. Inclusion and Exclusion Criteria

Clear inclusion and exclusion criteria were applied to refine the literature corpus.

- Inclusion: Peer-reviewed journal articles, conference papers, and policy reports published between 2000 and 2025; studies addressing AI integration in education with implications for SCL; studies exploring teacher roles, bias mitigation, co-design, or localisation strategies; English-language publication.

- Exclusion: Studies unrelated to AI in education, purely technical without an educational context; publications outside the 2000-2025 timeframe; non-English works.

3.4. Analytical Techniques

From the selected studies, relevant data were extracted systematically, including information on study context, participant demographics, AI tools and frameworks, implementation strategies, outcomes, and reported limitations. A thematic synthesis approach was employed to identify patterns and recurring themes, with findings categorised under the main areas of bias mitigation, teacher AI literacy, co-design practices, and localisation strategies.

4. Results

The systematic review identified studies that met the inclusion criteria and covered both global and local/regional contexts. The findings point to four recurring themes that shape the effectiveness of AI in supporting student-centered learning (SCL): bias mitigation, teacher AI literacy and professional development, co-design practices, and localised AI solutions.

The literature also underscores the value of co-design practices in ensuring that AI tools remain pedagogically relevant and culturally aligned. Meyer et al. (2020) describe how teacher–student–developer collaboration in iterative design processes improved the usability of AI tools, ultimately promoting learner engagement and customised instruction. Prinsloo et al. (2022), focusing on South Africa, show that participatory approaches to AI tool development increased both cultural relevance and ethical compliance, ensuring that outputs were consistent with local curricula and learner needs. Luckin et al. (2022) add to this by demonstrating that co-creation workshops between educators and developers fostered greater trust and increased adoption of AI systems. These examples highlight that co-design not only enhances tool usability but also strengthens trust and sustainability in AI integration.

The localisation of AI solutions is another critical factor, particularly in multilingual and diverse educational settings. Mabena (2025) and Mhlanga (2023) illustrate how the use of indigenous-language natural language processing tools in South Africa improved learner engagement among students whose languages are often underrepresented, thereby supporting inclusivity in SCL. Larusdottir et al. (2021) add that contextualised adaptive learning modules enhanced learner identity and participation, creating personalised and culturally relevant learning experiences. Similarly, Mhlanga (2023) shows that AI tools aligned with the South African curriculum led to higher levels of teacher adoption and improved learner outcomes, demonstrating the scalability and equity potential of localised AI solutions.

4.1. Challenges and Open Issues

Across the literature, bias mitigation emerges as a central concern. Several studies highlight the dangers of demographic bias in training datasets and the risks of algorithmic unfairness in learner assessment. For example, Nguyen et al. (2024) demonstrate that facial recognition and predictive analytics systems often reflect demographic biases embedded in their training data, underscoring the necessity of fairness-aware models for equitable learner evaluation. Similarly, Holstein and Doroudi (2021) show that bias audits and the inclusion of diverse datasets can improve personalised recommendations in adaptive learning platforms, thereby supporting SCL while avoiding the marginalisation of underrepresented groups. Nguyen et al. (2024) further confirm this by finding algorithmic bias in AI-driven assessment systems that disproportionately disadvantage underrepresented learners. Together, these studies reinforce the importance of representative datasets and continuous auditing to safeguard equity in AI-enabled education.

Teacher AI literacy and professional development also play a critical role in shaping the success of AI integration. Luckin et al. (2022) find that teachers who participated in professional development workshops with hands-on AI training were able to improve adaptive instruction, enhancing personalised learning experiences for their students. Mhlanga (2023) reports that in South Africa, online AI literacy courses not only increased teachers' confidence in using AI tools but also improved their ethical awareness, leading to more equitable Teacher–AI–Student interactions. Similarly, Cheng (2023) highlights the value of collaborative teacher networks, where peer learning enhanced the adoption of AI tools and promoted sustainable SCL practices. These findings collectively illustrate that teacher competence in interpreting and mediating AI outputs directly influences learner engagement and outcomes.

Taken together, these findings indicate that successful AI integration into SCL requires a holistic approach. Bias mitigation ensures fairness and prevents the reinforcement of existing inequities, while teacher AI literacy equips educators to interpret and apply AI-generated insights effectively. Co-design practices embed ethical, pedagogical, and cultural considerations into AI development, and localisation strategies guarantee inclusivity for learners from diverse linguistic and cultural contexts. When combined, these approaches strengthen the Teacher–AI–Student relationship, enabling adaptive, personalised, and equitable learning experiences that are responsive to both global advancements and local needs.

5. Discussion

The systematic review highlights that artificial intelligence (AI) has significant potential to enhance student-centred learning (SCL) by reshaping the Teacher–AI–Student relationship. When integrated thoughtfully, AI can support personalised, adaptive, and culturally responsive learning experiences, while also offering mechanisms to mitigate systemic inequities. The findings of this review reveal important insights for theory, practice, and policy, particularly regarding the roles of teachers, strategies for equity, participatory design, localisation, and future directions for AI in education.

A central theme emerging from the literature is the strengthening of the Teacher–AI–Student relationship. Rather than replacing teachers, AI is most effective when functioning as an augmenting partner that enhances pedagogical capacity. In this triadic relationship, AI tools analyse learner data, provide real-time feedback, and suggest instructional strategies, while teachers interpret these insights, contextualise them within their classrooms, and foster collaborative learning environments. When teachers are supported through professional development and AI literacy initiatives, they are better positioned to leverage these tools to promote learner autonomy and engagement (Luckin et al., 2022; Mhlanga, 2023).

The review also reveals the value of co-design approaches in shaping AI tools that are relevant, usable, and ethically grounded. Involving teachers and students in AI development ensures that pedagogical objectives remain central, ethical considerations are incorporated from the outset, and contextual realities are reflected in system design (De Martino et al., 2025; Prinsloo et al., 2022). Co-designed solutions not only enhance trust among educators and learners but also increase adoption and long-term sustainability, making them especially valuable in both global and local educational contexts.

Equally important is the role of localisation, which adapts AI tools to the cultural, linguistic, and curricular realities of specific educational settings. In multilingual and historically disadvantaged contexts such as South Africa, localised datasets and culturally responsive content have been shown to increase participation, engagement, and learner identity formation (Chaudhry & Kazim, 2022; Nguyen et al., 2024). Without such localisation, AI systems risk alienating learners and perpetuating structural disparities, undermining the goals of SCL.

Closely linked to this is the challenge of addressing bias and promoting equity. Without careful design, AI risks perpetuating or amplifying existing educational inequities, particularly for learners from underrepresented backgrounds or linguistic communities. The literature underscores the importance of fairness-aware algorithms, representative datasets, and continuous auditing as necessary safeguards to ensure that AI-generated recommendations promote equitable outcomes (Cheng, 2023; Holstein & Doroudi, 2021). Embedding ethical oversight within the Teacher–AI–Student relationship empowers teachers and policymakers to actively monitor AI outputs and intervene when needed, ensuring that SCL practices remain inclusive.

These findings carry important implications for both policy and practice. Investments in teacher professional development, infrastructure, and culturally aligned AI systems are necessary to maximise the benefits of AI-enabled SCL. Policymakers are encouraged to establish ethical guidelines and promote co-design frameworks that can guide equitable deployment, while also prioritising inclusion and diversity in AI datasets to counter systemic biases. Such measures will ensure that AI tools enhance, rather than hinder, educational outcomes.

6. Conclusion

This systematic review demonstrates that AI can transform SCL by enhancing the Teacher–AI–Student relationship, enabling personalised, adaptive, and inclusive learning experiences. Successful integration requires bias mitigation, teacher AI literacy, co-design practices, and localisation. Fairness-aware algorithms, representative datasets, and ongoing auditing prevent inequities. Professional development empowers teachers to interpret AI outputs effectively. Co-design ensures pedagogical relevance and ethical compliance, while localised solutions enhance learner engagement and equity.

For policymakers, educators, and developers, these findings offer a practical roadmap for responsible and inclusive AI integration. By embedding AI thoughtfully into the Teacher–AI–Student relationship, education systems, especially in diverse and resource-constrained contexts, can reduce inequities and foster personalised, meaningful learning.

Future research should examine long-term impacts, the effectiveness of co-designed tools, and mechanisms for iterative teacher support and system improvement.

7. Limitations of the study

While this study synthesises a broad body of literature, several limitations remain. Publication bias may have influenced the available evidence; studies from low-resource contexts are still underrepresented, and the inclusion of only English-language publications. Future research should

therefore examine the longitudinal impacts of AI-enabled SCL, assess the effectiveness of co-designed AI tools across varied settings, and explore sustainable models for continuous teacher support and AI system evaluation. Addressing these gaps will be essential for building a more comprehensive understanding of how AI can support equitable, student-centered education.

Declarations

Author Contributions. E.K.: Conceptualisation and design, literature search, writing: original draft and final draft. T.Z.: Review & editing. All authors have read and approved the published on the final version of the article.

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Data Availability Statement. The data that support the findings of this study can be openly accessed from multiple sources, including the websites of several organisations, publicly available reports, and indexed databases of academic journals.

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