



Exploring the impact of AI on teacher leadership: regressing or expanding?

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Abstract

This study aimed to investigate the impact of Artificial Intelligence (AI) on teacher leadership, specifically examining whether AI is expanding or regressing teacher leadership, as perceived by teachers who were using AI in their teaching practices. Using a qualitative research design, the study employed semi-structured interviews to collect data from 13 teachers from five countries. The data were then analyzed using thematic analysis. The findings of the study indicated that the use of AI has the potential to both expand and regress teacher leadership. AI can expand teacher leadership by providing tools for personalization, curriculum development, automating administrative tasks, and supporting professional development. However, AI was also viewed to be regressing teacher leadership, by narrowing the role because technology was taking over some of its aspects. Five sets of competencies were suggested by teachers for teacher leaders to sustain their roles in an AI era. The study concludes that the impact of AI on teacher leadership depends on how it is implemented and integrated into the education system. It highlights the importance of continued research and training in this area to inform future education policies and practices.

Keywords Teacher leadership · Artificial intelligence (AI) · Education technology

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1 Introduction

Schools are increasingly using artificial intelligence (AI) to enhance various aspects of education (Chen et al., 2020). AI algorithms can enhance personalized learning that meets individual student needs, by analyzing data related to their performance (Hwang et al., 2020). AI is also being used to improve student engagement and motivation by providing interactive learning experiences such as gamification and chatbots (Fidan & Gencil, 2022). Additionally, school leaders are using AI to support administrative tasks such as scheduling, grading, and student enrollment (Johnson et al., 2021). Through predictive analytics, school leadership is supported in identifying students who may be at risk of falling behind academically and intervene early to provide support (Robinson, 2019). Natural language processing (NLP) tools are also used to analyze student writing and provide feedback on grammar, spelling, and other writing skills (Fang, 2021).

Moreover, AI tools used by school leadership include chatbots, which can answer students' and parents' questions about school policies, schedules, and other information in real-time (Bertolin & Da Rin, 2020). Virtual assistants and voice recognition tools are also increasingly being used to support administrative tasks such as scheduling, record-keeping, and communication (Gonzalez & Guzman, 2020). Furthermore, some schools are experimenting with AI-powered teaching assistants that can help teachers grade assignments, identify student learning gaps, and suggest personalized learning materials (Bates, 2020).

AI in education is driving a transformation in teaching and learning practices and program development, making it a highly significant area of focus in educational research (Xia et al., 2022). While schools have ventured into experimenting and using a wide range of AI tools to support student learning, improve administrative efficiency, and enhance communication; many teachers are left hesitant and unsure of how AI would influence their roles (Shum & Luckin, 2019). Although few studies have focused on the role of school leadership in the AI era (Hejres, 2022; Tyson & Sauers, 2021), there have been no studies that addressed the envisioned teacher leadership role parallel to that.

This study explored teacher leadership through the lenses of teachers, focusing on the following research questions:

- 1) To what extent will AI expand/regress teacher leadership roles in schools?
- 2) What will be the new set of competencies required for teacher leaders to sustain their roles in an AI era?

2 Teacher leadership

Teacher leadership refers to the ability of teachers to assume leadership roles and responsibilities within educational settings, beyond their traditional classroom roles, to positively influence student learning, instructional practices, and school improvement efforts (Ghamrawi, 2010, 2011, 2023; Ghamrawi et al., 2023; York-Barr & Duke, 2004; Katzenmeyer & Moller, 2009). It involves teachers taking initiative, col-

laborating with colleagues, and actively contributing to decision-making processes that influence teaching and learning (Harris & Jones, 2019).

Teacher leadership encompasses various forms and activities, such as mentoring and coaching other teachers, designing and implementing professional development programs, participating in curriculum development and assessment practices, advocating for educational policies, and engaging in research and innovation (Bond, 2022; Chen, 2020; Lumpkin, 2016).

Through teacher leadership, educators play a vital role in shaping educational practices, promoting professional growth, and improving student outcomes (Ghamrawi, 2013). It empowers teachers to contribute their expertise, knowledge, and experiences beyond their classrooms, making a broader impact on their schools, districts, and the education system as a whole (Shen et al., 2020).

Some studies have restricted teacher leadership to formal roles that few teachers often occupy (Cooper, 2023). However, many studies suggest that teacher leadership goes beyond the confines of the classroom, allowing teachers to have an impact on the broader school community at various levels (Harris & Jones, 2019; Warren, 2021; Youngs & Evans, 2021). This paper supports the notion that teacher leadership is a function rather than a specific position. It embraces the notion that teacher leadership is not necessarily tied to formal titles, positions, or hierarchical authority.

Because teacher leadership involves empowering teachers to take on leadership roles within their schools, enabling them to contribute their expertise, it is believed to contribute to school improvement (Ghamrawi, 2023; Harris & Jones, 2019). Teacher leaders serve as catalysts for positive change (Ghamrawi, 2010, 2013, 2023), driving improvement initiatives (Harris & Jones, 2019) and promoting a culture of continuous learning (Youngs & Evans, 2021). Given the key role played by teacher leadership in school improvement, it is vital to explore whether artificial intelligence will be regressing or expanding it.

3 AI in education

AI in education holds immense promise in enhancing various aspects of education, including learning, teaching, assessment, and educational administration (Xia et al., 2022). It has the capacity to provide students with personalized and adaptive learning experiences, allowing them to learn in a way that suits their individual needs (Bates, 2020). It also aids teachers in gaining a better understanding of students' learning processes (Fang, 2021). Additionally, it enables the availability of machine-supported queries and instant feedback, accessible anytime and anywhere (Gonzalez & Guzman, 2020).

According to Hwang et al. (2020), AI has gained significance in the field of education due to its ability to make predictions, diagnoses, recommendations, and decisions through algorithmic power. The benefits of AI in education are increasingly getting acknowledged, for providing specialized support, bridging knowledge gaps, facilitating effective learning and teaching, and enabling real-time assessment of complex skills and knowledge (Guan et al., 2020; Shen et al., 2020). Furthermore, AI-powered educational systems are believed to be capable of analyzing classroom dynamics

and student engagement to identify at-risk students and intervene in a timely manner (Tsai et al., 2020).

On the other hand, the integration of AI in K-12 education raises concerns. One notable negative aspect is the one-size-fits-all approach inherent in many AI systems that might hinder the development of critical interpersonal skills, creativity, and nuanced understanding that come from direct human interactions (Berendt et al., 2020). Moreover, heavy reliance on AI could lead to over-reliance on technology, diminishing the role of teachers who provide not only subject knowledge but also guidance, mentorship, and emotional support (Chen & Lin, 2023). Additionally, issues related to data privacy and security might arise when using AI-powered tools to gather and process student information (Huang, 2023). In fact, the collection and utilization of student data by AI systems raise questions about privacy, consent, and the secure handling of sensitive information. There is a need to ensure that AI-driven recommendations and assessments do not inadvertently reinforce existing educational inequalities or biases present in the data (Akgun & Greenhow, 2021).

With AI being increasingly used in educational settings, it is vital to explore how it influences teacher leadership roles. The introduction of AI technologies in education is believed to be shifting roles and responsibilities of teachers in schools (Sanusi et al., 2022). Parallel to this, it is valuable to explore how AI introduction in schools will redefine or shift teacher leadership roles.

4 AI and discussions of replacing teachers

Discussions suggesting that AI will completely replace teachers (Nazaretsky et al., 2022) are often met with skepticism and debate within the educational community (Chiu, 2021). While AI has made significant advancements in various aspects of education (Zhai et al., 2021), it is important to approach these claims with critical analysis and consider the multifaceted nature of teaching.

In fact, despite that AI can automate certain administrative tasks and provide personalized learning experiences, it lacks the ability to fully replicate the human qualities and nuances that teachers bring to the classroom (Bertolin, & Da Rin, 2020). Effective teaching involves more than the transmission of information; it requires the cultivation of critical thinking skills, emotional intelligence, social interaction, and adaptability to diverse student needs. These aspects of education rely on the unique abilities of human teachers to engage, motivate, and inspire students (Guan et al., 2020).

Furthermore, the development of deep connections, trust, and mentorship between teachers and students is a fundamental component of the learning process (Shen et al., 2020). These interpersonal relationships play a vital role in fostering a positive and supportive learning environment, which is challenging for AI systems to replicate. Human teachers possess the capacity to provide empathy, understanding, and guidance that is essential for student development and well-being (Bertolin, & Da Rin, 2020).

It is worth noting that AI in education should be seen as a complementary tool rather than a complete replacement for teachers. By leveraging AI technologies,

teachers can enhance their instructional practices, personalize learning experiences, and gain valuable insights into student progress. AI can provide support by automating routine tasks, offering real-time feedback, and analyzing vast amounts of data to inform instructional decisions (Hejres, 2022). However, the expertise, creativity, and adaptability of teachers remain indispensable in designing effective educational experiences and nurturing the holistic development of students.

However, amidst the enthusiasm for AI's potential in education, it is crucial to strike a balance between technological advancements and the preservation of human interaction within the educational landscape. While AI can undoubtedly streamline certain tasks and offer valuable support, it should not overshadow the unique qualities that only human teachers possess. The complex nature of teaching encompasses not only the dissemination of knowledge but also the cultivation of critical thinking, emotional intelligence, and socio-cultural understanding - aspects that require the nuanced guidance and mentorship of skilled educators (Ouyang, F., & Jiao, 2021).

Moreover, as stated earlier, the role of teachers extends beyond imparting knowledge; they serve as role models, motivators, and facilitators of student development. The empathetic and empathic connections forged through human interaction are instrumental in fostering trust, encouragement, and a sense of belonging among students (Borenstein, & Howard, 2021). These essential elements of the learning process cannot be replicated by AI-driven systems alone.

In conclusion, the integration of AI in education has opened up new avenues for teachers to enhance their instructional practices and streamline administrative tasks. Nevertheless, it is vital to strike a balance that preserves the irreplaceable human touch in education. By harnessing the benefits of AI while remaining mindful of the unique contributions of teachers, it is possible to create an educational ecosystem that leverages technology to enrich learning experiences and empower students, all while maintaining the invaluable role of teachers as mentors, guides, and inspirations in shaping the minds of future generations.

5 Research methodology

The current study aimed to explore and understand the perceived effect of AI on teacher leadership in K-12 settings. It specifically examined whether AI had a regressing or expanding effect on teacher leadership. To gain in-depth insights into the experiences of teachers in schools where AI had been implemented, the study adopted a qualitative phenomenological approach. By employing a qualitative approach, the researchers aimed to go beyond mere quantitative measures and delve into the nuanced aspects of teachers' experiences and perceptions related to the explored concept (Eddles-Hirsch, 2015).

Phenomenology, as recommended by Vagle (2018), was chosen as the research methodology due to its focus on understanding individuals' lived experiences and the meanings they ascribe to those experiences. By using this approach, the study aimed to uncover the subjective perspectives and insights of teachers who had direct experience with AI in their professional lives.

Through qualitative phenomenology, the researchers aimed to explore the teachers' perceptions of how AI influenced their roles as leaders in the educational context. The research design involved conducting semi-structured interviews with participating teachers to gather rich and detailed descriptions of their experiences and viewpoints, capturing a range of experiences and perspectives, thus allowing for a comprehensive understanding of the impact of AI on teacher leadership.

5.1 Participants

Purposeful sampling was employed to recruit participant from schools where AI was being utilized for over two years. Because it was not easy to recruit teachers who were teaching in schools that utilized AI, the decision was to address teacher members of a virtual community of practice (vCoP). A vCoP is a platform that brings together teachers from across the Arab States Region sharing same interests, who collaborate virtually through Webinars, discussion boards, and common projects (Ghamrawi, 2022).

As such, having gained the ethical clearance of the University Board where the researchers worked, and the acceptance of the board of the vCoP; vCoP teachers were emailed by the vCoP Admin. The Admin inviting them to contact the researchers if they were interested in the study (as per a consent form shared with them). They were informed about inclusion criteria: (1) their school was using AI in learning and teaching; (2) they have at least one year of experience using AI in learning and teaching; (3) they had an overall teaching experience of more than five years; (4) they self-identified as teacher leaders; and (4) they spoke Arabic (because the vCoP platform was Arabic). The researchers received 23 emails from teachers expressing interest, however, only 14 fitted the selection criteria. One of those teachers was recruited for the pilot study. Thus, the study sample consisted of 13 participants who came from five Arab States.

5.2 Research instrument

A semi-structured interview schedule was developed for the purpose of this study, allowing the interviewer to delve into unexpected or important areas that may arise during the interview while ensuring that key topics are covered. The semi-structured format also facilitates comparability across different interviews by ensuring some consistency in the questions asked. It underwent iterative refinement and revision through pilot testing and feedback from experts to enhance its effectiveness and relevance to the research study.

In fact, two professors in educational leadership, refereed the interview schedule. Based on their feedback, the number of items was trimmed by two, as they thought those questions were already part of other questions. On the other hand, a pilot study was carried out with one teacher bearing the same characteristics as that of the study sample. The pilot study supported the researchers in estimating the time needed to carry out the interviews (35 min). Additionally, some rephrasing was made, thus enhancing the clarity of the interview items. The interview schedule is presented in Table 1.

Table 1 The Interview Schedule

Introductions	<ul style="list-style-type: none"> o Welcoming, self-introductions, overview of the topic, informed consent, and ground rules. o Why do you identify as a teacher leader? Give examples of roles you have taken up in your school. o In what capacity have you been using AI in learning and teaching in your school?
Enhancing	<ul style="list-style-type: none"> o Based on your understanding of AI, do you believe it has the potential to regress or expand teacher leadership? Why? o Can you identify any specific areas or tasks within teaching where AI could potentially enhance or support teacher leadership? How?
Regressing	<ul style="list-style-type: none"> o Are there any concerns or reservations you have about the use of AI in education, particularly regarding teacher leadership? What are they? o Have you encountered any instances or examples where AI tools or technologies have been used to promote or hinder teacher leadership? If yes, could you describe those instances?
Competencies	<ul style="list-style-type: none"> o What kind skills and competencies you believe teachers would need to effectively embrace and integrate AI while maintaining their leadership roles?
Closure	<ul style="list-style-type: none"> o Are there any other ideas you would like to add?

5.3 Data analysis

Data analysis followed open coding, axial coding, and selective coding, as suggested by Williams and Moser (2019). To ensure the validity of the codes and themes, peer debriefing was employed, whereby two of the researchers autonomously coded the data and subsequently cross-referenced and harmonized the codes and themes as suggested by Scharp and Sanders (2019).

In the process of analysis, the transcripts of the interviews were segmented into smaller units and assigned labels (codes), which were constantly compared and contrasted for similarities and differences. The next stage involved axial coding, whereby the codes were categorized into groups and connections were forged between them. The final stage involved selective coding, affording the researchers the opportunity to amplify and formulate the narrative of the instance by extending the central coding to a more abstract level (Flick, 2009). This method provided reinforcement in constructing signification and narrating a tale employing the amassed data (Charmaz, 2014).

5.4 Demographic data of participants

The characteristics of the sample that completed the survey are presented in Table 2.

Table 2 Sociodemographic characteristics of the study population

Gender	Male	5
	Female	8
Age	26–35 years	9
	36–45 years	4
	46 years and above	0
Overall Teaching Experience	5–7 years	6
	8–10 years	7
	11 years or more	1
Teaching experience using AI	1–2 years	13
	3–5 years	0
	6 years or more	0
Countries	UAE	3
	Qatar	3
	Saudi Arabia	3
	Jordan	2
	Lebanon	2

6 Findings

For ethical considerations, participants are identified using the formula T_yC , where ‘T’ stands for teacher, ‘y’ stands for the number given to him/her; and C is the first letter of the country this participant came from. For example, T_2S indicates a Saudi teacher numbered ‘2’.

6.1 Research question 1: to what extent will AI expand/regress teacher leadership roles in schools?

Participants in this study were polarized, some considering AI to be enhancing (6 out of 13), while others (7 out of 13) thought it was regressing to teacher leadership roles in schools. On one hand, teachers thought that teacher leadership may be regressed because teachers could become facilitators of technology, and problem-solvers around it.

‘AI’s regression of teacher roles is a valid concern. With the integration of AI systems in classrooms, there is a possibility of teachers being reduced to mere facilitators of technology. So we our leadership role will be diminished’ (T3-U).

‘AI’s potential regression of teacher roles should not be underestimated. As technology takes on more responsibilities, teachers might face reduced command over their students and colleagues. They can no more serve as resource providers for both’ (T6-Q).

‘Teachers may find themselves relegated to monitoring and troubleshooting technological systems rather than focusing on meaningful interactions with students. This could lead to a devaluation of teacher leadership roles in the classroom and outside it’ (T12-L).

In the same vein, according to participants, the encroachment of AI algorithms in education poses a significant threat to teachers' autonomy, diminishing their leadership roles and turning them into mere followers of predetermined instructional guidelines. AI was thought to undermine teachers' autonomy, transforming them into passive conduits for pre-determined algorithms, ultimately eroding their ability to exercise leadership and tailor instruction to their students and colleagues.

'Teachers may lose their autonomy in decision-making as AI algorithms dictate curriculum content and assessment methods. This degenerates their leadership roles' (T11-J).

'AI algorithms threatens to erode teachers' autonomy, relegating them to passive implementers of predetermined curriculum and assessment methods. This undermines their ability to lead and innovate in the classroom, which is at the heart of teacher leadership' (T7-S).

'The increasing reliance on AI algorithms to dictate curriculum content and assessment methods undermines teachers' autonomy, eroding their capacity to lead and make informed decisions that best serve their students' unique needs. So teachers are no more leaders around student learning' (T6-Q).

'AI may reduce the need for collaboration between teachers as technology takes over certain aspects of instructional planning and delivery. With AI handling automated tasks and providing pre-packaged materials, the traditional collaborative efforts among teachers to design curriculum and share resources might diminish' (T2-U).

'AI-powered tools and platforms can streamline administrative processes and provide ready-made instructional content, potentially reducing the opportunities for teachers to engage in collaborative efforts to develop innovative teaching strategies and share best practices' (T11-J).

On the other hand, other teachers thought that because AI has the potential of automating administrative tasks and providing data-driven insights, it can free up more time for teachers to focus on instructional leadership, mentoring students, and driving innovation in the classroom. Thus, teachers can become even more effective leaders in shaping the educational experiences of their students.

'In my view, AI empowers teachers to be leaders who can make informed decisions based on data and ensure each student reaches their full potential. This integration of AI technology empowers teachers to assume greater leadership in creating engaging, student-centered learning experiences' (T1-U).

'AI has the potential to be a game-changer for teacher leadership in schools. It has the potential to automate routine tasks, so, it can liberate teachers to focus

on personalized instruction, cultivating critical thinking skills, and fostering a positive classroom environment’ (T5- Q).

‘AI can augment teachers’ expertise by providing access to a wealth of educational materials and adaptive learning tools. Ultimately, this amplification of their leadership potential will enable teachers to have a greater impact on student learning outcomes’ (T8- S).

Parallel to its impact on student learning, teachers thought that the integration of AI in schools presents a unique opportunity for teachers to enhance their leadership roles by becoming mentors, coaches, and resource providers for their colleagues. By leveraging AI as a valuable resource, teachers can tap into a wealth of educational materials, data-driven insights, and adaptive learning tools to support their fellow educators.

‘I am optimistic about the impact of AI on teacher leadership roles in schools. With AI-assisted platforms and resources, teachers can streamline administrative tasks, giving them more time to engage in collaborative planning, professional development, and mentoring’ (T10- J).

‘Through AI powerful tools, teachers can support their fellow educators in implementing effective teaching strategies and fostering continuous professional growth. This way their leadership roles in school are enhanced’ (T13- L).

‘AI is a valuable resource through which teachers can serve as mentors, coaches, and resource providers to their colleagues. The abundance of educational materials, data-driven insights, and adaptive learning tools made available through AI empowers teachers to support and guide their fellow educators in adopting innovative practices and improving instructional strategies’ (T9-S).

In conclusion, teachers are polarized in their viewpoints regarding the impact of AI on teacher leadership roles. While some of them believe that AI may potentially regress teacher leadership by limiting autonomy and replacing human connection; others see it as a tool that can enhance teacher leadership through expanded mentorship, coaching, and resource provision opportunities.

Research Question 2: What will be the new set of competencies required for teacher leaders to sustain their roles in an AI era?

Five key emerging themes have surfaced, shedding light on the new set of competencies required for teacher leaders to sustain their roles in an AI era. These themes reflect the evolving landscape of education, where the integration of artificial intelligence (AI) presents both opportunities and challenges. The identified themes encompass technological literacy, adaptability and continuous learning, collaborative and coaching skills, data-informed decision making, and human-centered approaches.

6.2 Technological literacy

All participants emphasized the criticality of developing technological literacy skills as a core competency for teacher leaders in the AI era. They emphasized the need for educators to understand and effectively utilize AI-powered tools, data analytics, and educational technologies to support their colleagues in integrating AI resources into instructional practices.

‘In an AI era, teacher leaders need to be comfortable with technology and possess the ability to leverage AI tools effectively. It’s not just about being tech-savvy; it’s about understanding how AI works, analyzing data insights, and using technology as an enabler to enhance teaching and learning’ (T12- L).

‘Technological literacy is becoming an essential competency for teacher leaders. They must be equipped with the knowledge and skills to navigate AI-powered platforms, interpret data generated by AI systems, and leverage technology to optimize instructional practices and support their colleagues’ (T11- J).

6.3 Adaptability and continuous learning

The theme of adaptability and continuous learning emerged as a crucial competency for teacher leaders in the AI era. All participants stressed the importance of being open to new technologies, pedagogical approaches, and evolving roles. They highlighted the need for teacher leaders to engage in ongoing professional development, stay updated with AI advancements, and be willing to adapt instructional practices to effectively integrate AI tools and resources.

‘Teacher leaders must embrace a growth mindset and a commitment to continuous learning in the AI era. They need to be adaptable, willing to explore new technologies, and continuously refine their instructional practices to leverage AI tools for the benefit of their students and colleagues’ (T7- S).

‘In an era of rapid technological advancements, teacher leaders must be adaptable and open to change. They should actively seek out professional development opportunities, stay informed about AI developments, and be ready to adjust their teaching strategies to ensure that AI is seamlessly integrated to enhance student learning experiences’ (T6- Q).

6.4 Collaborative and coaching skills

The theme of collaboration and coaching skills emerged as essential competencies for teacher leaders to sustain their roles in an AI era. All participants emphasized the importance of fostering a collaborative culture among colleagues, promoting peer

learning, and serving as instructional coaches to support educators in effectively utilizing AI resources.

‘Teacher leaders need to excel in collaboration and coaching skills in the AI era. They should create opportunities for educators to collaborate, share best practices, and support each other in effectively integrating AI tools. Teacher leaders can serve as instructional coaches, guiding colleagues in leveraging AI resources to improve instructional practices’ (T2- U).

‘In an AI era, teacher leaders need to foster a culture of collaboration and create spaces for educators to learn from one another. They should facilitate peer learning, provide ongoing support, and serve as coaches who help their colleagues navigate the integration of AI tools in the classroom’ (T4- Q).

6.5 Data-informed decision making

Participants (5 out of 13) emphasized the importance of data-informed decision making as a key competency for teacher leaders in an AI era. They discussed the need for educators to be proficient in analyzing and interpreting data generated by AI systems, using insights to inform instructional strategies, personalize learning experiences, and identify areas for improvement.

‘Teacher leaders must possess strong data literacy skills in an AI era. They need to be able to analyze and interpret data from AI systems to make informed decisions about instructional practices, identify student needs, and drive evidence-based decision making to improve learning outcomes’ (T1- U).

‘Data-informed decision making is crucial for teacher leaders in the AI era. They should be adept at analyzing data insights generated by AI tools and leveraging that information to tailor instruction, identify learning gaps, and implement targeted interventions to meet the diverse needs of their students’ (T2- Q).

6.6 Human-centered approaches

The theme of human-centered approaches emphasized the importance of maintaining the human element in education despite the integration of AI. Participants (8 out of 13) stressed the need for teacher leaders to prioritize positive relationships, social-emotional development, and critical thinking skills while leveraging AI tools and resources.

‘Teacher leaders should champion the value of human educators in the AI era. While AI can enhance instruction, it is crucial to prioritize social-emotional development, promote critical thinking skills, and maintain meaningful rela-

tionships with students. AI should be used to complement and enrich the human experience, not replace it' (T10- J).

'In an era of AI integration, teacher leaders should ensure that the human element of education remains central. They should promote a holistic educational experience that values creativity, collaboration, and critical thinking, using AI as a tool to enhance student learning while preserving the personal connection between teachers and students' (T12- L).

7 Discussion

In an attempt to explore teacher leadership in the context of AI, this study addressed two research questions: the extent to which AI expands or regresses teacher leadership roles in schools, and the new set of competencies required for teacher leaders to sustain their roles in an AI era.

Regarding the impact of AI on teacher leadership roles, the study found a polarization among participants. Some teachers believed that AI had the potential to regress teacher leadership by diminishing autonomy, reducing collaboration, and transforming teachers into passive implementers of predetermined algorithms. This comes parallel to Nazaretsky et al. (2022) who reported similar fears of teachers.

Moreover, teachers expressed concerns about being reduced to mere facilitators of technology, losing their command over students and colleagues, and being relegated to monitoring and troubleshooting technological systems. While Sergeeva et al. (2020) reported this finding in AI in medicine, to the knowledge of the researchers, this has not been reported in earlier studies focusing on AI. In fact, the encroachment of AI algorithms was seen as a threat to teachers' ability to exercise leadership and tailor instruction to individual student needs.

On the other hand, a group of teachers viewed AI as a tool that could enhance teacher leadership. They highlighted its potential to automate administrative tasks, provide data-driven insights, and free up time for teachers to focus on instructional leadership, mentoring students, and driving innovation in the classroom. This is a finding that comes parallel to many of the revised studies such as Bertolin and Da Rin (2020), Shen et al., (2020), Chiu (2021), and Zhai et al. (2021). These teachers saw AI as empowering them to make informed decisions based on data, create engaging and student-centered learning experiences, and amplify their impact on student learning outcomes.

Moreover, the integration of AI in schools was perceived by participants as a significant opportunity for teachers to expand their leadership roles beyond the confines of their classrooms. They envisioned a future where teachers could assume the roles of mentors, coaches, and resource providers, utilizing AI as a valuable resource to support and guide their fellow educators. Participants recognized that AI-powered tools and platforms have the potential to streamline administrative processes, automate routine tasks, and provide access to a wealth of educational materials and resources. This newfound efficiency and accessibility would enable teachers to allocate more

time and energy towards supporting their colleagues. They envisioned teacher leaders leveraging AI to facilitate collaborative planning sessions, where educators could come together to design innovative teaching strategies, exchange best practices, and create a culture of continuous professional growth.

Teacher leaders would serve as valuable resource providers, curating and sharing AI-enabled tools, resources, and innovative teaching practices with their colleagues. They would stay informed about the latest advancements in AI technologies and identify the most relevant and effective resources that align with the specific needs of their colleagues and students. By acting as conduits of knowledge and resources, teacher leaders would foster a culture of collaboration and support, where educators could learn from one another and collectively harness the potential of AI to transform teaching and learning. While the literature suggests that AI has the potential to support teachers' endeavors by its strong analytical powers (Carpenter et al., 2022; Shen et al., 2020), suggesting that teachers' freed time would be beneficial for teacher leadership functions and roles has not been reported earlier.

Moving on to the second research question, the study identified five key themes that shed light on the new set of competencies required for teacher leaders to sustain their roles in an AI era: technological literacy, adaptability and continuous learning, collaborative and coaching skills, data-informed decision making, and human-centered approaches.

Parallel to Shen et al., (2020), technological literacy emerged as a critical competency, emphasizing the need for teachers to understand and effectively utilize AI-powered tools, data analytics, and educational technologies. Adaptability and continuous learning were highlighted as essential skills to embrace new technologies, pedagogical approaches, and evolving roles. Teacher leaders were encouraged to engage in ongoing professional development, stay updated with AI advancements, and adapt instructional practices to effectively integrate AI tools and resources.

Moreover, in line with Ghamrawi (2022), collaboration and coaching skills were deemed essential for teacher leaders to harness technological challenges. Fostering a collaborative culture among colleagues, promoting peer learning, and serving as instructional coaches were seen as ways to support educators in effectively utilizing AI resources. Additionally, as per Salas-Pilco et al. (2022), data-informed decision making was identified as another key competency, emphasizing the need for teachers to analyze and interpret data generated by AI systems to inform instructional strategies, personalize learning experiences, and drive evidence-based decision making.

Lastly, the theme of human-centered approaches surfaced the discussions on teaching in the AI era. Anderson et al. (2022) suggest the importance of human-centered approaches, but not within the context of teacher leadership enhancement as suggested in this study. According to this study, teacher who wish to maintain and enhance leadership functions were encouraged to prioritize positive relationships, and social-emotional development.

8 Conclusion

The study uncovered a dichotomy of perspectives among participants regarding the impact of AI on teacher leadership roles. Some teachers voiced apprehensions that AI had the potential to diminish autonomy, curtail collaboration, and relegate teachers to passive implementers of predetermined algorithms. Others saw opportunities for enhancement. These teachers saw an opportunity to streamline their workload, gain valuable insights into student performance, and create personalized learning experiences that cater to the unique needs of each student. This dichotomy of perspectives among participants regarding the impact of AI on teacher leadership roles might be attributed to teacher training and school approaches to implementing AI.

The apprehensions expressed by some teachers about the potential negative consequences of AI on teacher leadership roles could be linked to the level of training and familiarity they have with AI technologies. If teachers have limited exposure to AI or lack training on how to effectively utilize AI-powered tools, they may perceive AI as a threat to their professional autonomy. Without a solid understanding of AI's capabilities and potential benefits, teachers may fear being reduced to mere implementers of predetermined algorithms, leading to a loss of their instructional decision-making authority. Furthermore, the school's approach to using AI may also influence teachers' perceptions. If the implementation of AI in schools is primarily focused on automating administrative tasks or standardized instructional approaches, it can reinforce the concerns of teachers who view AI as diminishing collaboration and limiting their ability to tailor instruction to individual student needs.

In contrast, if schools adopt an inclusive approach that empowers teachers to leverage AI as a tool for personalized and innovative teaching practices, teachers may be more inclined to see AI as an opportunity for enhancing their leadership roles. The contrasting perspective of some teachers who view AI as an opportunity for enhancement likely reflects a different set of circumstances. These teachers may have received adequate training on AI technologies, allowing them to recognize the potential benefits of AI in terms of automating administrative tasks, providing data-driven insights, and freeing up time for instructional leadership and student mentorship. They may have experienced firsthand how AI can support their decision-making processes, personalize learning experiences, and amplify their impact on student outcomes. Such teachers may also have been exposed to successful implementations of AI in their schools, where AI is seen as a tool that empowers teachers and promotes collaboration rather than diminishing their autonomy.

To address this dichotomy of perspectives, further research studies are recommended. Future research could delve deeper into the factors influencing teachers' views, such as their prior experiences with AI, professional development opportunities, and the level of support provided by schools and educational institutions. By gathering a more comprehensive understanding of these factors, researchers can gain insights into how to effectively address concerns and promote opportunities for enhancement in the integration of AI.

Moreover, it would be valuable to examine the long-term effects of AI implementation on teacher leadership roles. A longitudinal study could track the evolving perceptions and experiences of teachers as they gain more exposure to AI technolo-

gies and become more proficient in leveraging them to enhance their leadership functions. This would provide valuable insights into the potential shifts in attitudes and practices over time and enable the identification of effective strategies for supporting teacher leaders in an AI era.

In the realm of AI, teachers recognize the significance of cultivating a new set of competencies to preserve their leadership roles. Technological literacy, adaptability, collaboration and coaching skills, data-informed decision making, and human-centered approaches emerge as indispensable attributes. These competencies empower educators to comprehend and harness the potential of AI tools, navigate the ever-evolving technological landscape, foster cooperative learning environments, make informed choices based on data insights, and prioritize the human element in education. Teachers thought that by embodying these multifaceted proficiencies, they could embrace their pivotal role in orchestrating a harmonious fusion between AI advancements and the irreplaceable essence of human guidance in the pursuit of academic excellence.

8.1 Summary

The study unveiled a clear divergence in viewpoints among participants regarding the impact of AI on teacher leadership roles. Some expressed concerns over AI potentially diminishing autonomy and collaboration, while others saw possibilities for enhancement. This divergence could be linked to differences in teacher training and school AI integration approaches. The apprehensions of certain teachers might arise from limited AI familiarity and training, impacting their perceived professional autonomy. On the other hand, educators viewing AI positively likely benefit from comprehensive AI training and exposure, which shape their appreciation for its benefits in decision-making, personalized learning, and student outcomes. To bridge this gap, further research is recommended to delve into influencing factors. Moreover, exploring the long-term effects of AI implementation on teacher leadership and cultivating necessary competencies to navigate AI's landscape were highlighted as significant avenues for future inquiry.

8.2 Limitations

Limitations of this study should be acknowledged to provide a comprehensive perspective on its findings and implications. Firstly, the sample size of 13 teachers from five countries might limit the generalizability of the study's conclusions to a broader population of educators using AI. The diverse educational systems, cultural contexts, and technology adoption rates across these countries could contribute to variations in teachers' perceptions and experiences, potentially impacting the study's external validity. Furthermore, the qualitative nature of the research design, relying on semi-structured interviews and thematic analysis, could introduce subjectivity and potential bias in data interpretation. The themes identified might reflect the researchers' interpretations and could be influenced by their perspectives, potentially limiting the objectivity of the study's findings.

Moreover, the study examined the perceived impact of AI on teacher leadership without capturing the perspectives of school administrators, students, parents, or policymakers. This omission restricts a holistic view of how various stakeholders perceive the effects of AI on teacher leadership and potentially limits the depth of the study's insights. It is recommended that future studies focus on the broader view pertaining to the researched topic.

Finally, it is important to note that this study relies on self-reported data obtained through semi-structured interviews, primarily drawing from participants' opinions and perspectives. As such, the findings are reflective of individual interpretations and may not be grounded in empirical evidence. While the insights provide valuable qualitative insights into the perceived impact of AI on teacher leadership, they should be interpreted within the context of participants' subjective viewpoints rather than being considered as definitive empirical conclusions. However, by focusing on teachers who have actively engaged with AI tools in their teaching practices for a substantial period, we sought to ensure that the participants' opinions and perceptions are informed by tangible experience rather than speculative notions.

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Data Availability The data that support the findings of this study are not publicly available. Data are however available from the corresponding authors upon reasonable request and with permission of the IRB at Qatar University.

Declarations

Conflicts of interest There is no potential conflict of interest.

Informed consent All participants in this study were informed of the purpose of the study and how data will be used. They were assured that their identities would remain anonymous across the study.

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