

Participatory Design for AI in Teacher Education: From Top-Down Directives to Teacher Empowerment

Ekta Shokeen, Aarhus University, ekta.shokeen@cc.au.dk
Ane Vielandt Jensen, Aarhus University, av@cc.au.dk,
Ole Sejer Iversen, Aarhus University, oiversen@cc.au.dk
Christian Dindler, Aarhus University, dindler@cavi.au.dk
Marianne Graves Petersen, Aarhus University, mgraves@cs.au.dk

Abstract: Empowering teacher educators to lead technology integration is essential for creating context-sensitive educational futures. This study examines how participatory design workshops can support educators in collaboratively developing sustainable capacity for integrating AI into teacher education. Drawing on a series of three participatory design workshops, the analysis focuses on the collaborative learning processes involved and the professional outcomes they produce. Structured around exploration, co-creation, and reflection, these workshops enabled educators to critically engage with the pedagogical, ethical, and institutional dimensions of AI, fostering both ownership and transformative agency. The findings demonstrate how participatory design can function not only as a design methodology but also as a framework for professional learning. A key contribution of this paper is the demonstration that participatory design supports sustainable AI integration by building educators' capacity for change through the design process.

Introduction

Artificial intelligence (AI) is reshaping education through adaptive learning systems, automated assessment, and data-driven decision-making (e.g., Holmes et al., 2019), raising urgent questions about both classroom practice and how teachers and teacher educators (TEs) are equipped to navigate this shift (Chounta et al., 2022; Lin & Van Brummelen, 2021). While AI promises innovation, its implementation often follows top-down models that marginalize TEs, reducing their role to passive adopters of pre-defined tools and policies (e.g., Zawacki-Richter et al., 2019; Williamson & Eynon, 2020).

This study argues that empowering TEs to actively shape technology is critical, not only for successful AI integration but for sustaining context-sensitive, pedagogically grounded change. Drawing on participatory design (PD) and Cultural-Historical Activity Theory (CHAT), we position TEs as co-creators rather than end-users, capable of engaging critically with AI to transform educational practices, policies, and resources (Ehn, 1993; Bødker et al., 2000; Sannino, 2015). Specifically, we examine:

How can participatory design workshops empower teacher educators to build capacity for integrating AI in teacher education?

Background

As digital technologies increasingly shape education, teacher empowerment has emerged as a central concern. The challenge extends beyond effective tool use to supporting educators in shaping the values, purposes, and pedagogical practices that guide technology integration. AI exemplifies this challenge: while it enables personalization, automated feedback, and data-informed instruction, it also raises ethical and pedagogical dilemmas related to bias, authorship, academic integrity, and the role of human judgment. TEs, who prepare future teachers, are therefore pivotal. Yet they are often positioned as passive recipients of AI policies and tools rather than as active agents shaping their implementation (Williamson & Eynon, 2020; Zawacki-Richter et al., 2019).

Emerging research challenges this passive framing. Evidence suggests that when teachers engage in participatory curriculum design, both contextual relevance and professional agency are strengthened (Lin & Van Brummelen, 2021; Tatar et al., 2024). Teachers recognize AI's instructional potential but consistently emphasize the need for ethical and pedagogical preparedness (Chounta et al., 2022). AI integration can disrupt evaluative roles, prompting reflection on authorship and academic integrity (Mohammadkarimi, 2023), highlighting the centrality of teachers' beliefs, values, and professional judgment in responsible adoption.

Teachers' attitudes toward AI are marked by both optimism and caution. While curiosity may drive engagement, meaningful and confident use depends on foundational AI literacy and ethical awareness (Long & Magerko, 2020; Edwards et al., 2018). Concerns about algorithmic bias, fairness, reduced student interaction, and

overreliance on automation underscore the need for professional development approaches that go beyond technical training to cultivate critical, reflective, and empowered engagement (Kaplan-Rakowski et al., 2023).

Drawing on Iversen's (2019) perspectives on digital technology this study foregrounds democratic participation and critical agency of educators where AI is approached not merely as an instructional aid but as a complex phenomenon that requires ethical reflection and value-driven integration within teacher education.

Theoretical framing

PD offers a robust framework for exploring teacher empowerment in AI integration. Widely applied in educational contexts to develop curricula and learning environments (Könings et al., 2014), PD foregrounds teachers' professional expertise and lived experiences. Methods such as prototyping, storytelling, and scenario building foster mutual learning, make assumptions visible, and support iterative refinement of ideas (DiSalvo et al., 2017). Beyond methodology, PD embodies an ethical and democratic stance, promoting shared ownership and critical engagement with technology (Durall & Kapros, 2020; Cumbo & Selwyn, 2022). Although extensively applied in K–12 contexts, its use with teacher educators (TEs) remains underexplored, despite their key role in linking classroom innovation to systemic change. Involving educators in PD enhances adoption and confidence in integrating emerging technologies (Severance et al., 2018; Durall & Kapros, 2020).

This study positions PD as an approach to cultivate transformative agency, *the collective capacity to question practices, envision alternatives, and reshape educational systems*, grounded in Scandinavian traditions emphasizing empowerment, ethics, and democracy (Ehn, 1993; Bødker et al., 2000). To deepen PD methodological approach, we draw on CHAT, which, like PD, focuses on socially situated activity systems and the generative potential of contradictions (Engeström, 2014). AI integration often exposes tensions between institutional rules, pedagogical aims, and technological affordances, which CHAT frames as drivers of expansive learning (Engeström, 2014). By linking PD and CHAT, workshops become both practical design spaces and sites of empowerment, enabling TEs to develop the agency needed for ethically grounded, sustainable AI integration (Sannino, 2015; Virkkunen, 2006).

Methods

This study was conducted within the Danish research project, which investigates AI integration in Danish teacher education. Nine teacher educators (TE1–TE9) from four university colleges participated, representing first language, art, pedagogical psychology, didactics, and pedagogy. PD workshops served as both intervention and data-collection sites, engaging TEs as practitioner collaborators in co-developing AI-integrated lesson plans. The study received ethics approval from Aarhus University, and informed consent was obtained from all participants.

Table 1
Workshop Activities Schedule

Activity	Workshop 1	Workshop 2	Workshop 3
A1	Introduction	Introduction	Introduction
A2	Initial reflections on AI (P, 40 min)	Technical – How does AI work? (P, 45 min)	Perspectives on generative AI (P, 30 min)
A3	Perspectives on AI (P, 20 min)	Perspectives on AI and AI literacy (P, 20 min)	Reflections on teaching AI experiences (D, 75 min)
A4	Relevance of AI literacy (P, 20 min)	Reflections on AI integration (D, 15 min)	AI & computational empowerment (P, 45 min)
A5	Technical – How does AI work? (P, 15 min)	Preparing lesson plan (150 min)	Exploring further connections (D, 90 min)
A6	Hands-on with <i>The Engine Room</i> & ChatGPT (50 min)	-	-
A7	Reflections on AI integration (D, 50 min)	-	-
A8	Drafting lesson plan (15 min)	-	-

Note: 'P' = Presentation; 'D' = Discussion. Duration of activities shown in parentheses.

Three in-person workshops were held over seven months, facilitated by eight researchers from five institutions across three locations. Workshops 1–2 focused on mutual learning and co-creation through small and large-group activities; Workshop 3 emphasized post-implementation reflection. Each workshop followed iterative stages: framing, exploration (including AI misconceptions), ideation, prototyping, and reflection. Activities (refer to Table 1) included collaborative design tasks and hands-on use of AI tools.

Data included 11.5 hours of workshop audio, images, video clips, artifacts, and seven semi-structured interviews (31–52 minutes; $M=40$). Recordings were transcribed in Condens and verified. Thematic analysis guided coding using a hybrid deductive–inductive approach (Saldana, 2011). An initial codebook, based on the research question, guided coding while allowing emergent themes. Three data subsets were independently coded by two researchers to refine codes, which were then applied to the full dataset. Weekly team discussions resolved discrepancies, clarified code meanings, and ensured consensus, enhancing reliability and transparency. This approach enabled systematic, participant-centered identification of themes reflecting perspectives.

Findings

1. From individual uncertainty to collective direction

Across the PD workshops, collaboration functioned as the central mechanism through which TEs developed transformative agency for AI integration. Rather than merely exchanging lesson ideas, participants engaged in collective sense-making that surfaced shared goals, tensions, and new possibilities for teacher education.

From the outset, TEs articulated both personal and collective objectives. Some sought professional growth. TE7 admitted wanting *“to get a more nuanced view of it - right now, I don’t think I have a particularly nuanced one, because I don’t know enough about it.”* Others framed AI integration as a systemic responsibility. TE5 argued that AI should be *“distributed in such a way that it becomes everyone’s responsibility as an educator in teacher education,”* while TE6 emphasized curricular progression so that *“pre-service teachers aren’t just introduced to AI in the same way every time... but that there’s also thought given to progression.”* Through dialogue, these perspectives converged into a shared vision of cross-curricular, developmentally structured AI integration marking a shift from individual uncertainty toward collective direction.

The PD workshops fostered multiple forms of collaboration among TEs and facilitators, across three interrelated dimensions: *articulating objectives, negotiating attitudes, and addressing concerns*. These collaborations unfolded shared inquiry, co-construction of knowledge, and the cultivation of agency.

2. Negotiating tensions and ethical concerns

The workshops also created space to negotiate conflicting attitudes. AI was not approached with uniform enthusiasm. TE7 described the surrounding pressures as *“completely draining,”* and TE2 worried that, *within first-language education, “there’s an educational or formative perspective that risks being lost.”* Yet these concerns were met with curiosity and openness. TE5 emphasized engagement *“so it doesn’t have to be rooted in fear or anxiety but can instead become something more positive.”*

Rather than fragmenting the group, the juxtaposition of skepticism and optimism became a resource for shared inquiry. Participants critically examined AI’s purpose and scope. TE6 asked, *“Is it about the empowerment perspective? Is it about focusing on computational thinking and understanding of data and algorithms? Or where are we, really?”* TE8 questioned proportionality: *“To what extent should it take up space—are we supposed to spend every day from morning to night for the rest of our lives discussing AI?”*

Ethical dimensions were equally central to dialogue during PD. TE3 warned that *“what the majority says ends up becoming the truth, and the nuances disappear,”* while TE8 stressed that *“algorithms are in control—that’s where computational empowerment comes in—it’s partly about highlighting bias.”* Even vulnerability became generative; TE4 acknowledged, *“I am navigating this somewhat blindly.”* Such admissions transformed uncertainty into shared capacity-building, reinforcing collaboration as a driver of transformative agency.

3. PD as capacity building and reframing AI

Hands-on PD activities grounded TEs reflections in practice. As TE3 described, the workshops offered *“a mini hook and hang something on it. And then you can unfold it yourself in your subject.”* This flexible structure supported disciplinary adaptation. TE5 valued *“all the different perspectives,”* noting how collaborative exchanges enriched planning.

Different pedagogical entry points emerged. Some began with technical foundations: TE1 explained how AI relies on *“generating language through coding and a kind of probabilistic reasoning,”* and TE3 emphasized that AI *“is not creative; it is a machine... based on statistics and vast amounts of data.”* Others foregrounded socio-cultural themes. TE5 connected AI to explorations of loneliness and socialization, while TE4 described how experimenting with School-GPT in writing tasks shifted AI from being *“both a tool, but also a subject area, something we need to know, be able to use, and understand.”*

Across these trajectories, a common progression emerged during PD workshops, for TEs AI moved from being treated primarily as a tool to becoming a site of empowerment and critical reflection. TE7 described structuring learning, so pre-service teachers begin with experience and *“suddenly... you’re able to go out and act*

on it.” During PD dialogues TE6 framed AI as “*a catalyst for societal change and transformation.*” These findings suggest PD potential to build capacity and reframing TEs perceptions of AI integration in education.

Discussion

This study examined how collaboration within PD workshops support TEs in developing transformative agency for AI integration. Drawing on CHAT, the findings show that PD workshops functioned not merely as training spaces but as collective arenas where contradictions in existing practices were surfaced, negotiated, and reworked. Rather than positioning AI as a top-down reform, the workshops enabled TEs to question prevailing assumptions, articulate shared purposes, and experiment with new pedagogical directions. In doing so, participants moved from adapting to technological change toward actively reshaping the conditions of their professional practice.

Consistent with AI literacy research emphasizing confidence, critical evaluation, and responsible adoption (Edwards et al., 2018; Chounta et al., 2022), the workshops created space for TEs to clarify goals, confront ethical dilemmas, and reconcile divergent attitudes. Dialogue in PD workshops supported a shift from uncertainty and skepticism toward shared, value-driven visions of AI integration. Through co-construction of lesson ideas and exchange of disciplinary expertise, participants developed ownership, adaptability, and confidence outcomes aligned with prior studies on collaborative professional learning (Severance et al., 2018; Durall & Kapros, 2020; Lin & Van Brummelen, 2021).

From a CHAT perspective, contradictions between optimism and skepticism, institutional mandates and pedagogical values, technical functionality and ethical responsibility, acted as drivers of expansive learning (Engeström, 2014; Sannino, 2015). PD workshops made these tensions visible and discussable. Participants reframed pressures surrounding AI as shared challenges rather than individual burdens, collectively interrogating the rules, roles, and tools that shape their activity systems. In this sense, contradiction became a generative resource for systemic reflection and redesign.

The identified collaborative practices articulating objectives, negotiating attitudes, and addressing concerns map onto dimensions of transformative agency (Virkkunen, 2006). By envisioning progression in teacher education, questioning dominant technological discourses, and foregrounding ethical implications, TEs enacted agency as a collective, emergent process rather than an individual trait. PD methods grounded this agency in practice. Hands-on experimentation with AI tools, prototyping, and structured reflection bridged abstract critique and concrete implementation. Diverse trajectories of integration technical, socio-emotional, or critical-analytical were accommodated, yet converged on empowering pre-service teachers to engage critically with AI. This flexibility demonstrates how PD can honor disciplinary differences while sustaining shared ownership. Importantly, participants reframed AI integration around democratic and emancipatory purposes. AI was positioned not simply as a tool to master but as a phenomenon to question, shape, and situate within broader societal aims. Such reframing reflects expansive learning: redefining the object of teacher education from preparing students to use AI toward preparing them to critically influence its role in society.

Overall, the study positions PD workshops as collaborative knowledge-building environments where professional learning, identity, and systemic innovation are co-constructed. For CSCL, it highlights democratic participation and collective design as central to cultivating TEs transformative agency in AI integration.

Limitations and next steps

These contributions should be considered in light of several limitations. Although participant diversity in expertise was intentional, the findings cannot be generalized to any single subject domain within teacher education. Additionally, the analysis emphasizes established dimensions of PD in teacher education rather than foregrounding innovative applications of AI itself, an important direction for future inquiry.

Conclusion

This study shows that empowering TEs to integrate AI requires more than tools or technical training; it requires approaches that cultivate agency, collaboration, and critical engagement. Framing PD as both a methodology and an ethical stance grounded in empowerment and democracy, the study demonstrates how PD workshops can build sustainable capacity for AI integration in teacher education. Through iterative cycles of exploration, co-creation, and reflection, TEs surfaced contextual tensions and reimagined practices aligned with their professional values. AI became a site for inquiry and collective learning rather than a top-down mandate. Methodologically, the study positions PD workshops as spaces for shared knowledge construction and highlights democratic participation as central to educator-led, sustainable digital transformation.

References

- Bødker, S., Ehn, P., Sjögren, D., & Sundblad, Y. (2000). Co-operative design—perspectives on 20 years with “the Scandinavian IT Design Model”. *Proceedings of NordiCHI*, 2000, 22–24.
- Chounta, I.-A., Bardone, E., Raudsep, A., & Pedaste, M. (2022). Exploring teachers’ perceptions of Artificial Intelligence as a tool to support their practice in Estonian K-12 education. *International Journal of Artificial Intelligence in Education*, 32(3), 725–755.
- Connelly, L. (2023). The engine room. <https://maskinrummet.github.io/#/en>
- Cumbo, B., & Selwyn, N. (2022). Using participatory design approaches in educational research. *International Journal of Research & Method in Education*, 45(1), 60–72.
- DiSalvo, C., Clement, A., & Pipek, V. (2017). Participatory design for, with, and by communities. *International handbook of participatory design*, 182-209.
- Durall, E., & Kapros, E. (2020). Co-design for a Competency Self-assessment Chatbot and Survey in Science Education. In *International conference on human-computer interaction* (pp. 13-24). Springer International Publishing.
- Edwards, C., Edwards, A., Spence, P. R., & Lin, X. (2018). I, teacher: Using artificial intelligence (AI) and social robots in communication and instruction. *Communication Education*, 67(4), 473–480.
- Ehn, P. (1993). Scandinavian design: On participation and skill. In D. Schuler & A. Namioka (Eds.), *Participatory Design* (pp. 41–77). CRC Press.
- Engeström, Y. (2014). *Learning by expanding: An activity-theoretical approach to developmental research*. Cambridge University Press.
- Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education promises and implications for teaching and learning*. Center for Curriculum Redesign.
- Iversen, O. S., Dindler, C., & Smith, R. C. (2019). *A Design Approach to Understanding Technology*. Dafolo.
- Kaplan-Rakowski, R., Grotewold, K., Hartwick, P., & Papin, K. (2023). Generative AI and teachers’ perspectives on its implementation in education. *Journal of Interactive Learning Research*, 34(2), 313–338.
- Könings, K. D., Seidel, T., & Van Merriënboer, J. J. G. (2014). Participatory design of learning environments: Integrating perspectives of students, teachers, and designers. *Instructional Science*, 42(1), 1–9.
- Lin, P., & Van Brummelen, J. (2021). Engaging Teachers to Co-Design Integrated AI Curriculum for K-12 Classrooms. *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, 1–12.
- Long, D., & Magerko, B. (2020). What is AI Literacy? Competencies and design considerations. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, 1–16.
- Mohammadkarimi, E. (2023). Teachers’ reflections on academic dishonesty in EFL students’ writings in the era of artificial intelligence. *Journal of Applied Learning and Teaching*, 6(2), 105–113.
- Saldana, J. (2011). *Fundamentals of qualitative research*. Oxford university press.
- Sannino, A. (2015). The emergence of transformative agency. *Learning, Culture and Social Interaction*, 4, 1–3.
- Severance, S., Penuel, W. R., Sumner, T., & Leary, H. (2018). Organizing for teacher agency in curricular co-design. In *Cultural-historical activity theory approaches to design-based research* (pp. 45–78). Routledge.
- Tatar, C., Jiang, S., Rosé, C. P., & Chao, J. (2024). Exploring Teachers’ Views and Confidence in the Integration of an Artificial Intelligence Curriculum into Their Classrooms: A Case Study of Curricular Co-Design Program. *International Journal of Artificial Intelligence in Education*.
- Virkkunen, J. (2006). Dilemmas in building shared transformative agency. *Activités*, 3(3-1).
- Williamson, B., & Eynon, R. (2020). Historical threads and future directions in AI in education. *Learning, Media and Technology*, 45(3), 223–235.
- Zawacki-Richter, O., Marin, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education—where are the educators?. *International journal of educational technology in higher education*, 16(1), 1-27

Acknowledgments

We sincerely thank the participating teachers for their invaluable contributions to this work. This research was supported by the Ministry of Higher Education and Science in Denmark (Grant No. 4301-00001B). The views expressed in this paper are those of the authors and do not necessarily reflect the position of the funding agency.

DotQuest: Accessible STEM Games to Support Blind and Visually Impaired Learners

Ariel Han, Utah State University, ariel.han@usu.edu

Rajeev Joshi, Daniel Tsivkovski, Dylan Ravel, Maryam Etezadbrojerdi, Franceli Cibrian
rajoshi@chapman.edu, tsivkovski@chapman.edu, ravel@chapman.edu, etezadbrojerdi@chapman.edu,
cibrian@chapman.edu
Chapman University

Abstract: Blind and low vision (BLV) students face persistent barriers to full participation in STEM learning, particularly due to the limited availability of accessible tools. This study introduces DotQuest, a technology probe that integrates haptic feedback, and a conversational agent to create narrative-driven, game-based STEM activities. To examine how such tools might support equitable participation, we conducted interviews with seven Teachers of Students with Visual Impairments (TVIs) across U.S. Analysis revealed that teachers emphasize the importance of simultaneous tactile and auditory access, the need for classroom tools that foster both independence and inclusion, and the value of designing accessibility from the outset rather than as an accommodation. Findings show that multimodal game-based environments can enhance STEM engagement while revealing systemic barriers for BLV learners. This work contributes to the learning sciences by deepening understanding of how multimodal and inclusive design can guide the development of equitable STEM learning environments.

Introduction

STEM subjects often rely heavily on visual representations, yet equivalent multimodal tools that integrate tactile, auditory, and interactive supports remain limited (Ávila-Soto et al., 2017). As a result, Blind and low vision (BLV) students are frequently excluded from the kinds of rich, hands-on learning experiences that promote conceptual understanding, motivation, and equitable engagement (Wu et al., 2025). This study is motivated by the goal of designing accessible, tangible, and interactive learning environments that expand STEM opportunities for BLV learners (Pires et al., 2019; Lang et al., 2023; Kim & Yeh, 2015).

This study represents the first phase of a design-based research (DBR) project aimed at iteratively designing and refining DotQuest, an accessible, multimodal, game-based STEM learning environment for BLV students (Anderson & Shattuck, 2012). To connect theoretical perspectives on learning with the designed features and observed processes of our intervention, we used conjecture mapping (Sandoval, 2014). This phase focuses on eliciting expert insights to refine the system's design conjectures, features, and pedagogical functions before classroom implementation (Sandoval, 2014). By engaging Teachers of Students with Visual Impairments (TVIs) as co-design informants, we seek to connect theoretical principles of multimodal and inclusive learning with the pragmatic realities of STEM teaching for BLV learners (Hutchins & Biswas, 2024).

This work contributes to the Learning Sciences by articulating and refining design conjectures that link multimodal accessibility, narrative game structures, and tactile–auditory integration to equitable STEM engagement for blind and low-vision learners (Chen et al., 2024). Through teacher-informed conjecture mapping, DotQuest demonstrates how inclusive, multimodal game design can operationalize theoretical principles of sociocultural learning (Vygotsky, 1978) and Universal Design for Learning (UDL) into tangible design features (Rose, 2000). The study contributes a model for bridging accessibility research and design-based inquiry, expanding how the field conceptualizes equity-oriented learning environments beyond visual modalities (Uttamchandani, 2018). This study was guided by the following research questions: (1) *How do TVIs conceptualize the design features and pedagogical affordances needed for multimodal, game-based STEM learning environments for blind and low-vision learners?* (2) *How do TVIs' insights inform the refinement of DotQuest's design conjectures that link tactile–auditory integration, narrative-based interaction, and inclusive design principles to equitable STEM engagement?*