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Empowering pre-service teachers with generative artificial intelligence and microlearning: pathways to self-directed growth

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Abstract

This study explores the impact of generative artificial intelligence (GenAI) tools and microlearning strategies on the professional development of pre-service language teachers in Hong Kong. Grounded in self-regulated learning (SRL) and self-directed professional development (SP-PD), the research explores how teachers develop technological and pedagogical competencies through flexible, informal learning. Through semi-structured interviews with 14 pre-service teachers, it identifies four key themes: navigating GenAI with curiosity, microlearning as a practical scaffold, integrating SRL strategies, and reimagining teachers' identity and agency. The findings reveal that the participants valued the accessibility and responsiveness of GenAI and microlearning, but faced cognitive and emotional challenges, particularly when they lacked institutional support. Notably, GenAI tools functioned not only as instructional aids but also as co-regulators of learning, facilitating goal-setting, feedback, and reflection. By positioning GenAI as an active agent in teacher learning, this study contributes to the field and advocates for integrating AI literacy, SRL, and ethical frameworks into teacher education. It proposes reimagining professional development to strike a balance between autonomy and support and between innovation and pedagogical integrity in GenAI-enhanced educational contexts.

Keywords: Generative AI, microlearning, self-regulated learning, teacher agency, AI literacy, pre-service teacher education, self-directed professional development

Introduction

Since ChatGPT's release in November 2022, generative artificial intelligence (GenAI) has reshaped the educational landscape, transforming teaching practices and professional growth (Kohnke et al., 2023; Tan et al., 2025). As tools like ChatGPT, Claude, and Gemini become

increasingly sophisticated, educators are expected to integrate them into classroom practice (Case et al., 2025; Zhu & Wang, 2025). This necessitates developing AI literacy, which enables educators to critically understand and apply AI tools in pedagogically sound ways (Kohnke et al., 2025a). However, evidence about how pre-service teachers use GenAI in authentic contexts is limited, creating a pressing need to identify effective practices, supports, and risks.

Conventional teacher professional development (TPD) models frequently fail to provide the immediate need and flexibility required for effectively engaging with emerging technologies (Tan et al., 2025; Zhu & Wang, 2025). Many educators adopt informal, self-directed learning strategies that offer flexibility and personalisation (Chiu, 2024; Cleary et al., 2022). This form of informal, learner-driven growth aligns with the concept of self-directed professional development (SP-PD), which emphasises teachers' agency in shaping personalised, flexible learning pathways (Koya, 2023; Lopes & Cunha, 2017). SP-PD provides a framework for navigating professional learning beyond traditional institutional structures; it could be useful for designing and evaluating TPD that supports teachers' adoption of artificial intelligence (AI)-powered tools and microlearning (Kohnke et al., 2025b).

Microlearning – delivering content in short, multimodal chunks – supports knowledge retention and encourages constant adaptation, assisting teachers to develop skills in integrating AI tools into lesson planning and making informed decisions about technology use in their teaching practice (Kohnke & Zou, 2025a; Kohnke et al., 2025b). Such attributes align with self-regulated learning (SRL) principles (Reinhardt & Elwood, 2019). This study explores the intersection of GenAI and microlearning as an innovative pathway for the professional development of pre-service language teachers. It investigates how SP-PD-oriented, AI-driven microlearning empowers these teachers to build technological and pedagogical skills at their own pace by acquiring bite-sized knowledge nuggets (Kohnke & Moorhouse, 2024; Kohnke et al., 2024).

However, gaps persist in the context of pre-service language teachers: much published work remains conceptual or tool-focused and targets in-service teachers, with limited practice-based evidence and sparse analysis of SRL mechanisms. This creates urgency as programs face pressure to "embed AI" without empirically grounded models, risking superficial adoption and inequities. Positioned within the teacher agency discourse and research on SD-PD, this study examines how pre-service language educators leverage GenAI and microlearning to navigate contemporary teaching demands. It contributes to understanding how informal, technology-mediated strategies empower teachers in their professional journeys within the evolving landscape of AI-enhanced education. The study addresses the following research questions:

1. How do pre-service language educators perceive GenAI tools and microlearning strategies in their practice?
2. How do SRL principles influence pre-service language educators' engagement with AI-driven microlearning resources?

Literature Review

GenAI in Education

AI refers to computer systems designed to perform tasks that typically require human intelligence; GenAI is a type of AI that creates new content rather than simply analysing or predicting it. GenAI refers to algorithms such as generative pre-trained transformers that create new content (e.g. code, audio, images, text, simulations, and videos) (McKinsey, 2024). GenAI tools such as MagicSchool and Diffit can automatically create personalised learning materials, provide real-time feedback, and streamline grading processes for language teachers

(Ulla et al., 2023). In the context of TPD, GenAI can also support on-demand coaching, simulate classroom scenarios for reflection, and generate adaptive learning resources tailored to individual teachers' needs (Zawacki-Richter et al., 2022). These affordances may reduce workload, increase flexibility, and enhance the relevance of training. However, educators still struggle to incorporate these tools into their pedagogical practices (Moorhouse et al., 2024). This disconnect between the availability of advanced tools and their practical use in classrooms highlights a broader issue: the lack of systematic support and pedagogical training for teachers. Initial language teacher education has not evolved quickly enough to keep pace with these changes, leaving pre-service teachers feeling underprepared to use the technology (Farjon et al., 2019; Moorhouse & Kohnke, 2024; Ngao et al., 2022). Even in-service teachers often lack the time, resources, and institutional backing to experiment with and adopt new tools, further widening the gap between technological innovation and its use in education. Without structured support, critical literacy, and pedagogical guidance, the potential of GenAI may remain underutilised or misapplied in educational contexts (Farjon et al., 2019; Octavio et al., 2024).

Teachers must understand how AI algorithms are trained, how to identify bias in AI-generated content, and how to help students navigate a GenAI-driven world (Kohnke & Zou, 2025b; Pack & Maloney, 2023). If these competencies are not embedded in professional development, teachers may have only a superficial understanding of GenAI and lack the pedagogical expertise to use it effectively (Choi et al., 2025). They must develop foundational AI literacy to be able to transform rather than replicate traditional practices (Kohnke et al., 2025a). Pre-service language teachers, in particular, face challenges, as they are not often given structured opportunities to explore and apply GenAI in classroom contexts (Moorhouse et al., 2024). This results in a skills gap that requires innovative and flexible professional learning solutions.

AI Literacy for Educators

AI literacy provides a foundation for understanding the competencies teachers require to engage meaningfully with GenAI for teaching and administrative tasks, including lesson planning, assessments, and feedback. To use these tools effectively, teachers must develop technical skills as well as ethical and pedagogical judgment (Kohnke & Zou, 2025b; Kohnke et al., 2025a; Sperling et al., 2024). Several frameworks and definitions have been proposed for AI literacy. Long and Magerko (2020, p. 2) defined AI literacy as "a set of competencies that enable individuals to critically evaluate AI technologies, communicate effectively with AI, and use AI as a tool across various contexts". UNESCO's AI competency framework and the European Union's DigiComp 2.2 framed AI literacy as central to digital competence (Miao & Cukurova, 2024; Vuorikari et al., 2022). Ng et al. (2021) identified four components of AI literacy: understanding AI, applying AI, evaluating and creating AI, and addressing AI ethics. This study conceptualises GenAI literacy as the dynamic knowledge, skills, and critical awareness that empower teachers to use AI reflectively, ethically, and effectively. Empirical studies have shown that structured AI training can enhance pre-service teachers' confidence, ethical awareness, and classroom readiness (e.g., Ulla et al., 2023).

Self-Regulated Learning

SRL provides a model for teachers to develop and sustain AI literacy in a rapidly evolving educational landscape. SRL is a cyclical process in which teachers act as active and reflective agents of their learning, engaging in planning, monitoring, and evaluating their teaching strategies and student outcomes (Ortube et al., 2024; Pintrich, 2002; Zimmerman, 2002). Teachers who regulate their learning set goals, assess progress, and adjust their learning strategies accordingly (Karlen et al., 2023; Pintrich, 2002). Previous studies have found that AI technologies

can promote SRL by enabling learners to access and apply content while providing immediate and tailored feedback (Chiu, 2024). Technology-enhanced microlearning environments empower learners to set goals, track progress, and receive real-time feedback (Shamir-Inbal & Blau, 2022). These features support autonomy, foster reflection, and promote iterative learning, which are essential characteristics and skills for teachers engaging with GenAI. Furthermore, AI tools can enhance SRL by offering real-time learning analytics, such as AI-generated progress tracking, automated goal recommendations through intelligent tutoring systems, and adaptive feedback (Darvishi et al., 2024; Kohnke et al., 2025b). These technologies facilitate personalised learning experiences that help teachers identify gaps in their understanding and adjust their approaches to meet diverse student needs.

Integrating SRL into teacher training programmes fosters lifelong learning and maintains teachers' proficiency in a rapidly evolving field (Lopes & Cunha, 2017; Ortube et al., 2024). However, teachers must be supported in developing metacognitive strategies to regulate their learning, particularly in the informal and flexible environments in which much professional learning now occurs. To succeed in self-directed learning, teachers must be self-aware, self-monitoring, and self-motivated.

Microlearning

As a modality, microlearning offers a promising modality for operationalising SRL in teacher learning. It supports the autonomy and metacognition essential for engaging with GenAI tools, which often require experimentation, reflection, and iterative learning. Microlearning complements SRL by offering flexible, focused learning opportunities tailored to accommodate the demanding schedules of teachers. Emerging in the early 2000s (Hug, 2005), microlearning delivers bite-sized learning units that are accessible and engaging (Khong & Kabilan, 2022). These modules utilise multimodal features such as animations, videos, infographics, and chatbots, and are accessible on mobile devices anywhere (Kohnke, 2024).

Microlearning enhances engagement (Manning et al., 2021), self-regulation (Shamir-Inbal & Blau, 2020), learning performance (Kohnke et al., 2025b), and motivation (Rof et al., 2024). Additionally, it mitigates cognitive overload by presenting information in manageable chunks (Fidan, 2023; Taylor & Hung, 2022), rendering it particularly effective for learning about complex and rapidly evolving topics such as GenAI. Furthermore, microlearning can be designed to align with AI literacy frameworks, offering teachers scaffolded pathways to develop their competency incrementally. For example, short modules can focus on specific AI literacy competencies, such as understanding GenAI-based text generation, and conclude with reflection prompts or classroom application tasks. For pre-service teachers developing both pedagogical and technological fluency, microlearning offers a scaffolded approach to building confidence with GenAI tools through manageable, practical learning tasks.

However, some researchers caution that microlearning may not foster deep learning or higher-order thinking due to its brevity (Rof et al., 2024). The concise nature of microlearning can limit opportunities for sustained reflection and comprehensive exploration of complex topics, processes, or behaviours (Buchem & Hamelmann, 2010), potentially constraining understanding and application. Combining microlearning with reflective and collaborative activities, such as peer discussion or follow-up projects, can mitigate this limitation. Although there is no universal agreement on the optimal duration or delivery method for microlearning, we adopt the definition provided by Kohnke and Moorhouse (2024), which specifies that microlearning activities should last between 2 to 8 minutes and use technology to offer learners personalised content. Teachers can seamlessly integrate learning into their busy schedules through microlearning lessons that provide quick, interactive solutions (Kohnke et al., 2025b; Zhang & West, 2019).

Self-Directed Professional Development

SP-PD provides a flexible and personalised environment in which microlearning and SRL can thrive. It refers to teachers taking the initiative and responsibility for their professional growth (Hiver, 2013). Unlike traditional TPD, SP-PD is flexible, personalised, and aligned with individual goals and classroom needs. However, SP-PD can be emotionally and cognitively demanding. Teachers often experience frustration, disappointment, and self-doubt when critically reflecting on their practices (Guskey, 2002). These challenges are exacerbated when they must adapt to new technologies like GenAI. They may feel overwhelmed by the rapid pace of technological change or uncertain about their ability to evaluate the legitimacy of AI tools and resources (Kohnke et al., 2025b). Teachers' agency plays a crucial role in self-directed learning, especially for pre-service teachers who are shaping their professional identities in an AI-enhanced educational landscape (Beauchamp & Thomas, 2009; Kennedy & Castek, 2025). Empowering these future educators to make informed decisions about their learning fosters autonomy and long-term adaptability. Support from peers, mentors, and professional learning communities helps them navigate emotional barriers (Lave & Wenger, 1991; Wenger, 1998).

Previous studies have investigated how pre-service teachers enact SP-PD by setting individual learning goals, curating resources beyond coursework, and engaging in cycles of practice and reflection (Kohnke et al., 2025b; Li et al., 2025). In technology-mediated contexts, they commonly use online communities (e.g. forums, social media groups), microlearning platforms, and AI-powered tools to plan lessons, generate materials, and obtain rapid feedback (Kohnke & Zou, 2025a). Recurrent challenges, which increase the demands of SRL and shape support needs, include evaluating the credibility of digital resources, managing cognitive load, and addressing ethical concerns with AI (Tan et al., 2025). Peer mentoring and participation in professional learning communities provide accountability and modelling that sustain SP-PD (Lopes & Cunha, 2017).

Collaborative environments facilitate the exchange of ideas and strategies, helping teachers to reframe challenges as opportunities for growth and development (Wenger, 1998). Teachers can use strategies such as setting incremental goals, practising mindfulness, and celebrating small wins to sustain motivation (Ryan & Deci, 2020). Over time, this self-directed approach fosters resilience, adaptability, and a continuous improvement mindset (Karlen et al., 2023). Practices reported in the literature include (a) goal setting and targeted resource use, such as articulating short-term learning goals and consulting curated digital resources relevant to specific pedagogical skills (Shamir-Inbal, & Blau, 2022); (b) interactive practice with feedback, such as trialling technology-supported lesson materials and incorporating mentor or peer input when available (Reinhardt & Elwood, 2019); and (c) reflective documentation, such as brief reflective notes on what was tried, what worked, and what needs adjustment (Koya, 2023; Ngao et al 2022). Studies to date that consider GenAI-related practices offer limited descriptions; accordingly, we refer to these practices as indicative rather than exhaustive and consider them to be contingent on context and available support (Tan et al., 2025; Zhu & Wang, 2025).

Methodology

This section describes the research design, selection of participants, data collection, and data analysis methods that were used to explore the pre-service teachers' integration of AI and their AI readiness. Grounded in a phenomenological approach (Creswell, 2013), the study captured the richness and complexity of the participants' lived experiences by exploring how they made sense of AI-driven technologies in relation to their professional development, teacher identity, and instructional practice. This approach provided a robust framework for examining the intersection of emerging technologies, SRL, and teacher education.

Research Design

This qualitative study investigated how secondary pre-service teachers navigate the use of AI in teaching and their development of AI readiness. We adopted a phenomenological approach to capture the participants' lived experiences and the subjective meanings ascribed to AI readiness in education (Creswell, 2013). This included their perceptions of GenAI tools, engagement with microlearning, use of SRL strategies, and reflections on their evolving teacher identities. Through this approach, we examined the participants' subjective perceptions, emotions, and interpretations related to AI-driven tools and microlearning platforms. We prioritised depth over breadth to explore the complex and evolving phenomena inherent in teacher development.

Participants

We employed purposeful sampling to recruit 14 secondary pre-service teachers enrolled in a teacher education programme at a university in Hong Kong. This sampling strategy allowed us to select participants with prior exposure to AI-based educational technologies during their coursework or practicum experiences. The participants, all English-language education majors in their fourth year, brought a degree of maturity and pedagogical awareness to their reflections. The sample comprised eight females and six males aged between 22 and 23 years. Participation was voluntary, and informed consent was obtained from all participants. An information sheet described the study, procedures, and risks; it was explained to them that participation was voluntary and that they were free to withdraw at any time without penalty. To ensure confidentiality, pseudonyms were assigned to protect their identities.

The participants had to have at least one academic semester of routine (e.g. weekly) use of GenAI tools such as ChatGPT, Claude, MagicSchool, Diffit, Canva, Brisk Teaching, or Grammarly in their coursework or practicum activities. This ensured that they could provide informed insights into both technical interaction with GenAI tools and their pedagogical use.

Table 1. Participants' demographics.

No.	ID	Gender	Age
1	T1	Female	22
2	T2	Male	22
3	T3	Male	23
4	T4	Female	23
5	T5	Female	22
6	T6	Female	23
7	T7	Male	23
8	T8	Female	22
9	T9	Male	23
10	T10	Female	23
11	T11	Female	23
12	T12	Female	22
13	T13	Male	22
14	T14	Male	22

Data Collection

Data were collected during semi-structured interviews (30–46 minutes; mean (M) = 38 minutes) conducted in May 2025. This approach aligned with the phenomenological framework, allowing the participants to articulate their lived experiences and subjective interpretation of AI readiness in a flexible yet focused manner (Creswell, 2013). The semi-structured format balanced structure and openness, enabling an exploration of pre-defined topics while accommodating the participants' unique insights and perspectives (Kvale & Brinkmann, 2019). Combining open-ended questions with in-depth probing facilitated the collection of rich, descriptive data.

An interview protocol was developed to guide the interviews and elicit detailed narratives about the participants' experiences with AI in their learning and teaching preparation. The interviews focused on the following areas:

1. Participants' perceptions and attitudes towards GenAI tools;
2. Practical experiences using GenAI tools in lesson planning, content creation, and feedback;
3. Engagement with microlearning strategies and platforms;
4. SRL strategies used while engaging with AI;
5. The impact of GenAI on the participants' teacher identity, agency, and views on ethical use in education.

Given the participants' unfamiliarity with the concept of microlearning, we informed them that microlearning referred to short, focused learning experiences or activities, typically lasting 2–8 minutes, that utilise technology such as podcasts, videos, animations, and infographics (Kohnke et al., 2025a). To facilitate understanding, we shared specific examples, such as YouTube explanations, TikTok tutorials on AI tools, and Coursera mini-courses. This approach enabled the participants to identify and reflect on relevant experiences, even if they had not previously recognised them as microlearning.

The participants were encouraged to describe their specific interactions with AI tools, including the platform they used, the types of tasks they completed (e.g., generating rubrics, simplifying reading texts), and their reflections on the pedagogical and ethical implications of their AI use. This tool-specific probing allowed us to gather detailed narratives about the affordances and limitations of various GenAI platforms.

The interviews, each lasting approximately 45–60 minutes, were conducted via a secure conferencing platform. Audio recordings were made and transcribed verbatim. To ensure accuracy and validity, the participants were provided with copies of their transcripts for initial member checks (Merriam & Tisdell, 2016), allowing them to confirm or clarify their responses.

Data Analysis

The study employed thematic analysis, following Braun and Clarke's (2006) six-phase framework. This method was chosen for its flexibility and rigour in identifying and interpreting patterns within qualitative data. The analysis was conducted by a single researcher, using the procedure detailed below.

Phase 1: Initial Coding

The initial coding involved (a) reading and re-reading the transcripts to become familiar with and immerse myself in the data, (b) generating initial codes for the significant features across the dataset, (c) reviewing and organising the emergent themes that reflected shared or divergent

experiences, and (d) finalising the themes and subthemes related to the coded extracts and the dataset as a whole. Data saturation during the initial coding phase was approached by continuously analysing the data until no new significant themes emerged (Braun & Clarke, 2006). The 14 interviews allowed comprehensive theme development and provided in-depth data.

Interim Stage: Re-coding Process

I incorporated an interim re-coding stage two weeks after the initial coding to validate the coding process. This code–recode strategy (Anney, 2014) involved revisiting the dataset to eliminate preconceptions, comparing new and initial codes to identify discrepancies, and resolving inconsistencies to finalise the coding scheme. Specifically, I (a) revisited the dataset to eliminate preconceptions from the first round of coding, (b) compared new and initial codes to identify discrepancies and ensure consistent coding, and (c) reviewed inconsistencies and made final decisions on the most appropriate codes. This iterative process was essential, given the evolving nature of the participants' engagement with GenAI tools. It allowed me to capture the complexity of their reflections on identity, ethics, agency, and SRL strategies. The results were consistent, confirming the reliability of the initial coding and substantiating the trustworthiness of the findings.

Phase 2: Final Analysis

Selected representative excerpts from the interviews were used to produce the final thematic analysis report. To ensure transparency and trustworthiness, I conducted a follow-up member check (Merriam & Tisdell, 2016), providing the participants with copies of the themes, subthemes, and illustrative quotes. No participants asked for changes or offered additional suggestions.

Results

Four key themes emerged from the interviews, reflecting the complex experiences and perceptions of pre-service teachers when engaging with GenAI tools and microlearning strategies. These themes represent different experiences and perceptions but intersect in their focus on autonomy, adaptability, digital confidence, and pedagogical repositioning in professional development.

Theme 1: Navigating GenAI with Cautious Curiosity

The interviews revealed that participants approached GenAI tools with a mix of curiosity and uncertainty. All of the participants had experimented with ChatGPT or Claude. Others mentioned Perplexity, MagicSchool, Brisk Teaching, and Diffit. Several indicated that they were continuing to explore other pedagogical GenAI tools.

Most teachers reported using GenAI as a supportive planning tool. Participants typically used it to spark ideas and draft materials, then tailored the outputs to their objectives and learners' levels, verifying the accuracy of the material and balancing speed and variety with concerns about errors and generic tone. T4 clarified, "I use the university version of ChatGPT to brainstorm lesson ideas, but I have to check everything twice, making me doubtful since it's not always that accurate." T11 was more enthusiastic about AI: "I view it as a helpful aid in planning as long as I think hard and long about what it produces." Echoing this description of a collaborative approach, T3 noted, "It's now part of my planning habits. I develop basic ideas with AI tools and refine them with my professional knowledge. I used Claude recently to generate role-play dialogues for a speaking task."

Several participants used Diffit to simplify reading passages for learners at different levels; others employed MagicSchool to generate writing prompts and rubrics. T8 appreciated how AI can "generate content for different proficiency levels quickly", making it easier to manage various learning needs. Still, he expressed concern: "I'm worried I won't develop my teaching voice." Similarly, T1 asserted, "Sometimes responses sound great but are wrong … misleading, and you have to know enough to recognise the mistakes." T7 provided a more positive assessment: "Having worked with different AI tools over the past year, I've figured out how to put in the best prompts that will give me reliable materials and those that I have to review carefully." T2, however, highlighted the limitations: "I tried Brisk Teaching to generate a feedback comment bank, but the tone felt robotic. I had to rewrite most of them. It's a support tool, not a replacement."

Some participants highlighted their growing skills in prompt engineering. T6 explained, "I've started keeping a prompt log, so I know what inputs give me the best outputs. It's like learning a new language." This cautious optimism suggested a desire for more structured support to evaluate and implement GenAI tools in their teaching. T12 noted, "We've had no AI training. I'm learning it all by myself from YouTube tutorials and teacher TikToks." T2 added, "It seems like we're flying solo, learning as we go along and crashing occasionally." However, T9 highlighted emerging peer support: "Our programme has started sharing effective prompts, which have made me more confident in using these tools appropriately."

This theme illustrates that the teachers were attempting to balance potential pedagogical gains against legitimate concerns while navigating a largely unsupported professional learning process. They demonstrated caution and agency in determining how these new tools might enhance, not replace, their professional abilities.

Theme 2: Microlearning as a Practical and Personalised Scaffold

All of the participants had engaged in microlearning, typically through platforms like YouTube, Instagram reels, TikTok tutorials, or app-based tutorials. They appreciated microlearning's brevity, flexibility, and accessibility, especially when juggling coursework, teaching practicums, and part-time jobs. T5 remarked, "I love short videos that explain one concept in three minutes. I can watch them on the MTR [subway]." T14 agreed: "Microlearning fits my attention span, and it's easier to focus for five minutes than 40 minutes."

The participants explained that bite-sized learning helped them gradually build confidence in using GenAI tools at their own pace. T3 described a brief course on prompt engineering: "Each lesson was less than 10 minutes, and I actually remember a lot more than I expected." Others explained how microlearning helped them "feel in control" (T3); they could "choose what, when, and how I learn" (T10). T7 noted, "I'm usually able to apply immediately what I've learned to my lesson plans, so it stays in my head."

Others took advantage of structured microlearning, like Coursera micro-credentials. T3 shared: "I completed a 2-hour course on AI for teachers. It was broken into short videos with explanations and quizzes, and it helped me understand AI bias and ethical use." Some participants followed education influencers who share AI hacks through reels or TikTok tutorials. T12 elaborated: "I follow a few teachers who post AI teaching tricks, like how to use ChatGPT to create vocabulary games or Canva Magic Write for writing prompts."

However, others worried about depth and retention. T13 mentioned that "Sometimes it's too superficial, and I want to see more follow-up or reflection included." T6 suggested, "It's a good starting point, but to actually know how to apply AI in teaching, I require more interactive and collaborative learning." T9 offered a more nuanced view: "Microlearning is effective for particular techniques, but I still need comprehensive frameworks to inform my general approach to AI integration."

This theme suggests that microlearning is an effective way to learn new tools and technologies; it fits busy schedules and offers various learning modes. The participants valued its flexibility and accessibility but desired more in-depth and interactive training to optimise the use of GenAI in education.

Theme 3: Developing SRL Strategies with AI Support

The participants described a range of useful SRL strategies for engaging with GenAI and microlearning, including setting goals, tracking progress, and adjusting approaches based on reflection and feedback. They varied in how they used these strategies. T3 shared that "I keep digital notes of prompts that worked well and on what didn't. This helps me to improve them over time." T7 described how he "created little goals, like trying out one aspect of a tool each week, [which] keeps me motivated and not feeling overwhelmed." T12 said, "I created a personal learning plan with specific goals for AI integration in my teaching practice, which gave me some structure."

T7 recorded voice memos after experimenting with AI tools: "I talk to myself about what worked and what didn't. Then I adjust how I use the tool next time." Some used platforms like Notion or Google Sheets to organise their learning journeys. T10 created a digital tracker: "I have a Notion board with categories like *Tools Tried*, *Prompt Success*, and *Next Steps*. It keeps me focused." T8 said, "I use[d] Grammarly to refine the feedback comment[s] I write for my students. It helped me become more aware of how my tone sounded."

Some participants explained that AI tools supported SRL by providing immediate feedback or helping them identify knowledge gaps. T6 explained, "I will have ChatGPT create homework questions and then quiz myself." T1 described how "ChatGPT helps to clarify difficult concepts" and "If I still don't get it, I simply need to study more." T1 continued, "I use AI to scan my lesson plans and give me suggestions on improving them, which gets me thinking more clearly about my teaching strategy."

Others noted that SRL requires discipline and self-awareness, especially in informal learning environments with minimal structure. T13 noted, "It's easy to get sidetracked when you learn on your own. I must remind myself that this is part of my professional growth." T8 said, "I use timers and to-do lists to keep track. Otherwise, I end up going down an AI rabbit hole." T4 added, "The toughest part is determining what I've learned and how it has impacted my teaching, so I've started keeping a reflection journal to reflect on AI in the classroom."

This theme illustrates how the teachers developed metacognitive frameworks to guide their engagement with emerging technologies. Their learning strategies reflected proactive accommodations to a rapidly evolving educational context. SRL was both a personal compass and a pedagogical model they could introduce to their students in the classroom. Although informal learning raises concerns about long-term engagement, participants valued the flexibility of systematic self-regulation in transforming casual exploration into meaningful professional development.

Theme 4: Reimagining Teachers' Identity and Agency in an AI-Enhanced Landscape

A dominant theme across the interviews was how the participants' encounters with GenAI and microlearning influenced their emerging teacher identities. Several felt empowered by these tools, despite the demand of integrating new technologies into their practice. T9 noted, "With AI, I feel like a creative teacher." Similarly, T7 added, "It's a tool and not a threat, and… [it can] improve the way we teach." T14 noted, "Learning to integrate AI has made me confident in adapting to whatever technologies emerge next in my teaching life." T13 described a shift in her teacher identity: "I used to see myself as someone who delivers information. Now, I see

myself as a facilitator who helps students navigate tools like AI to communicate critically." T4 reflected, "Teaching with AI has allowed me to see what it is about teaching that is special and human, like the emotional connections and the quick responses to students' needs that the AI cannot replicate."

The participants tended to associate GenAI with their sense of agency, especially in SP-PD. They appreciated how informal learning enabled personalised development that sometimes was better tailored to their needs than top-down training. For instance, T2 stated, "I don't think I should have my teachers teach me everything. If a tool is available to assist me in teaching more effectively, I will figure out how to use it myself." T12 discussed how the availability of GenAI made him "feel more in control of my learning now than in my first two years at the university." T3 commented, "Taking ownership of my professional development with AI tools has helped me define what kind of teacher I want to become." However, this sense of agency was accompanied by frustration about the lack of institutional support or guidance. T11 explained, "We require somebody to lead us through these AI tools, for instance, using them ethically and purposefully in our teaching practices." T5 responded, "Yes, it is empowering but also overwhelming. There's all this material available, and it's not always obvious what's legit." T1 continued, "The university talks about us being prepared to be ready for next-generation classrooms, but there's a disconnect between that rhetoric and the support we actually have for incorporating AI."

Using GenAI tools prompted some of the participants to consider the implications of being an ethical instructor in today's world. T10 explained that "I've started to think more about what type of digital role model I want to be for my students." T4 observed that "Some students already use AI to complete their assignments. We need to teach them how to use it ethically, as we teach about citation[s] and academic integrity." T8 raised a similar concern: "I want to teach students how to use AI responsibly, so I need to know more about it myself first."

This theme illustrates a complex evolution in professional identity, with pre-service teachers positioning themselves as change-makers in the face of technological change. Through experimentation with GenAI, they acquired competencies and a deeper understanding of themselves as professionals; they strove to balance technology integration with their ethical responsibilities and human-centred teaching. The process reveals a generation of teachers who view technology as a resource requiring thoughtful management rather than a solution or threat.

Discussion

This study investigated how pre-service teachers interacted with GenAI tools and microlearning activities, as well as the role of SRL principles in their professional growth. The results provided insights into the evolving nature of teacher agency, the benefits of informal learning contexts, and the impact of AI technologies on the development of teacher identity.

Perceptions of GenAI Tools and Microlearning

The first research question inquired about pre-service language teachers' perceptions of GenAI tools and microlearning strategies. The participants expressed measured optimism, recognising the potential of tools like ChatGPT, Diffit, and MagicSchool for lesson planning, personalising materials, and feedback generation. However, their concerns about accuracy, bias, and overreliance echoed those raised in the literature (Pack & Maloney, 2024). This duality reflects a broader pedagogical uncertainty around AI integration (Case et al., 2025). Teachers are interested in the possibilities but often lack structured support for meaningful implementation (Moorhouse & Kohnke, 2024). Taken together, these results corroborate prior reports of cautious optimism and concerns about accuracy and bias, while extending the literature with

practice-based evidence from pre-service teachers' SP-PD (e.g., concrete planning workflows, differentiation, and SRL strategies). The findings clarify where structured supports are most needed.

The participants' use of GenAI for brainstorming, creating differentiated materials, and giving feedback supported the view that teachers have integrated AI into their professional repertoires (Kohnke et al., 2025b; Tan et al., 2025). However, their hesitation and varied confidence levels suggested a gap between access to tools and pedagogical readiness that reinforces calls for embedding AI literacy into teacher education programmes (Ng et al., 2021; Sperling et al., 2024).

Microlearning emerged as a highly valued modality for acquiring GenAI-related skills due to its flexibility, practicality, and time efficiency. The participants appreciated short, targeted videos and tutorials that they could integrate into their daily lives (Kohnke et al., 2025b; Manning et al., 2021). This approach enabled them to build AI-related competencies incrementally, at their own pace, supporting the potential of microlearning as a scaffold for professional development in rapidly evolving fields such as education technologies (Khong & Kabilan, 2022). Although microlearning served as a gateway to more complex professional competencies, the participants recognised its limitations: microlearning's takeaways can be superficial and the lessons offer limited opportunities for critical reflection (e.g. Buchem & Hamelmann, 2010). These findings suggest that microlearning is effective for acquiring technical skills but may benefit from complementary reflective or collaborative components to foster deeper pedagogical understanding.

SRL Principles and AI-Driven Learning

The second research question asked how SRL principles influence pre-service teachers' engagement with GenAI and microlearning. The participants adopted SLR strategies to manage their GenAI learning journeys and engaged in goal-setting, tracking progress, and reflective practices using tools like Notion boards, voice memos, and digital journals. These practices aligned with the SRL model proposed by Pintrich (2002) and Zimmerman (2002), which emphasises metacognitive control and iterative learning. They enabled the participants to manage learning autonomously and meaningfully, despite the informal nature of their learning environments.

A novel contribution of this study was the finding that the participants used AI tools not just for content generation but also as co-regulators of learning. Tools like ChatGPT were used to generate quizzes, critique lesson plans, and simulate reflective dialogue, supporting cognitive and metacognitive processes and transforming casual exploration into purposeful development. This finding expands on prior research indicating that GenAI can facilitate SRL by helping teachers set goals, receive feedback, and monitor progress through real-time feedback, adaptive learning paths, and data-driven insights (Chiu, 2024; Shamir-Inbal & Blau, 2022).

However, the participants found the emotional and cognitive demands of managing their learning trajectories challenging, particularly without institutional support. This aligns with the literature on SP-PD, which highlights the motivational and psychological cost of autonomous learning (Kohnke & Moorhouse, 2025; Koya, 2023). Without mentorship or community support, SP-PD can be isolating and difficult (Guskey, 2002). Although SP-PD fosters agency and adaptability, it also requires robust metacognitive skills and emotional resilience – traits that some novice teachers may not yet possess. Several participants noted the emergence of peer support networks, which suggests that collaborative microlearning environments may offer a promising middle ground between independent learning and formal training (Wenger, 1998).

This study contributes to theory by proposing that GenAI tools, used strategically within SRL frameworks, can function as co-regulators of teacher learning and conceptual lenses that warrant further exploration. It also reinforces the view that SP-PD, AI literacy, and SRL reinforce each other, enabling teachers to navigate complex, technology-enhanced educational landscapes.

Repositioning Teachers' Identity and Agency

A key theme across the findings was the repositioning of teacher identity. Participants described a shift from viewing themselves as content deliverers to facilitators of critical and ethical AI use. The evolution mirrors Beauchamp and Thomas' (2009) argument that teacher identity is dynamic and co-constructed through engagement with tools, contexts, and communities. The participants' growing sense of agency and ownership over their professional learning also supports the concept of SP-PD as a vehicle for identity formation (Kennedy & Castek, 2005). This shift is particularly significant in the context of GenAI, where teachers must mediate using powerful yet opaque tools in ethically responsible ways (Moorhouse & Kohnke, 2024).

However, the lack of institutional support was challenging. The participants viewed informal learning as empowering because of the sense of control it gave them over their professional trajectories, but they also found it overwhelming, especially when navigating the rapidly evolving technological landscape. This tension highlighted a critical need for systematic support, including access to tools and ethical guidance, structured reflection, and collaborative learning opportunities (Farjon et al., 2019; Moorhouse et al., 2024).

Conclusions, Implications, and Future Directions

This study advances the conversation about the role of GenAI in education by exploring how pre-service language teachers engage with GenAI tools and microlearning through the lens of SLR. The findings illuminate how these technologies and strategies shape teachers' knowledge acquisition and influence the development of professional identity, agency, and ethical awareness in an increasingly AI-mediated educational landscape. The pre-service teachers demonstrated emerging AI literacy and employed SRL strategies to design informal, self-directed learning pathways. GenAI tools functioned not as mere content generators but as co-regulators of learning, supporting goal setting, feedback, and reflection. These findings indicate a conceptual shift from viewing AI as a tool to treating it as an active participant in the teachers' learning process. The recognition of this shift advances the theoretical discussion of SRL and TPD in digital contexts.

Microlearning emerged as an effective modality for acquiring GenAI-related competencies because of its flexibility and accessibility. However, the participants recognised that its use could result in superficial engagement and a lack of critical reflection, which underscores the need to situate microlearning within broader pedagogical frameworks. Additionally, the study revealed tensions between autonomy and institutional neglect. The participants valued the feedback from SP-PD, but many also expressed uncertainties and a desire for meaningful guidance. This duality highlights the importance of structured, ethically grounded support systems within teacher education programmes.

Implications for Teacher Education

The findings have significant implications for teacher education policy and practice: (1) AI literacy and SLR development should be embedded in teacher education curricula as foundational competencies for navigating AI-integrated classrooms; (2) microlearning initiatives should include reflective, dialogic, and collaborative elements to foster deep engagement and

support the meaningful transfer of GenAI into pedagogical practice; and (3) professional learning ecosystems should balance teachers' agency with structured scaffolding, helping educators to access mentorship, ethical balance, and communities of practice to navigate the fast-evolving landscape of GenAI in education.

Limitations and Future Research

This study focused on a small cohort of pre-service teachers in Hong Kong, which may limit the generalisability of the findings. The reliance on self-reported data from interviews may also have introduced personal bias or selective recall. Additionally, the rapid development of GenAI technologies means that the participants' experiences may not reflect those of future pre-service teachers. Future research could investigate the dynamics of AI use among educators across in-service contexts, subject areas, and cultural settings. Furthermore, scholars should consider how AI-embedded microlearning options can be balanced to allow autonomous learning but also pedagogical depth.

Overall, this study suggests that preparing teachers for AI-enhanced education goes beyond technical training, requiring a reimagined approach to professional learning that balances flexibility, autonomy, and ethical responsibility within reflective spaces. Teacher preparation programmes must equip educators to use AI while empowering them to manage its use with pedagogical purpose and professional integrity.

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