

Enhancing the Transition Phase in Lesson Planning Using AI Systems: A Grounded Theory Exploration

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Abstract

Integrating artificial intelligence (AI) systems into education poses significant challenges for teachers during the transition phase of adapting technologies in lesson planning. We adopt a grounded theory approach to examine the characteristics, strategies, and outcomes of 51 K-12 teachers' transition phases when utilising AI systems in China. Data including a 68,807-word transcription from two rounds of interviews with eight teachers revealed that K-12 teachers can be classified into technology followers, technology conservatives, technology pioneers, and technology disengagers. The study identifies three distinct phases of adaptation. The first phase is operation focusing on mastering AI system functionalities. The second is application integrating AI tools into pedagogical practices. The final is adaptation achieving stable and tailored usage. The outcomes are categorised into Basic Alignment meeting routine needs and Advanced Alignment enhancing instructional innovation. The outcome reflects different levels of openness, proactiveness, and effectiveness in developing strategies to overcome the challenges. The findings highlight that teachers' perceptions of transition difficulties and external factors influence teachers' AI adoption. Teachers' perceptions of transition difficulties including valuing new methods and using AI tools matter. External factors such as training support, peer influence, and policy requirements significantly influence their

UNISA



Education as Change

Volume 29 | 2025 | #18941 | 24 pages



<https://doi.org/10.25159/1947-9417/18941>

ISSN 1947-9417 (Online)

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strategies and outcomes. The study offers three recommendations on adapting policies to align with teachers' stages of AI system adoption, balancing technical and pedagogical training, and fostering collaborative lesson planning through AI systems. Future research should explore the key metrics to quantify and track transition characteristics of the transition phase and long-term in-depth observation of K-12 teachers for a more comprehensive understanding.

Keywords: transition phase; lesson planning; grounded theory

Background and Research Questions

The application of artificial intelligence (AI) and big data technologies in education has emerged as a crucial driver of instructional innovation (Kharchenko et al. 2024; Kumar et al. 2024). *The Guidelines for Enhancing the Information Technology Application Skills of K-12 Teachers* issued by the Education Department of China (Ministry of Education of the People's Republic of China 2024) emphasise adopting intelligent technologies in teaching reform and enhancing teachers' AI technology application competencies. Lesson planning, as a core component of teaching and learning, encompasses processes such as student analysis, instructional design, and performance evaluation (Zaragoza, Seidel, and Santagata 2023). Integrating intelligent systems can potentially enhance teacher efficiency and foster educational innovation significantly (Cheon et al. 2002).

AI systems have been implemented in various regions of China to support lesson planning and instructional delivery. However, K-12 teachers often experience a "transition phase" during which their usage of these systems varies, leading to inconsistent efficiency in their adoption (Oliveira et al. 2021). The transition phase refers to the period during which K-12 teachers adapt to integrating AI systems into their lesson planning practices. This phase is characterised by two sequential challenges: operational adaptation and application adaptation. The transition phase concludes when teachers achieve a stable state of AI system usage. A noticeable gap has emerged between teachers' willingness to use AI systems and the outcomes that have become increasingly apparent under mandatory policy interventions (Akhras 2012). This transition phase hinders the effective use of AI systems and slows the overall progress of teaching reforms.

In this context, the study examines the transition phase that K-12 teachers go through while using AI systems for lesson planning. It aims to address the following key questions:

- Why do K-12 teachers experience a transition phase when using AI systems for lesson planning?
- What are the defining characteristics of this transition phase?

- What strategies do K-12 teachers employ to navigate this period, and what outcomes do these strategies yield?

By addressing these questions, this research aims to uncover the dynamics of the transition phase in AI system adoption for lesson planning, providing theoretical insights and practical recommendations for optimising the implementation of AI systems and related policy support.

Literature Review

Factors and Barriers to Technology Integration

A growing body of literature explores teachers' challenges during the adoption phase. Previous studies emphasise the importance of addressing extrinsic and intrinsic barriers to technology adoption. Barriers are categorised into primary (e.g., infrastructure and time) and secondary (e.g., teachers' beliefs and pedagogical approaches) factors (Ertmer 1999), which are essential to understanding how K-12 teachers transition to using AI systems in lesson planning. The secondary barriers, such as teachers' resistance to changing their teaching practices, significantly affect the success of technology integration (Kim et al. 2013).

Teachers are classified into technology adopters and resisters based on their level of technology adoption (Lee 1996). These typologies offer insight into the diversity of teachers' responses to new technologies. The theme is echoed in recent work identifying the role of teachers' attitudes and pedagogical beliefs in shaping their adaptation trajectories (Adnan et al. 2024). Therefore, tailored interventions of differentiated training and policy adjustments are necessary to better support K-12 teachers through the transition phase.

Most research adopts a quantitative approach grounded in models such as the technology acceptance model (TAM) to investigate factors influencing teachers' acceptance and use of technology (Al-Adwan et al. 2023; Kurniabudi, Sharipuddin, and Assegaff 2014; Ren 2009). The effectiveness of policy enforcement (Petchdakul and Athipchatsiri 2011), the availability of hardware and software (Wu and Shang 2019), and the cultural environment of schools significantly influence technology adoption (Balta et al. 2020). Teachers' perceptions of how technology enhances their performance and ease of use strongly affect their behavioural intentions (Yuen and Ma 2008). External training support and peer collaboration are critical in motivating teachers to adopt technology (Tondeur et al. 2020). External and internal factors dynamically interact in authentic teaching contexts and influence technology adoption.

The transition to AI-supported lesson planning involves internal factors (teacher traits) and external factors (environmental conditions). Internal factors include openness, information and communications technology (ICT) competence, and perceived value. External factors include training quality, peer collaboration, policy flexibility, and

resource availability. These factors interact. Addressing both internal factors and external factors ensures smoother transitions. Ultimately, balancing teacher readiness with institutional support is key to moving from basic AI use to meaningful classroom integration.

Characteristics of Technology Application

Integrating AI systems during the transition phase involves distinct stages characterised by teachers' varying levels of engagement. Teachers' decision to adopt technology is influenced mainly by technology competence and perceived usefulness. K-12 teachers who perceive new technologies as manageable and beneficial are more likely to integrate such technologies in lesson planning. Whitt (2017) found that elementary school teachers receiving student-supported professional development were more likely to embrace technology. K-12 teachers may initially struggle to see the value but later come to appreciate its utility through hands-on experience and sustained support.

The unified theory of acceptance and use of technology (UTAUT) expands on TAM and introduces additional factors such as social influence, facilitating conditions, and effort expectancy (Yilmaz and Yilmaz 2023). Beyond individual perceptions external influences such as peer support, policy requirements, and available resources play a crucial role. Kopcha et al. (2020) summarise three features of the technology integration process, which are value-driven use, dynamic decision-making, and conceptual understanding.

Phases of Technology Adoption

The process of adopting AI systems in lesson planning is not linear but unfolds through several stages including initial resistance, experimentation, and eventual integration. Teachers' progression through these phases can be classified into technology followers, technology conservatives, technology pioneers, and technology disengagers (Adnan et al. 2024). Huang et al. (2021) classify teachers into four types based on their responses to technology training. "Green bamboo" teachers proactively adopt and apply technology in practice. "Ephemeral flower" teachers are initially enthusiastic but struggle to maintain development due to external pressures. "Duckweed" teachers rely on external support and lack initiative for independent application. "Thorn bush" teachers resist new technology and typically attribute challenges to external factors. Each typology reflects different levels of openness, proactivity, and effectiveness in overcoming the challenges of integrating technology into teaching practices. Teachers exhibit distinct patterns during technology integration, progressing through various stages. Yao et al. (2019) describe four phases: conservatism, adaptation, transformation, and proficiency. This differentiation suggests that interventions should be tailored to the specific needs in different phases.

The Role of Support and Training

The transition phase is often marked by varying responses to the challenges. Ertmer (1999) categorises the challenges into two barriers. The primary barriers are a lack of resources and time. The secondary barriers include teachers' beliefs and pedagogical practices. Secondary barriers also include resistance to change and lack of confidence. Practical support such as professional development and peer collaboration is essential for overcoming these barriers (Tondeur et al. 2020). Training addresses the technical aspects of AI tools and helps teachers reshape their pedagogical beliefs to align with new technology (Ogwu et al. 2023). The dynamic interaction between internal factors such as teachers' attitudes and self-efficacy and external factors such as institutional support and policy enforcement significantly shapes the adoption process (Balta et al. 2020). Collaborative lesson planning or seeking additional training can substantially impact the success of technology integration. The findings from the UTAUT model and studies on teachers' technology acceptance reinforce the need for robust support systems facilitating teachers' transition from initial resistance to full integration.

Existing research has explored the barriers, influencing factors, and stages of technology integration. Few studies have examined how K-12 teachers actively navigate challenges and develop strategies to overcome them. K-12 teacher adaptation to technology is a dynamic and context-specific process that cannot be fully understood through a single lens. This study focuses on the specific context of lesson planning using AI systems by employing an inductive grounded theory approach to systematically examine the trajectory of K-12 teacher adaptation in China. The study aims to analyse the characteristics of different phases of the adaptation process, summarise teachers' strategies during the transition phase, and uncover the underlying patterns to provide a comprehensive understanding of how K-12 teachers overcome the challenges associated with AI system adoption. The findings fill gaps in the existing literature and offer practical recommendations for enhancing K-12 teacher support and fostering effective technology integration.

Research Methodology

Scholars have differing views on the timing and role of literature reviews during the grounded research process. Researchers maintain an openness to empirical findings in the area under investigation, free from preconceived notions derived from theoretical frameworks based on existing theories (Walsh et al. 2015). However, literature can also be reviewed at different research stages, inspiring the generation of grounded theory (Hutchinson 1986). He and Liu similarly support the role of a literature review at any stage but emphasise its role in comparison and clarification (He and Liu 2022).

This study integrates Glaser's theoretical framework, particularly applying the principles of theoretical sampling and constant comparison during the data analysis process (Glaser 2007). To avoid the influence of existing theories at the early stages of research, researchers construct a theory generated through data collection and analysis

to ensure the “authenticity” and “emergence” of the research findings (Gehman et al. 2018). This article adhered to the principle by postponing the literature review until after identifying core categories, instead focusing initially on preliminary data collection and analysis to form early theoretical conclusions. This approach ensured that the theory emerged organically from the data rather than being deduced from pre-existing theoretical assumptions.

Following the principle of theory generation grounded in empirical data, we employed constant comparative methods to examine how K-12 teachers navigate the transition phase when using AI systems for lesson planning. Data collection, analysis, and theory generation proceeded iteratively throughout the study. After conducting initial interviews, additional relevant materials, such as policy documents and academic literature, were collected and reviewed to deepen the analysis.

Data Collection and Initial Coding

This article explores how K-12 teachers transition through the adaptation phase using AI systems. Fifty-one K-12 teachers were interviewed. These teachers were selected to represent a variety of demographics, including gender, subjects (both sciences and humanities), and years of teaching experience. Additionally, teachers varied in their familiarity with and usage of AI systems for lesson planning.

In this study, 51 K-12 teachers were initially recruited as part of a broader research cohort to ensure diversity in demographics and familiarity with AI systems. However, the grounded theory approach necessitated iterative, in-depth data collection and analysis. To achieve theoretical saturation, the research focused on eight teachers who participated in two rounds of semi-structured interviews. These eight teachers were selected as a representative subset of the larger cohort, reflecting the diversity of the original 51 participants. Fifty-one teachers formed the foundational cohort, while the eight interviewees provided the primary qualitative data.

The first round of interviews included six K-12 teachers with differing years of experience, ranging from senior to relatively new. We interviewed three experienced K-12 teachers (Mr Yang, Ms Dong, and Mr Li) and three younger K-12 teachers (Ms Ji, Ms Yuan, and Ms Zhang). This round generated 181 minutes of audio recordings and 43,093 words of text.

Table 1: Demographics of participants

Name	Gender	Subject	Teaching Experience (Years)	AI Usage Duration	First Round Interview		Second Round Interview	
					Duration (Minutes)	Word Count	Duration (Minutes)	Word Count
Mr Yang	Male	Physics	38	3 years	23	5335	24	5780
Ms Ji	Female	Mathematics	2	4 months	33	8105	25	6243
Ms Yuan	Female	Mathematics	2	1.5 years	20	5502	21	5489
Ms Dong	Female	Chinese	31	2 years	46	10278	–	–
Ms Li	Female	Chinese	26	2 years	27	6979	–	–
Ms Zhang	Female	Mathematics	7	2 years	32	6894	–	–
Mr Zhao	Male	Physics	12	2 months	–	–	39	4609
Ms Chen	Female	English	3	6 months	–	–	20	3593

Upon completion of the interviews, the recordings were transcribed verbatim, and the initial coding process was undertaken. The first step was labelling the data, identifying key concepts in the interview transcripts, and assigning labels that conceptualise the data. In the second step, similar codes were grouped into categories. In the third step, the attributes and dimensions of these categories were identified, providing a deeper understanding of each concept. For example, when coding Chen’s responses, we identified various recurring themes such as “technical barriers”, “adjustment strategies”, and “peer support” as part of the transition process.

To achieve theoretical saturation, we conducted a second round of interviews with K-12 teachers who had already been interviewed in the first round. Additionally, we included teachers such as Zhao and Chen, resulting in 129 minutes of audio and 25,714 words of text. These second-round interviews refined and enriched the categories identified during the initial coding phase. After four rounds of data collection and analysis, six major categories and their attributes were identified, as shown in Table 2.

Table 2: Categories, attributes, and dimensions

Category	Attribute	Dimension
1. Impact of AI Technology	Technological impact	Strong, Weak
	Lesson planning framework impact	Strong, Weak
2. Teachers' Transition Phase with AI Systems	Operational adaptation	High, Low
	Application adaptation	High, Low
3. Assessment of Transition Difficulty	Value recognition	High, Low
	Technology competence	High, Low
4. External Environment	Training support	Sufficient, Insufficient
	Peer influence	Active, Passive
	Policy requirements	Strong, Weak
5. Navigating the Transition Phase	Proactiveness	High, Low
	Openness	High, Low
6. Transition Outcomes	Willingness for normalised use	High, Low
	Educational adaptability of integration	Fundamental adaptability, Advanced adaptability

Second-Level Coding: Identifying Core Categories

After the initial coding, we followed Strauss and Corbin's (1990, 56) steps to identify the core categories central to the research questions. This stage was accomplished by organising the identified categories into a coherent storyline, capturing the essence of the teachers' experiences and responses to the transition phase when using AI systems. The storyline was built upon the following narrative:

To facilitate teaching reforms, many schools have introduced AI systems to support lesson planning. However, K-12 teachers face difficulties during this integration period, primarily due to the technical challenges of using new systems and the need to adapt their teaching methods to accommodate these technologies. Whether novice or experienced, K-12 teachers encounter these obstacles. However, their ability to adapt depends on various factors, including assessing the transition difficulty, the influence of policies, available training, and peer support.

Based on this narrative, the core category was identified as "Navigating the Transition Phase", which encapsulates the key phenomenon in the study. This category serves as the "sun" around which other categories (or "planets") revolve. Although these categories are essential, they remain on the same level as the core category, unlike a hierarchical structure where the core category is superior. This approach allowed for the identification of key themes such as "technical adaptation", "teacher strategies", and "environmental factors".

Third-Level Coding: Linking Categories

After identifying the core category, we used Strauss and Corbin's (1990) coding paradigm to establish relationships between the key categories, linking them to a meaningful process model. The following six categories were identified:

A (Causes): Technological disruption; disruption in lesson planning frameworks.

B (Phenomenon): When using AI systems for lesson planning, K-12 teachers experience a transition phase.

C (Context): Operational adaptation; pedagogical application adaptation.

D (Intervening Conditions): Teachers' assessment of transition difficulty; external factors such as policy, training, and peer influence.

E (Actions/Interactions): Teachers' enthusiasm and openness to change.

F (Outcomes): Willingness to use the system consistently; alignment of the system with teaching needs.

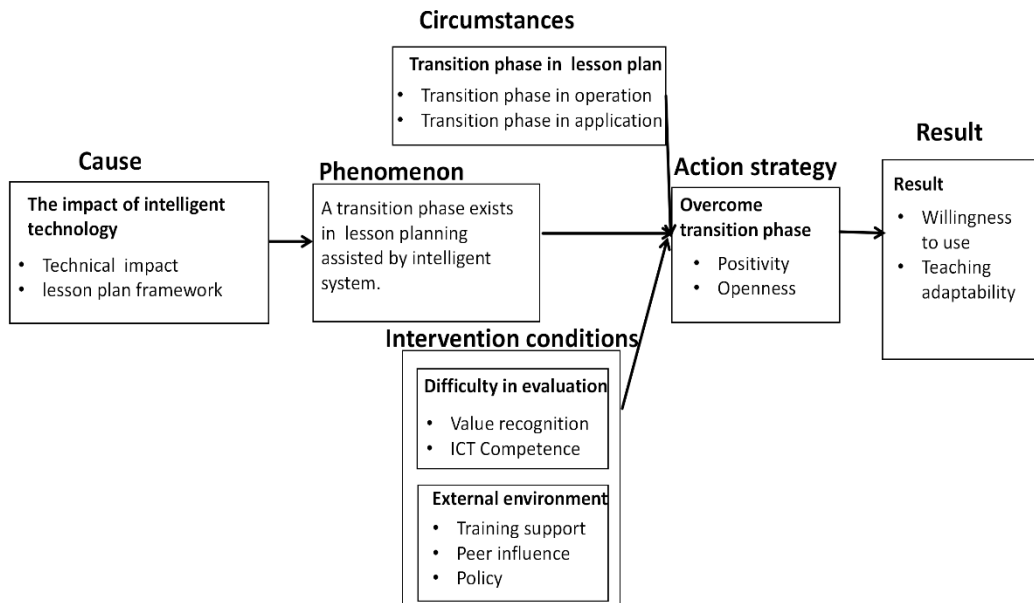


Figure 1: A model of overcoming transition phase in lesson planning with AI system

These categories were linked on a dimensional level to form a conceptual model, as shown in Figure 1. The model illustrates how internal and external factors influence teachers' adaptation strategies and their willingness to continue using AI systems in their lesson planning. This model provides a comprehensive framework for analysing

how K-12 teachers navigate the transition phase, their strategies, and the outcomes they experience.

Findings

Core Characteristics and Phases of the Transition Phase

The findings reveal that a transition phase is characterised by operational adaptation and application adaptation. Operational adaptation refers to familiarising oneself with the system's essential functions and workflows. Application adaptation involves effectively integrating the system's functionalities into teaching practices. These two aspects define the core characteristics of the transition phase.

Based on the analysis of interview data, the transition phase can be divided into three phases: Phase I, Phase II, and the Adaptation Phase (see Table 3).

Table 3: Phases of teachers' transition and adaptation to AI systems

Phase	Operational Level	Application Level
Phase I	High	Low
Phase II	Low	High
Adaptation Phase	Low	Low

The Familiarisation Phase: Teachers learn to operate the system and navigate its features.

The Integration Phase: Teachers work on incorporating the AI tools into their teaching practices.

The Stabilisation Phase: Teachers achieve a stable and tailored usage of the AI system.

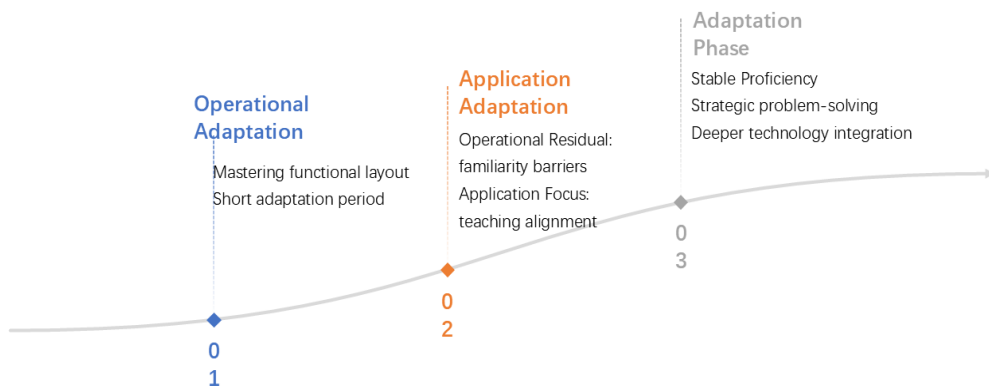


Figure 2: Three adaptation phases and interrelationships

Phase I (Initial Operational Adaptation)

During this early stage, K-12 teachers focus on overcoming fundamental operational challenges. Firstly, K-12 teachers need to address issues such as “not knowing where to find certain functions” (Interview Data 00201) and “not knowing how to use functions or being unclear about specific operations” (Interview Data 00302). The first stage involves understanding and mastering the AI system’s functional layout, application scenarios, and operational steps. Subsequently, K-12 teachers focus on subject-specific functions, exploring and adapting to them in greater depth. For instance, Yuan mentions, “What impressed me most was that the stylus on the tablet was not very responsive, which required some adaptation; also, setting up classroom exercises was quite complex, so I made some adjustments in using this function” (Interview Data 00402). Yang’s concern was “getting familiar with how to find resources” (Interview Data 00602), while Zhao’s issue was “how to write neatly on the electronic whiteboard and how to use the erase function” (Interview Data 00701).

It is important to emphasise that while K-12 teachers are familiarising themselves with the system’s operations, they are also actively considering how these functions can be applied in future teaching. However, the primary task at this stage is to overcome the AI system’s operational challenges. Based on the experiences of all interviewed teachers, the time required for K-12 teachers to adapt to operating the AI system is relatively short.

Phase II (Application Adaptation)

Compared to Phase I, Phase II appears to be a more extended and variable stage, with significant individual differences among teachers. During this phase, the focus shifts to “application adaptation”, and teachers’ progress strongly depends on their specific teaching contexts. For example, some K-12 teachers remain relatively unclear regarding how to apply the system’s functions in teaching: “After roughly mastering the basic functions, I still face challenges with some details. I know what features are available, but I still have trouble integrating them into teaching” (Interview Data 00302). Others can identify and focus on their current challenges: “I find it difficult to select resources during lesson planning. Sometimes I hesitate, wondering if a particular resource can achieve my teaching objective” (Interview Data 00201).

Phase II may also involve some challenges related to “operational adaptation”. For instance, Ji notes, “Perhaps the level of familiarity with the system for both my students and me affects class time. When designing lesson content, I must account for how these operations might compress the overall content of my lessons”. Phase II is a relatively complex stage that integrates operational and application adaptation challenges.

Adaptation Phase

After successfully navigating the transition phase, K-12 teachers reach a relatively stable state in their teaching practices, marked by proficient system use and higher levels of technology integration. The adaptation phase follows the conclusion of the transition phase. From the perspective of adjustment attributes, adaptation does not mean that all problems related to the operation and application of AI systems have been resolved. Instead, it emphasises that K-12 teachers have developed strategies for addressing and solving problems in lesson planning with AI systems. K-12 teachers can easily handle challenges and move towards deeper technology integration in teaching.

In the interviews, Yuan defines the hallmark of entering the transition phase as “instinctively thinking about how to use the tablet for this lesson”. She also mentions, “At first, I did not use it much, but gradually, the usage increased. Now, it has reached a steady state” (Interview Data 00401). The adaptation phase represents a relatively stable state for K-12 teachers to achieve after transitioning through the adjustment period. K-12 teachers establish a stable teaching model at this stage and conduct regular teaching practices based on AI systems.

Strategies for Navigating the Transition Phase

K-12 teachers have adopted different strategies to navigate the adaptation period. Two intervention strategies—“adaptation assessment” and “external environment”—are implemented to support K-12 teachers during the adaptation period. “Adaptation assessment” refers to K-12 teachers evaluating the difficulty of adapting to the AI system platform. The assessment includes teachers’ judgements about the external features of the AI system (such as convenience, usefulness, ease of use, the applicability of system functions, and the appeal of system resources) as well as their evaluation of their ICT literacy. “Adaptation environment” refers to the influence of external factors during the adaptation process, including training support (the comprehensiveness of training content, training duration, and on-site personnel support), peer influence (collaborative lesson planning based on the AI system, peers’ attitudes towards system use, peer collaboration, and peer demonstrations), and policy requirements. The former are more closely related to the teachers’ internal characteristics, while the latter focus more on the external environment. These factors interact with one another and collectively influence K-12 teachers to navigate the adaptation period, affecting effectiveness.

K-12 teachers employed different strategies during the transition phase to overcome operational and application adaptation challenges. These strategies can be categorised into four types (see Table 4), with representative examples highlighted below:

Table 4: Teachers' transition strategies

Strategy	Openness	Proactiveness	Description
A: Proactive Integration	High	High	Proactively explores AI systems and embraces new functions and approaches.
B: Passive Openness	High	Low	Passively accepts AI systems but remains open to experimenting with features.
C: Focused Utilisation	Low	High	Actively engages in AI systems but focuses narrowly on specific tasks.
D: Minimal Engagement	Low	Low	Minimally engages with AI systems and avoids broader exploration.

High Proactiveness and High Openness (Strategy A)

Strategy A demonstrates a strong willingness to engage with intelligent technology and a high level of openness to using its functions in lesson planning. Zhao exemplifies this strategy. Zhao proactively enrolled in training sessions and explored the system's functionalities. Zhao raised his lesson planning standards, integrating resources, student feedback, and interactive features provided by the system into his teaching. Furthermore, Zhao emphasised the importance of peer collaboration to facilitate his smooth transition and progression into the adaptation phase.

Low Proactivity and High Openness (Strategy B)

This strategy indicates that K-12 teachers are less enthusiastic about adapting to intelligent technology but are still open to using its functions in lesson planning. No such type of K-12 teacher has been identified in the current interview data.

High Proactiveness and Low Openness (Strategy C)

Strategy C represents K-12 teachers who are enthusiastic about adapting to intelligent technology but less open to using its functions in lesson planning. Yang demonstrates a highly proactive approach to learning the system but limited use of narrow functionalities such as resource integration. Although Yang quickly adapted to system operations, his approach did not fully exploit the system's potential to enhance teaching.

Low Proactiveness and Low Openness (Strategy D)

Strategy D refers to K-12 teachers who are less enthusiastic about adapting to intelligent technology and less open to using its functions in lesson planning. Ji employed a passive strategy to comply with policy requirements. Her utilisation remained superficial as a substitute for traditional tools rather than a platform for innovation. This strategy resulted in limited system integration.

Outcomes of the Transition Phase

K-12 teachers ultimately form a relatively stable teaching model after navigating the adaptation period and entering the adaptation phase. There are notable differences in their states, primarily evident in the willingness for regular use and the adaptability of teaching integration during adjustments. “Willingness for regular use” refers to teachers’ desire to continue regularly using the AI system for lesson planning after completing the adaptation period, even without mandatory policy requirements. “Teaching adaptability” refers to how the relatively stable lesson planning model formed after the adaptation period fits the teacher’s teaching needs. It consists of fundamental adaptability and advanced adaptability. “Basic adaptability” refers to a lesson planning model that meets the teacher’s fundamental daily teaching needs. In contrast, “advanced adaptability” refers to a model that supports teachers’ further improvement in teaching quality.

Table 5 shows that the two attributes in the adaptation process create three different types.

Table 5: Attributes and dimensions of transition outcomes

Outcome	Normalised Use Willingness	Adaptability	Description
A: Basic Substitution	High	Basic Adaptability	Teachers are willing to use AI systems regularly but focus on fulfilling basic teaching needs.
B: Advanced Improvement	High	Advanced Adaptability	Teachers actively integrate AI systems to improve and innovate teaching methods.
C: Passive Substitution	Low	Basic Adaptability	Teachers passively use AI systems to meet policy requirements without deeper engagement.
D: Unavailable	Low	Advanced Adaptability	This scenario was not observed in the current study.

Proactive Substitution (Type A)

Yang willingly uses AI systems for lesson planning to meet basic instructional needs. Yang is “quite accepting” of the regular use of the AI system for lesson planning (Interview Data 00601). However, Yang generally does not incorporate the interactive

features of the AI system into lesson planning, as he believes these interactive components do not align with the characteristics of high school students and are incompatible with the needs of daily teaching.

Proactive Enhancement (Type B)

Zhao actively adopts AI systems to meet basic needs and improve instructional outcomes. He states, “The more advanced the teaching platform, methods, and tools with functional capabilities, the better” (Interview Data 00701). When planning lessons with the AI system, in addition to using resources such as lesson materials and assignments used in traditional lesson planning, Zhao designs pre-class, in-class, and post-class assignments using the AI system. These K-12 teachers leverage the system’s functionalities to innovate and enhance their teaching practices.

Passive Substitution (Type C)

K-12 teachers are unwilling to regularly use the AI system for lesson planning, using it passively under policy requirements. They view the AI system as a simple replacement for previous technological tools. The functions used for lesson planning mainly meet the basic needs of daily teaching. K-12 teachers such as Ji reluctantly use AI systems to fulfil policy requirements. Their system use remains superficial, limited to basic functionalities, and has minimal impact on instructional improvement.

The Correlation between Engagement Levels and Teacher Typology

Differences in teachers’ engagement persist throughout the transition phase. During Phase I (Operational Adaptation), pioneer-type teachers rapidly acquire technical proficiency through high proactiveness, whereas disengagers withdraw prematurely due to technical barriers or policy pressures. In Phase II (Application Adaptation), engagement diverges further: Followers incrementally enhance openness under peer modelling, while conservatives restrict AI usage to substituting conventional tools due to limited ICT competence and scepticism about pedagogical value. Ultimately, in the Adaptation Phase, engagement stabilises into two poles: Pioneers sustain innovation, while passive teachers maintain minimal engagement driven solely by policy mandates. This dynamic reveals that engagement is not merely a manifestation of the transition phase but also its intrinsic driving mechanism.

Discussion

Research Conclusions

Following the grounded theory approach, this study analysed teachers’ orientations and strategies for navigating the transition phase when using AI systems for lesson planning. Innovative systems are designed to reduce teachers’ workload and improve the efficiency and quality of lesson preparation. However, due to the differences between AI system-based lesson planning and traditional methods, K-12 teachers often experience a transition phase characterised by various challenges. K-12 teachers

employed diverse strategies to adapt to this transition, which resulted in varying outcomes. Based on these strategies and outcomes, K-12 teachers are classified into four typical types.

Table 6: Four types of K-12 teacher classifications

Teacher Type	Key Characteristics
F: Technology Followers	Cautiously adopt and slowly explore functions, only expanding their usage after recognising tangible benefits.
C: Technology Conservatives	Selectively explore basic functionalities to meet minimal teaching needs, maintaining the status quo.
P: Technology Pioneers	Actively explore and integrate system features, continuously improving teaching practices.
D: Technology Disengagers	Initially enthusiastic but withdraw due to external pressures, ceasing further exploration.

Type F (Followers)

These K-12 teachers exhibit cautious attitudes towards technology and use its features tentatively. Once convinced of its benefits, they gradually expand their usage. When K-12 teachers recognise the value of technology, they are more inclined to integrate it into their teaching practices (Ottenbreit-Leftwich et al. 2010). Teachers exhibit cautious attitudes towards technology. Teachers gradually expand their usage when convinced of the benefit of using new technology in lesson planning. The process often stems from teachers' beliefs about the instructional value of technology (Ertmer et al. 2012). Type F teachers perceiving technology as enhancing student learning tend to transition from low-level to high-level use as their confidence grows. Factors such as technical support and training significantly impact teachers' readiness and beliefs. Teachers' beliefs about technology's relevance to student achievement are central to this gradual adoption process (Inan and Lowther 2010).

Type C (Conservatives)

While open to new technology, these K-12 teachers only explore functionalities that meet basic teaching needs and resist further changes. Examples include Yang and Ji. Personal and contextual factors often influence the cautious approach of Yang's and Ji's technology adoption. Teachers' existing beliefs, readiness, and contextual support significantly shape their willingness to integrate technology. Yang and Ji demonstrate limited technology integration, restricting its use to activities. Limited technical support and a lack of targeted training exacerbate resistance (Inan and Lowther 2010). The barriers reinforce conservative usage patterns of high access and low use (Cuban, Kirkpatrick, and Peck 2001) as teachers find exploring unfamiliar functionalities without robust support structures challenging. The reluctance to adopt technology aligns with findings that teachers often require direct benefits to their teaching practices before

expanding their adoption (Hew and Brush 2007). Type C teachers prefer stability and familiarity and further limit the scope of their technology use.

Type P (Pioneers)

These K-12 teachers are proactive and open to exploring new technologies. They actively experiment with features, integrate them into teaching, and continuously refine their practices. Examples include Zhao and Yuan. Peer support, curriculum design, and available resources are crucial in fostering a positive attitude towards new technology (Nordlöf, Hallström, and Höst 2019).

Type P teachers benefit from dynamic support systems and a culture of innovation. Collegial discourse and collaborative environments can empower teachers to implement innovative tools in classroom teaching (Prestridge 2017a). Successful adoption of technology relies on teachers' perceptions of its relevance to pedagogical goals. Pioneer teachers use intelligent technology tools to deliver content and foster higher-order thinking and collaboration (Nordlöf, Hallström, and Höst 2019). Technology acts as a catalyst for innovative teaching and helps navigate the challenges of resource constraints. Type P teachers such as Zhao and Yuan are involved in cultivating a supportive environment to provide collaborative opportunities and resources. These elements are essential in enabling these K-12 teachers to sustain innovation and contribute to the evolution of educational technology practices (Niemi, Kynäslähti, and Vahtivuori-Hänninen 2013).

Type D (Disengagers)

Initially enthusiastic, these K-12 teachers explore technology broadly. However, their exploration diminishes over time due to external pressures or constraints. An example is Chen. Negative attitudes arise from insufficient support and resources, resulting in inefficiency in teaching (Gutierrez Martín, Palacios Picos, and Torrego Egidio 2010). Insufficient knowledge can lead to anxiety and further reinforce negative attitudes towards the use of AI systems in the classroom (Khlaif, Sanmugam, and Ayyoub 2023).

Technology followers (Type F) are cautious and incremental adopters. They begin tentatively using AI systems, gradually expanding their integration only after observing clear benefits to teaching outcomes. Their adoption is driven by perceived instructional value and confidence-building through peer support, training, or policy incentives. For example, a teacher initially uses AI tools for basic resource sharing but later adopts interactive features after witnessing improved student engagement. Pioneers (Type P) are proactive innovators. They exhibit high openness and enthusiasm for experimentation. Their adoption is self-driven, often prioritising pedagogical innovation over external mandates. For example, a teacher redesigns lesson plans to incorporate AI-driven analytics and collaborative tools, even before institutional support is fully established.

Pioneers initiate exploration independently, while followers require external validation to expand usage. Pioneers prioritise transformative applications, whereas followers focus on incremental, low-risk enhancements. Followers rely heavily on structured training and peer validation, whereas pioneers thrive in flexible environments that encourage experimentation.

Recommendations

This study identified two key factors influencing teachers' strategies and outcomes during the transition phase: evaluation of transition difficulty (value recognition and ICT competence) and external environmental factors (training support, peer influence, and policy requirements). To help K-12 teachers efficiently overcome the transition phase and achieve normalised use of AI systems, the following recommendations are proposed:

1. Teacher-Centric Policies to Avoid Formalism

The impact of policy varies across different phases of the transition. During the initial phase, most K-12 teachers require strong policy-driven support. As K-12 teachers begin to explore AI systems, they prefer encouragement and flexibility. After reaching adaptation, K-12 teachers value developmental support more than enforced mandates. Policies should evolve from performance-based assessments to providing tailored support aligned with teachers' specific stages of AI system use. Teachers who successfully integrate technology often attribute their success to internal factors such as a passion for technology, a problem-solving mentality, and external supports such as administrative encouragement (Ertmer 2005). Individual dispositions and environmental conditions influence K-12 teachers' transition from tentative to more confident technology use. This dynamic and expert performance-based approach for different phases prevents rigid formalism and fosters long-term K-12 teacher growth.

Enquiry-driven, contextual, and flexible policies that adapt to teachers' evolving needs are essential to avoid formalism. Tailored support enables K-12 teachers to experiment and integrate without the pressure of rigid mandates (Prestridge 2017a). The stage-specific policy framework ensures that K-12 teachers are empowered to explore and innovate.

2. Balanced Training Emphasising Integration of Technology and Teaching

The purpose of training and curriculum significantly affects teachers' ability to use AI systems effectively. However, current training programmes exhibit a narrow and simplistic approach focusing primarily on explaining and demonstrating system functionalities and operations. These programmes fail to address the specific needs of grassroots teachers, such as integrating technology into pedagogy. Training often adopts a "lecture-driven" format characterised by one-way knowledge transfer from instructors to participants. This approach overlooks the value of collaborative learning among the teaching community to generate innovative insights through peer interaction with AI

system-based teaching. There is a need to enhance programmes that focus on integrating technology and pedagogy, and to develop teachers' AI-empowered teaching competencies. Creating spaces for collaborative learning and encouraging enquiry-based activities can allow K-12 teachers to exchange ideas and engage in reflective practices to foster a deeper connection between technology and pedagogy.

Targeted interventions such as tailored training programmes and collaborative learning can lead to effective technology integration. Training programmes should balance technical skills and pedagogical application (Ertmer and Ottenbreit-Leftwich 2010), providing opportunities for teachers to explore and reflect on intelligent teaching practices (Prestridge 2017b; Tondeur et al. 2012). Collaborative, enquiry-based training formats such as workshops and peer discussions should be encouraged to promote active learning and innovation among teachers.

3. Reflective Collaborative Lesson Planning to Normalise AI System Use

Reflective collaborative lesson planning is critical for improving teachers' AI system usage. Participants reported limited use of AI systems in group planning, and they were used primarily for uploading and sharing content rather than co-creating resources. Strategies to enhance collaborative lesson planning include leveraging teachers' strengths from different age groups to foster mutual assistance, organising demonstration lessons and case study discussions to showcase best practices, and establishing standardised collaborative planning routines that incorporate AI systems comprehensively.

This study attempts to construct a theoretical framework for understanding how teachers navigate the transition phase using AI systems. However, it has several limitations. Retrospective accounts of the transition phase may lack precision, making delineating distinct phases (early, middle, and late) challenging. Future studies should develop key metrics to quantify and track transition characteristics. While this study identifies factors influencing the transition process (e.g., training, peer influence, and ICT competence), it does not fully explore how these factors interact, which are core drivers, and how they collectively shape K-12 teacher outcomes. Participants in this study were experienced K-12 teachers with relatively short transition phases. Their accounts of initial challenges often referenced colleagues' experiences rather than their own. Future research should include in-depth interviews with K-12 teachers actively experiencing different stages of the transition phase to gain a more nuanced and comprehensive understanding. While this study provides valuable insights, its generalisability may be limited by the Chinese educational context, including policy frameworks and region-specific AI systems. Findings may not fully apply to novice teachers or diverse AI tools with differing functionalities. Future cross-cultural studies and longitudinal observations are needed to validate the model's universality and explore interactions between contextual factors and transition outcomes.

Acknowledgement

This work was supported by the following projects:

1. Project No. JGCG2024357: Reform and Practice of Classroom Micro-Skill Evaluation Mechanisms in Agent-Assisted Subject Teaching (English), Zhejiang International Studies University, led by Dr. Liu Yi.
2. National Social Science Fund Project: Research on the Integrated Curriculum System Reform of “English Education Major” Highlighting Teacher-Training Features.
3. Research on Teacher Collaboration Based on Social Interdependence Theory (Boda Teacher Research Enhancement Special Programme, Zhejiang International Studies University) (2021QNZD2).

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