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Examining Growth Mindset as Mediator Between AI Self-Efficacy and Adoption Willingness in Pre-Service Language Teachers

Dil Öğretmeni Adaylarında Yapay Zekâ Öz-yeterliği ile Benimseme İstekliliği Arasında Aracı Olarak Büyüme Zihniyetinin Etkisi

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Abstract: This quantitative correlational study investigated whether growth mindset mediates the relationship between digital self-efficacy and AI usage among pre-service English language teachers. Data were collected through convenience sampling from undergraduate students at a Turkish university to better understand psychological pathways influencing technology adoption in teacher education. Participants completed validated scales measuring digital self-efficacy, growth mindset, and AI usage willingness. PROCESS Model 4 mediation analysis with bootstrap procedures tested the hypotheses. Results revealed moderately high digital self-efficacy, high AI usage, and moderately high growth mindset levels among participants. All structural paths in the tested model were found to be statistically significant. Digital self-efficacy positively predicted growth mindset, indicating that higher confidence in using digital technologies was associated with stronger beliefs about ability development. Growth mindset positively predicted AI usage, suggesting that individuals with growth-oriented beliefs were more likely to adopt AI tools. Digital self-efficacy maintained a significant direct effect on AI integration even after mediated by growth mindset. The indirect effect through growth mindset was statistically significant, supporting partial mediation. All hypotheses were supported, demonstrating that growth mindset serves as a meaningful psychological pathway through which digital self-efficacy influences AI adoption among pre-service English teachers, contributing to theoretical understanding of technology acceptance in teacher education contexts.

Keywords: Digital self-efficacy, growth mindset, artificial intelligence usage, mediation analysis, educational technology

Öz: Bu çalışma, hizmet öncesi İngilizce öğretmenleri arasında dijital öz-yeterlik ile yapay zekâ (YZ) kullanımı arasındaki ilişkide büyüme zihniyetinin aracılık rolünü incelemiştir. Nicel, ilişkisel bir tasarım kullanılarak, veriler Türkiye'deki bir üniversitedeki lisans düzeyindeki hizmet öncesi öğretmen adaylarından kolayda örnekleme yoluyla toplanmıştır. Katılımcılar, dijital öz-yeterlik, büyüme zihniyeti ve YZ kullanım isteğini ölçen doğrulanmış ölçekleri doldurmuştur. SÜREÇ Model 4 aracılık analizi, önyükleme prosedürleriyle hipotezi test etmiştir. Sonuçlar, katılımcılar arasında orta derecede yüksek dijital öz-yeterlik, yüksek YZ kullanımı ve orta derecede yüksek büyüme zihniyeti düzeyleri ortaya koymuştur. Aracılık modelindeki tüm yapısal yollar istatistiksel olarak anlamlıydı. Dijital öz-yeterlik, büyüme zihniyetini olumlu yönde yordamıştır; bu da dijital teknolojileri kullanma konusunda daha yüksek güvenin, yetenek geliştirmeyle ilgili daha güçlü inançlarla ilişkili olduğunu göstermektedir. Büyüme zihniyeti, YZ kullanımını olumlu yönde yordamıştır; bu da büyüme odaklı inançlara sahip bireylerin YZ araçlarını benimseme olasılığının daha yüksek olduğunu göstermektedir. Dijital öz-yeterlik, büyüme zihniyeti kontrol edildikten sonra bile YZ kullanımı üzerinde önemli bir doğrudan etkiye sahip olmaya devam etmiştir. Büyüme zihniyeti aracılığıyla dolaylı etki istatistiksel olarak anlamlı olup, kısmi aracılık etkisini desteklemektedir. Tüm hipotezler desteklenmiş ve büyüme zihniyetinin, dijital öz yeterliliğin hizmet öncesi İngilizce öğretmenleri arasında YZ benimsenmesini etkilediği anlamlı bir psikolojik yol olarak hizmet ettiği ve öğretmen eğitimi bağlamlarında teknoloji kabulünün teorik olarak anlaşılmasına katkıda bulunduğu gösterilmiştir.

Anahtar Kelimeler: Dijital öz yeterlilik, büyüme zihniyeti, yapay zeka kullanımı, aracılık analizi, eğitim teknolojisi

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Introduction

The integration of artificial intelligence (AI) in educational contexts has become an important area of research in language teaching where pre-service teachers need to move quickly to adapt technological changes. The more educational organizations realize the potential of using AI based tools to advance teaching and learning, the more critical it is to investigate the psychological factors of technology adoption for successful implementation. Teachers' self-efficacy beliefs, mindset orientations and willingness to use AI technologies represent a complex interaction of cognitive and motivational constructs worthy of systematic investigation (Chow & To, 2025; Dang & Liu, 2022).

Digital self-efficacy can be defined as an individual's belief in his or her ability to complete tasks that integrate technology. This has been defined as a significant predictor of technology adoption in educational contexts (Bandura, 1997). Previous research supports this link as it relates to technology that self-efficacy is positively correlated with flexible learning beliefs, resilience, and openness to new challenges, as part of the adaptive psychological dispositions (Tzafilkou et al., 2022). This emphasis is critical in the consideration of AI and technology, as successful integration depends on addressing teachers' need for technical competencies and confidence in using sophisticated technological tools. Moreover, growth mind-set, defined as the beliefs about the changeability of one's abilities through effort and learning (Dweck, 2006), has also been hypothesized as something that could support openness to challenge and further learning behaviors for supporting the integration of technology. Thus, individuals with a strong growth mindset consider effort as an essential

asset for mastery, which likely increases their attitude towards a higher openness to the use of such technologies as AI within educational contexts (Yeager & Dweck, 2012).

Pre-service English language teachers may be a particularly interesting population to explore these relationships, as they are in a unique position between traditional pedagogical preparation and the demands of new technology. Their attitudes and beliefs about AI technologies while they are preparing to be educators may have a transformational influence on their future professional practices and willingness to use new tools and resources in their classrooms. Understanding how the interaction between digital self-efficacy and growth mindset influences AI usage behaviors of this population can provide insight for teacher education programs and professional development opportunities for encouraging technology integration. Using PROCESS Model 4 mediation analysis, the study evaluates whether or not growth mindset acts as a mediator between the relationship between digital self-efficacy, and AI integration for pre-service English language teachers.

Theoretical Background

The swift emergence of AI technologies for education has influenced the parameters of both teaching and learning. Researchers have recognized the need for knowledge of the factors affecting technology adoption to support pre-service teachers at a broader level. One factor that has received substantial research attention in studies of action based on the psychological construct of mindset and technology adoption is digital self-efficacy. It is commonly defined as an individual's belief in their ability to use digital tools effectively (Bandura, 2021; Chen et al., 2023). In the field of English language teaching (ELT), there are plenty of examples of AI adoption from language assessment to personalized learning, and the pre-service teachers' readiness to integrate AI tools, and their associated attitudes will affect AI use. Each of these factors influencing the decision to integrate AI into their practice is often constructed alongside the various mindsets of the individual teacher, specifically the distinction between a fixed mindset and a growth mindset. Mindset, along with the behaviors that are sustained when adopting new technologies, will assist teachers to make sound decisions about how to engage with new technology, due to their desire to persist and persevere learning new ways to practice in their classrooms (Dweck, 2017). This section aims to examine the link between mindset, digital self-efficacy, and AI use.

Digital Self-efficacy

Digital self-efficacy, described as peoples' belief in their personal ability for using digital technologies for a task (Bandura, 2021), has been shown to be an important predictor of technology acceptance and continued use (especially when tasks become challenging) (Hsu & Ching, 2022). Digital self-efficacy is correlated with motivation and engagement in learning. Positive attitudes toward digital tools can help to facilitate digital learning environments wherein successful technology integration can occur. Low digital self-efficacy can lead to avoidance of or misuse of technologies or technology-mediated resources that negatively impact productive digital engagement toward tasks, whether those tasks occur face-to-face or remotely (Kim et al., 2024). Given the changing nature of daily living and professional contexts toward digital realms, it is pertinent to develop an understanding of digital self-efficacy, which would enhance users' ability to maneuver in and utilize what technologies have to offer.

Teacher digital self-efficacy is key in educational contexts. Teachers must not only adopt many types of pedagogical technologies but also produce, implement, and fix digital learning activities (Kahveci, 2021). When teacher digital self-efficacy exists, educational technology can be effectively implemented in the face of rapid technological change and shifting educational technology landscapes (Garzon & Garzon, 2023). In addition, focused professional development supports the teacher in developing confidence, working on pedagogically consistent innovation, and developing student engagement. Digital self-efficacy is even more valued for pre-service English language teaching (ELT) candidates, where language teachers need to enact communicative competence, intercultural awareness, and personalized feedback using both specific and general digital tools (Lee & Lee, 2024). They use interactive platforms (e.g., task-oriented language practice through pairing), AI-based language applications (e.g., chatbots), and multimodal resources to engage diverse learners effectively. Thus, growing teacher digital self-efficacy in pre-service ELT teachers allows them to navigate the reflexive theory–practice relationship with sustainable confidence and create labor-intensive but innovative, learner-centered pedagogy in digitally mediated language education.

Growth Mindset

The growth mindset argues that intelligence, abilities and skills are qualities that can be changed and learners can grow those skills through effort, strategic learning, and perseverance versus a fixed trait (Dweck, 2017). Given this model has strong relationships to increased motivation, resilient responses to failure, and improved learning outcomes in a range of contexts, it has gained attraction in educational psychology research (Yeager & Walton, 2011). People with a growth mindset will accept obstacles as chances for improvement and will look at failures as feedback to reflect on and improve when starting again. This aligned well with the context of this study, where participants were learning a new technology or changing a practice. There is research evidence that learners with growth-oriented mindsets engage through persistency during tough learning experiences and recover more from mistakes, which enables deeper engagement and achievement whether they are learning traditionally or in a technology-enhanced manner.

Creating a growth mindset is an important part of teacher training because it drives educators' continual dedication to professional learning (Schunk & DiBenedetto, 2022). Educators with a robust growth mindset tend to embrace trial-and-error experimentation, reflect upon their instructional errors, and adapt their practice as their educational context requires. Professional development programs that target mindset development as a specific purpose have been shown to enhance the quality of instruction and the engagement of students (Dweck, 2006); growth-minded teachers also reported higher instances of digital self-efficacy as their recognition of internal growth facilitated development of technological skills (Lee & Lee, 2024). Considering the teaching of pre-service English language teaching (ELT) candidates, these dynamic tensions are even more significant in that the journey of developing language learners is difficult to predict, requiring ELT educators to act within risk, use flexible modalities that incorporate interactive platforms, AI, and multimodal resources. Pre-service ELT teachers who develop a growth mindset in their own practice will be more likely to remain in ambiguities that are natural aspects of language learning, continue to develop digital skills, and

produce emergent AI and educational technology that promotes learner-centered and resilient pedagogies.

AI Usage of Pre-service English Language Teachers

The emerging integration of AI for language teaching has changed the game both for teachers and learners. Specifically, AI tools have provided new opportunities for extending instruction, personalized feedback, and engaging learners by providing adaptive learning platforms and natural language processing systems for pre-service English language teachers (Lu & Zhang, 2025). Applications that employ automated essay scoring, pronunciation assessment, and AI chatbots produce authentic and interactive experiences in ways that do not fit within traditional classrooms (Rodriguez et al., 2024).

Despite clear advantages in usability and flexibility, barriers to effective implementation of AI are evident in digital competency gaps, limited AI using skills, and uncertainty of its integration pedagogically (Thompson & Davis, 2024). Studies show that pre-service teachers' attitudes toward AI and digital self-efficacy are the best predictor of pre-service teachers' willingness to use AI (Brown et al., 2025). Further, language teaching is not just a matter of mastery of communicative forms and intercultural competence; the context that teachers have to consider makes it even more complex. To maximize the pedagogical possibilities AI offers, teacher education programs must help pre-service EFL instructors develop AI literacy and a mindset of supportive decision-making. Developing these competencies will allow them to use AI in more interesting and responsive ways and develop learning outcomes for their learners while remaining flexible in a digital world.

Overview of Previous Research

As digitalization continues to shape the future of English Language Teaching (ELT), researchers have sought to explain how the affective-motivational constructs of growth mindset, digital self-efficacy, and readiness to use artificial intelligence (AI) serve as levers for effective technology use. Dweck's original growth mindset theory (1999, 2006) distinguishes between different mindsets. However, it claims that intelligence and aptitude are flexible concepts and they can be advanced by determination, learning strategically, and staying the course when faced with challenges. In the case of ELT and second language (L2) learning, learners with a growth mindset provide evidence of greater resilience and perseverance in dealing with challenges in language and technology (Barkati, 2024). Growth mindset beliefs in e-learning environments help to promote more motivation and adaptive behaviors and engagement, providing learners the opportunity to significantly process the knowledge and information in digital forums, reflecting the learning opportunity (Hasan et al., 2025; Wang, 2025; Gao & Zhou, 2024). Meta-analytic and review studies underscore the success of mindset interventions in technology-supported learning. For example, Kizilcec et al. (2024) have noted short, intentional mindset interventions targeting incremental theories of intelligence that improve academic resilience and promote positive beliefs in AI-supported environments.

Concurrently, a large body of researchers are in an attempt to explore the construct of digital self-efficacy, defined as individuals' beliefs about themselves in using digital tools in order to accomplish certain tasks. Grounded on Bandura's (1997) social cognitive theory, Digital self-efficacy has been shown to as a strong predictor of technology use, and persistence when faced with technology challenges (Paredes-Aguirre et al., 2024). Research shows that greater digital self-efficacy is related with task-technology fit, adaptive academic behaviors (e.g., seeking feedback and reflective practice), and informal digital learning behaviors (Barkati, 2024; Xu et al., 2025). Additional moderating variables, including digital literacy and technology anxiety, also moderate the predictive value of self-efficacy on confidence in virtual teaching.

With respect to AI readiness, researchers have developed and validated measures of teachers' inclination towards implementing AI tools, which emphasizes curiosity, perceived utility and inherent interest (Galindo-Domínguez et al., 2024). Willingness to engage with AI is strongly correlated with digital self-efficacy, and with a growth mindset (Arnautovska et al., 2024). Wang's (2025) empirical work with rural professional education indicates receptivity to AI plays a vital role in engagement and satisfaction with digital interventions. Schultz and Werner (2025) identify growth mindset as the greatest predictor of AI readiness for ELT students.

Outside learner populations, research focusing on pre-service ELT teachers emphasizes the importance of developing both digital self-efficacy and a growth mindset for future pedagogical innovation. Boonsathirakul (2025) argues that on-the-web identity construction plays a foundational role in technology acceptance among teacher candidates. Al-Hattami (2025) further shows that digital self-efficacy developed during teacher education courses directly contributes to pedagogical confidence, particularly in online teaching contexts. In addition, Arnautovska et al. (2024) highlight the facilitating role of human support and instructional scaffolding in teachers' digital adoption processes. Taken together, these findings indicate that both individual psychological beliefs and contextual supports are central to pre-service teachers' readiness for technology integration, which provides a clear empirical and theoretical basis for the research questions and hypotheses of the present study.

When these strands of previous research are viewed holistically, the result is a dynamic, multifaceted interaction among psychological dispositions, digital competencies, and AI readiness. However, existing research tends to isolate a construct or examine simple relationships through bivariate designs. The current research builds on previous work while closing the gap from the existing literature into a clearer understanding of the complex process in which digital self-efficacy acts as a facilitator between growth mindset and attitude towards AI use in an ELT context. Here we respond to recent calls for more sophisticated and integrative models in education examining multiple factors of motivation, cognition, and technology (Kizilcec et al., 2024; Xu et al., 2025). Through the implementation of regression-based mediation analyses with a pre-service ELT cohort, we ascertain how belief systems related to intelligence and digital competencies can operate together in predicting future teachers' readiness to engage in AI-supported pedagogical practices.

Despite the growing body of literature on growth mindset, digital self-efficacy, and AI readiness, current research has largely examined these constructs in isolation or through direct, bivariate relationships. There is still limited empirical work that explains the *mechanisms* through which these variables jointly operate, particularly in the context of pre-service language teacher education. In particular, the potential mediating role of digital self-efficacy in linking growth mindset to willingness to adopt AI in ELT remains underexplored. By addressing this gap, the present study contributes to the literature by proposing and testing an

integrative, process-oriented model that clarifies not only whether these constructs are related, but also how and through what pathway belief systems about intelligence and digital competence shape future teachers' readiness for AI-supported pedagogy. Therefore, following research questions and hypothesis were proposed:

RQ1. To what extent does digital self-efficacy predict growth mindset among pre-service English language teachers?

RQ2. To what extent does growth mindset predict AI usage among pre-service English language teachers?

RQ3. To what extent does digital self-efficacy have a direct effect on AI usage among pre-service English language teachers?

RQ4. Does growth mindset mediate the relationship between digital self-efficacy and AI usage among pre-service English language teachers, and if so, to what extent?

Hypothesis 1 (H1)

Digital self-efficacy will significantly predict growth mindset among pre-service English language teachers.

This assumption is predicated on the postulate that the possessors of an abundant digital self-efficacy tend to exhibit adaptive psychological characteristics, and a growth mindset. Recent research also confirms this by showing that technology-related self-efficacy was positively related both to flexible learning beliefs, which is a component of the human growth paradigm, as well as the elements of resilience and an openness to challenges that are central to that growth mindset (Tzafilkou et al., 2022).

Hypothesis 2 (H2)

Growth mindset will significantly predict AI usage among pre-service English language teachers.

People with a growth mindset are generally more willing to welcome new challenges and see effort as a means of mastery, suggesting a greater willingness to incorporate new technologies like AI in educational contexts. Recent studies have indicated that individuals with stronger growth mindsets tend to embrace new technologies and have a higher acceptance of technology (Chow & To, 2025; Dang & Liu, 2022).

Hypothesis 3 (H3)

Digital self-efficacy will have a significant direct effect on AI usage among pre-service English language teachers.

We assume that in-service teachers who self-confidently handle digital technologies are also more likely to explore and implement AI tools in educational settings. This is supported by research which shows that digital self-efficacy is a strong predictor of technology adoption and technology use in more complex situations or new digital environments such as AI applications in education (Tzafilkou et al., 2022).

Hypothesis 4 (H4)

Growth mindset will significantly mediate the relationship between digital self-efficacy and AI usage among pre-service English language teachers.

We hypothesize that students with higher digital self-efficacy may tend to develop a growth mindset, which in turn enhances their engagement with AI tools. Mediation studies in educational contexts have shown that growth mindset can function as a psychological bridge between self-beliefs and technology adoption behaviors (Chow & To, 2025).

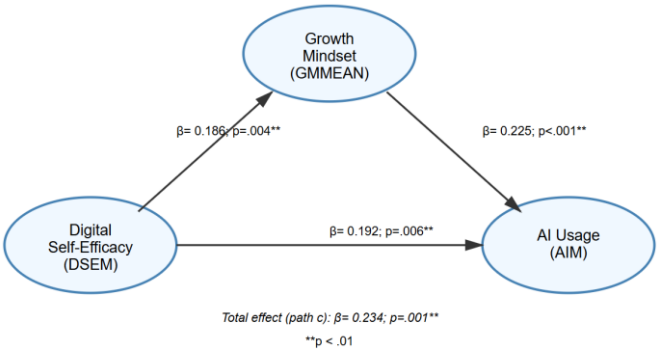

Figure 1. The pathway diagram

With respect to the hypotheses, Figure 1 represents the conceptual framework. The model assumes that there would be a relationship between digital self-efficacy (DSEM) and growth mindset (GMMEAN) (H1), AI use (AIM) (H3). It was also assumed that there would be a relationship between growth mindset and AI use (H2). In addition, it is intended that growth mindset will be the mediating variable on the effect of digital self-efficacy (independent variable) on AI use (dependent variable) (H4).

Methodology

Research Design

A quantitative correlational design was utilized to investigate the role of growth mindset as the mediating variable for the relationship between digital self-efficacy and AI use in ELT contexts. This design was used because it allows the researcher to systematically examine the relationships between two (or more) variables in terms of correlations, therefore, find patterns and relationships that can inform theoretical understanding in educational contexts by having ecological validity, or naturalistic surroundings. (Bloomfield & Fisher, 2019). A questionnaire method was employed in this study in an effort to find possible relationships between the variables, specifically, the mediating role of digital self-efficacy.

Participants and the Context

The research was carried out with 166 undergraduate pre-service teachers enrolled at an ELT department at a university in Turkey. The average age was calculated as 23,2. Among the participants, 81 were females, 83 were males, and two participants preferred not to specify their gender. The participants were students from a 4-year English language teaching program, where they get both theoretical and practical training. During the four years of education, they are provided to use AI technology numerous of times including assignments, material development, micro-teaching sessions, and the teaching practicum where they teach in real classes under the supervision of teachers and faculty members. Hence, each participant has enough experience about the integration of the AI to fulfil the requisites of the program.

Procedures for Data Collection

Data was collected during the spring term of 2025, utilizing an anonymous web survey. The survey was given to participants using convenience sampling, which is a sampling method that relies upon data being collected from an easily accessible and available group of people (Stratton, 2021). The individuals are not sampled because they are the most representative of the entire population, instead they are sampled because they are the most accessible to the researcher. Convenience sampling is especially common in educational research, particularly with

pre-service teachers, because it relies on the existences of naturally occurring cohorts of study participants within teacher preparation programs (Creswell & Creswell, 2018). Convenience sampling in this way allowed for effective data collection in a manner that remained consistent with standard methodological practice for data collection in studies involving trainee educators. The survey was conducted using a secure web-based questionnaire. Informed consent was provided from the participants. The question form was completed in approximately five minutes on average. Participation was entirely voluntary, and no personal information of any kind was collected to ensure anonymity.

Data Collection Instruments

Three different scales were employed to quantify the constructs being examined in this research: Growth Mindset, Digital Self-Efficacy, and Willingness to Use Artificial Intelligence.

Growth Mindset Scale

Growth mindset was measured by a shortened version of Dweck's (1999, 2006) original questionnaire that measures attitudes toward one's own intelligence. Each item on the scale responses was rated on a 5-point Likert scale ranging from 1 (Strongly disagree) to 5 (Strongly agree). A representative item is: "You have a certain amount of intelligence, and you can't do much to change that."The original scale has been widely used with a variety of educational populations and demonstrated a strong construct validity.

Digital Self-efficacy Scale

Digital self-efficacy was measured with the Digital Self-Efficacy Scale created by Ulfert-Blank and Schmidt (2022). The instrument is composed of 19 items in five dimensions: Information and Data Literacy, Communication and Collaboration, Digital Content Creation, Safety, and Problem-Solving. We used a 5-point Likert scale ranging from 1 (Completely disagree) to 5 (Completely agree). An example item is: "I distinguish between correct and incorrect online information."The adapted version had good psychometric properties, with overall internal consistency at α =.93.

Willingness to Use AI Scale

The amount of willingness that participants had in using artificial intelligence with teaching practices was assessed through a modified version of the Willingness to Use AI subscale developed by Galindo-Domínguez et al. (2024). While the original five items were available, one item from pilot testing was removed because of poor item-total correlation, thus leaving four items in the final scale. The rest of the items attempted to assess the degree of openness and receptiveness of teachers as to the use of AI tools in their teaching. The items were rated through a 5-point scale (1 = Strongly disagree, 5 = Strongly agree). The sample items included “I am willing to use artificial intelligence in my classroom practice,"and “I would like to be able to use artificial intelligence in my teaching work."The scale had high internal consistency (Cronbach's α =.91).

Data Analysis

The mediation analysis was conceptually grounded in the causal steps framework proposed by Baron and Kenny (1986) and the general guidelines summarized by Hair et al. (2014), but was empirically conducted using Hayes’ PROCESS macro (Model 4), in line with contemporary best practices in mediation analysis. The Baron and Kenny approach was used to establish the basic conceptual prerequisites for mediation, namely: (1) a significant effect of the independent variable on the dependent variable, (2) a significant effect of the independent variable on the mediator, and (3) a significant effect of the mediator on the dependent variable while controlling for the independent variable. To examine the first prerequisite, a model without the mediator was tested, and the results indicated that digital self-efficacy was a significant positive predictor of AI use (β = 0.234, p =.002). Having satisfied this conceptual condition, the mediation effect of growth mindset on the relationship between digital self-efficacy and willingness to adopt AI in language teaching was then formally tested using PROCESS Model 4 with bootstrapped confidence intervals.

Procedure for Data Analysis

To analyze the data, the statistical software IBM SPSS Statistics 25.0 was used. The data were cleaned and their normality checked before the main analysis was conducted. In accordance with recommended best practices to prevent potential method variance problems, Harman's single-factor test (Podsakoff et al., 2003) was utilized to assess common method bias, and multicollinearity was assessed using the variance inflation factor (VIF) (Hair et al., 2014). Descriptive statistics and Pearson correlation analysis were then used to gain a deeper understanding of the fundamental connections between the variables. AI usage was the dependent variable (Y), growth mindset was the mediator (M), and digital self-efficacy was the independent variable (X) in the mediation analysis. To test the total, direct, and indirect effects, the mediation analysis was carried out using Model 4 of the PROCESS macro for SPSS (Hayes, 2017, 2018). Both standardized and unstandardized path coefficients were calculated for every mediation analysis, and the results were presented. Cohen's (1988) guidelines were used to interpret the various path coefficient effect sizes: an effect size of less than.30 was considered small, one between.30 and.50 was considered moderate, and one of.50 or more was considered large (Nieminen, 2022). In addition, a bootstrap method was used for a total of 5,000 resamples with 95% confidence intervals to test the significance of the indirect effects; the mediation was considered significant when the confidence intervals did not include zero.

Results

Preliminary Analyses

Prior to mediation analysis, normality tests were conducted. The Shapiro-Wilk test for digital self-efficacy (W =.987, p =.156), AI usage (W =.983, p =.089), and growth mindset (W =.979, p =.052) were all non-significant, confirming normal distribution. Additionally, all variables' skewness and kurtosis values were within normal parameters (−2 to +2; George & Mallery, 2010; Tabachnick & Fidell, 2013), with skewness range −.412 to.298 and kurtosis range −.634 to.789. Together, these findings confirmed that the assumption of normality was satisfactory and justified the regression-based mediation via PROCESS Model 4.

Table 1. Descriptive statistics and correlations

Variable	M	SD	1	2
1. Digital self-efficacy	3.77	.51		
2. AI usage	4.43	.72	.234**	
3. Growth mindset	3.81	.89	186*	.273**

*p <.05, **p <.01*

Table 2. Regression-based mediation analysis of the direct effect of digital self-efficacy on AI usage via growth mindset

Path	β	SE	*t*	*p*	95% CI
Path a: Digital Self-Efficacy → Growth Mindset	0.186	0.064	2.91	.004**	[0.060, 0.312]
Path b: Growth Mindset → AI Usage	0.225	0.056	4.02	<.001**	[0.115, 0.335]
Path c': Digital Self-Efficacy → AI Usage (direct)	0.192	0.069	2.78	.006**	[0.056, 0.328]
Path c: Digital Self-Efficacy → AI Usage (total)	0.234	0.070	3.34	.001**	[0.096, 0.372]

****p < .01**

As revealed by descriptive statistics, participants reported moderately high digital self-efficacy (M = 3.77, SD = 0.51), high AI usage (M = 4.43, SD = 0.72), and moderately high growth mindset levels (M = 3.81, SD = 0.89). Additionally, the correlation analysis revealed positive relationships for all variables as: Digital self-efficacy and AI usage (r =.234, *p <.01*), digital self-efficacy and growth mindset (r =.186, *p <.05*), and growth mindset and AI usage (r =.273*, p <.01*).

Following the correlational analysis, we calculated a mediation analysis using regression-based path analysis, specifically following the causal steps approach (Baron & Kenny, 1986), via PROCESS macro (Model 4). The results are presented on Table 2.

The structural model examined the connections between pre-service English language teachers' use of AI, growth mindset, and digital self-efficacy. Every path was statistically significant, as can be seen in Table 2. First, growth mindset was predicted by digital self-efficacy (β = 0.186, *p =.004*), suggesting that stronger growth mindset beliefs were linked to higher levels of digital self-efficacy. AI usage was significantly positively predicted by growth mindset (β = 0.225, *p <.001*), indicating that people who believed in growth mindset were more likely to use AI tools. Even after adjusting for growth mindset, there was still a substantial direct link between digital self-efficacy and AI adoption (β = 0.192, *p =.006*), suggesting partial mediation.

These findings align with theoretical expectations. Individuals with higher digital self-efficacy may be more open to the belief that their abilities can be developed (growth mindset), as their confidence in handling digital technologies provides a foundation for embracing continuous learning. This growth-oriented belief system, in turn, facilitates greater willingness to adopt and use emerging AI technologies.

The Indirect

effect of digital self-efficacy on AI usage through growth mindset was found to be statistically significant, b = 0.058, SE = 0.022, 95% CI [0.018, 0.104]; standardized effect β = 0.042, 95% CI [0.013, 0.075]. Since the confidence intervals did not include zero, partial mediation was supported. These results suggest that growth mindset served as a significant partial mediator in the relationship between digital self-efficacy and AI usage among pre-service English language teachers.

Finally, we conducted regression model analysis to find out the extent to which digital self-efficacy and growth mindset predict AI usage among pre-service English language teachers. Regression model summaries are shown in Table 4. In the first model, digital self-efficacy significantly predicted growth mindset, F(1, 164) = 5.91, *p =.016*, R^2 =.035, indicating that 3.5% of the variance in growth mindset was accounted for by digital self-efficacy. In the second model, where AI usage was regressed on digital self-efficacy and growth mindset, the model was significant, F(2, 163) = 9.57, *p <.001*, R^2 =.105. This suggests that the two predictors explain 10.5% of the variance in AI usage of pre-service English language teachers. The results for the hypothesis testing are found on Table 5.

Table 3. Bootstrap estimates of the ındirect effect of digital self-efficacy on AI usage through growth mindset

Effect	b	SE	95% CI	β	95% CI
Digital Self-Efficacy → Growth Mindset → AI Usage	0.058	0.022	[0.018, 0.104]	0.042	[0.013, 0.075]

Table 4. Regression model summary for growth mindset and AI usage

Dependent Variable	**R**	**R^2**	**Adjusted R^2**	**F**	**df**
Growth Mindset	.186	.035	.029	5.91	1, 164
AI Usage	.324	.105	.094	9.57	2, 163

*p <.05, **p <.01.

Table 5. Hypothesis testing results for PROCESS model 4 mediation analysis

Hypotheses	**β**	**SE**	**t**	**p**	**Result**
H1: Digital self-efficacy → Growth mindset	0.186	0.064	2.91	.004**	Supported
H2: Growth mindset → AI usage	0.225	0.056	4.02	<.001**	Supported
H3: Digital self-efficacy → AI usage (direct effect)	0.192	0.069	2.78	.006**	Supported
H4: Digital self-efficacy → AI usage via growth mindset (indirect effect)	0.042	0.022	—	<.05*	Supported (Partial Mediation)

*Bootstrap CI does not include zero, **p <.01

Discussion and Conclusion

The present study examined whether growth mindset mediates the relationship between digital self-efficacy and AI usage among pre-service English language teachers.

The findings revealed a significant partial mediation effect, indicating that growth mindset serves as a meaningful pathway through which digital self-efficacy influences AI adoption, while maintaining a significant direct effect. This pattern of partial mediation contributes to the understanding of technology use in educational contexts and has important implications for teacher preparation programs.

The relationship between digital self-efficacy and growth mindset supports the integration of Bandura's (1997) self-efficacy theory with Dweck's (2006) mindset framework in technology contexts. This finding aligns with Zeng et al.'s (2022) meta-analysis demonstrating strong correlations between teachers' digital self-efficacy and technology integration competence across 7,777 participants. The relationship suggests that confidence in digital skills provides a foundation for developing growth-oriented beliefs about technological abilities. When pre-service teachers experience success with digital tools, they develop not only task-specific confidence but also broader beliefs about their capacity to develop new technological competencies. This connection is particularly relevant in rapidly evolving domains like AI, where continuous learning and adaptation are essential (Ulfert-Blank & Schmidt, 2022).

The significant influence of growth mindset on AI use is consistent with the findings of Chow & To (2025) that technological growth mindset predicts AI use through performance expectancy, effort expectancy, and reduced technology anxiety. Pre-service teachers with growth mindset view AI tools as opportunities for improvement of skills rather than threats to competency. This perspective is important in view of the extraordinary difficulties language teachers have in integrating AI into their repertoire. These challenges include authenticity in language learning, the conflict between technological efficiency and pedagogical effectiveness (Dang & Liu, 2022).

The persistence of a significant direct effect alongside the indirect effect indicates that digital self-efficacy influences AI usage through multiple mechanisms. This finding supports Wang and Zhao's (2021) demonstration that ICT self-efficacy mediates most but not all effects on technology integration. The direct pathway may represent automatic or habitual responses developed through repeated successful technology use, while the mediated pathway through growth mindset involves more deliberate cognitive processes related to learning and development. This dual-pathway model aligns with contemporary technology acceptance theories that recognize both cognitive and affective routes to adoption (Venkatesh et al., 2003; Demir & Lüta, 2026).

Our findings are particularly relevant given current challenges in AI integration within teacher education. As reported by Fernández-Batanero et al. (2024) most student teachers lack full preparation for AI classroom integration despite positive attitudes. The mediation effect suggests that fostering growth mindset could bridge this preparation gap. When pre-service teachers believe their AI-related skills can be advanced by effort and strategy, they are more likely to engage with AI tools despite initial difficulties or setbacks. This psychological resilience is essential given the steep learning curve associated with educational AI applications.

The cluster analysis by Michos et al. (2022) identified that 77% of prospective teachers show high attitudes but only moderate self-efficacy, while 23% display average attitudes with low self-efficacy. Our mediation model provides theoretical explanation for these profiles. Teachers with similar digital competence levels may show different AI usage patterns based on their growth mindset orientations. Those with growth mindsets translate their self-efficacy into action more readily, viewing challenges as learning opportunities rather than competence threats.

The modest variance explained is consistent with other psychological models of technology adoption (Adnan et al., 2024) and suggests that environmental and contextual factors also play substantial roles. However, the significant mediation effect demonstrates that psychological mechanisms are meaningful contributors to AI adoption decisions. The partial mediation pattern indicates that interventions targeting either digital self-efficacy or growth mindset alone may be insufficient; comprehensive approaches addressing both constructs are likely more effective.

Methodologically, our use of PROCESS Model 4 with 5,000 bootstrap resamples provides robust evidence for partial mediation, moving beyond traditional Baron and Kenny (1986) procedures. The significance of both component paths (a and b) combined with the significant indirect effect meets contemporary standards for demonstrating mediation (Hayes, 2018). This methodological rigor strengthens confidence in the theoretical contributions of the study.

Beyond confirming previously reported associations, the main contribution of this study lies in shifting the focus from *whether* digital self-efficacy and growth mindset matter to *how* they jointly operate in shaping AI adoption among pre-service language teachers. By empirically demonstrating a process-oriented, partial mediation mechanism, the study advances current literature from predominantly variable-centered and correlational accounts toward a more structurally explanatory model. Conceptually, it clarifies that growth mindset is not merely an additional predictor, but a psychological transformation mechanism that conditions how competence beliefs are converted into actual pedagogical technology use. This provides a more precise target for teacher education interventions by indicating that strengthening technical competence alone is insufficient unless accompanied by mindset-oriented pedagogical work. In this sense, the study contributes not only empirical evidence, but also a more differentiated theoretical account of the motivational–cognitive architecture underlying AI adoption in language teacher education.

This study provides empirical evidence that growth mindset partially mediates the relationship between digital self-efficacy and AI usage among pre-service English language teachers, contributing to the theoretical integration of self-efficacy and mindset perspectives in educational technology contexts. However, this partial mediation also suggests that other unexamined factors, such as institutional expectations, access to technological resources, or prior experiences with AI, may independently shape AI usage and interact with psychological variables. It is also plausible that the observed relationships are context-sensitive, as teacher education programs differ substantially in how they frame and support technology use, which may condition the extent to which beliefs translate into actual adoption behaviors.

While the findings indicate that a growth mindset may facilitate the translation of digital competence into AI use, the continued significance of the direct effect of digital self-

efficacy points to a more complex and potentially reciprocal process. From a practical perspective, this implies that teacher education programs should not only aim to strengthen individual beliefs, but also attend to contextual and structural conditions that enable or constrain technology use. Accordingly, future interventions and research should consider both psychological and environmental factors when seeking to promote effective and sustainable AI integration in language teaching contexts.

Implications

The partial mediation effect has important implications for teacher education programs. Professional development initiatives should integrate growth mindset cultivation with technical training rather than treating them as separate domains. When introducing AI tools, educators should emphasize that competence develops through practice and strategic effort, not innate ability. Programs like Google's "Generative AI for Educators"could incorporate modules addressing beliefs about ability development alongside technical instruction. Teacher educators should create mastery-oriented learning environments that celebrate improvement and strategic problem-solving over performance comparisons. Assessment practices should reflect growth-oriented values, focusing on progress and effort rather than solely on outcomes. Additionally, mentor teachers modeling growth mindset while using AI tools could provide powerful vicarious learning experiences for pre-service teachers. These integrated approaches recognize that psychological and technical dimensions of AI adoption are intertwined and mutually reinforcing.

Limitations

Several limitations were considered for the study. First, the cross-sectional design prevents causal inferences about relationship directionality. Second, the sample's restriction to pre-service English language teachers from a single institution limits generalizability to in-service teachers or other subject areas. Therefore, the findings should be interpreted with caution and should not be assumed to represent broader teacher populations or different educational contexts without further empirical validation. Finally, the relatively low variance explained suggests important variables may be missing, such as institutional support, perceived usefulness, or facilitating conditions identified in technology acceptance research.

Future Research Directions

Future research should employ longitudinal designs tracking pre-service teachers from preparation through early career stages to establish temporal precedence and examine how mediation relationships evolve. Experimental studies testing growth mindset interventions specifically designed for AI adoption could establish causal relationships. Cross-cultural investigations examining whether mediation patterns vary across educational systems would enhance theoretical generalizability. Research incorporating multiple mediators simultaneously, including technology anxiety, perceived usefulness, and social influence, could identify the most influential pathways for intervention. Studies using objective measures of AI usage, such as system logs, would complement self-report data.

Author Contributions

The authors contributed equally to the preparation of this manuscript. Both authors have read and approved the final version of the manuscript.

Ethical Declaration

This study was conducted in accordance with the approval decision number 28/72 of the Çanakkale Onsekiz Mart University Human Research in Social Sciences Ethics Committee (Protocol No. 2025-YÖNP-0744) at its meeting on August 22, 2025.

Conflict of Interest

The authors declare that they have no conflict of interest with any institution or person within the scope of the study.

Declaration of Generative AI Use

During the English language editing stage of this study, the Microsoft 365 Word translation tool was used to a limited extent and exclusively for language translation purposes. The translated text was carefully reviewed for accuracy by the authors, and all necessary revisions were made. The authors take full responsibility for the content of the manuscript.

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