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The Perceptions of New Generation Specialists towards Innovative Pedagogy, Their Professional and Digital Competencies, and Burnout Levels

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Abstract

With the increasing integration of artificial intelligence in education, understanding how teachers' innovative behaviors shape their digital competence and well-being has become a critical yet underexplored area in teacher development research. The purpose of this study is to examine the effects of innovative behaviors of new teachers (≤5 years) on digital competence, burnout, and self-efficacy, as well as the mediating roles of burnout and teacher self-efficacy. Building on findings from a foresight session in the Atyrau region of Kazakhstan, where experts emphasized the personalization of learning through artificial intelligence, the study used a correlational survey model with 269 new teachers. Data were collected with the Scales of Innovative Work Behavior, Digital Competence, Burnout, and Teacher Self-Efficacy and analyzed using PROCESS macro version 4.2 for SPSS with Model 6. Innovative behavior was treated as the independent variable, digital competence as the dependent variable, and burnout and self-efficacy as sequential mediators. Results indicate that innovative behavior has a direct positive effect on digital competence; however, when burnout and self-efficacy are included, the effect becomes fully mediated. Specifically, teacher self-efficacy mediates positively, while burnout mediates negatively. Thus, strengthening teachers' self-efficacy and reducing burnout are essential for enhancing digital competence. The study suggests further research in different cultural contexts and emphasizes supporting innovative pedagogy through self-efficacy-based workshops, digital innovation activities, and structured mentoring systems.

Keywords: *Innovative pedagogy, Foresight, Digital competency, Burnout, Teacher professional development*

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Introduction

Education systems are constantly evolving in line with the needs of the 21st century under the influence of globalization and digital transformation. The transition to a knowledge economy has caused student-centered approaches and technology integration to become a basic need in teaching processes. Therefore, education policies are being restructured to support teachers' flexibility and creativity in pedagogical design. New generation teachers are more adaptable to programs that include digital literacy and professional development components. Generation Z teachers develop their skills in using digital tools for pedagogical purposes in their early careers (Redecker, 2017). Teachers, especially experts who are new to the profession, aim to increase student participation by incorporating innovative pedagogical principles into their teaching repertoires (Sawyer, 2019). Innovative pedagogical approaches are being focused on in a way that responds to the reshaped needs of learners (Halder, 2023).

In this regard, the present study aims to examine the multivariate interaction among innovative pedagogy perceptions, professional competence, digital competence, and burnout. In this context, the main purpose of the research is to examine the effects of innovative behaviors of new teachers (5 years) on digital competence, burnout, and self-efficacy levels and to reveal the mediating roles of burnout and teacher self-efficacy on digital competence.

Although innovative pedagogy, digital competence, burnout, and teacher self-efficacy have been widely discussed in the literature, studies focusing on the interplay of these variables among new teachers with less than five years of experience remain scarce. Existing research often concentrates on experienced teachers or general teacher populations, overlooking the unique challenges and opportunities faced by early-career educators. Addressing this gap, the present study specifically investigates how these variables are integrated in the context of new teachers, thereby contributing novel insights to the field.

Theoretical Framework

Innovative Pedagogy and New Generation Teachers

The concept of innovative pedagogy differentiates itself from traditional teaching approaches in the field of education and makes learning processes more dynamic. This approach redefines course

design by emphasizing student-centered activities and technology integration. Halder (2023) considers innovative pedagogy as a framework that provides a systematic view of pedagogical transformation processes and points out that there is a multidimensional ecosystem that includes flexibility, interaction, and the use of data-driven learning analytics in 21st-century classrooms. Thus, innovative pedagogy makes it possible to create interactive and measurable learning environments that respond quickly to students' needs.

While innovative pedagogical models differ, they all incorporate technology-supported active learning, problem-solving, and collaborative approaches. Sawyer (2019) matches creativity-based models with collaborative learning strategies, while Halder (2023) examines technological integration, personalized learning, and the use of learning analytics as three basic dimensions under innovative pedagogy. Widiastuti et al. (2022) state that flexible learning paths and microlearning strategies are integral components of innovative pedagogy. Castillo (2020) evaluates student-centered, research-based, and reflective practices, while Joseph and Mathew (2019) evaluate active learning, project-based learning, and flipped classroom practices within the scope of pedagogy innovation. Learning analytics data continuously optimizes both interaction-oriented and technology-supported models, influencing teacher decision-making processes.

Pandey et al. (2023) suggest that new generation teachers face some problems in integrating these models into their program development processes. Carvalho et al. (2021) and Naifeld and Simon (2017) emphasize the importance of choosing a model suitable for different learning styles. As can be seen, there are some points to be considered in the process of using innovative pedagogical models and encountering various difficulties. Joseph and Mathew (2019) state that the lack of resources and inadequate technology infrastructure make adaptation processes in the classroom environment difficult. However, they emphasize that the lack of support from school administration prevents teachers from adopting innovative strategies. Herodotou et al. (2019) state that early career teachers' hesitations to take pedagogical risks limit their innovation efforts. Purohit and Dutt (2024) draw attention to institutional policies that threaten the sustainability of innovative practices in educational management. The incompatibility between time constraints and program requirements can cause teachers to return to traditional methods.

According to Toh et al. (2016), the diffusion of innovation in non-established education systems becomes difficult in this context, and the lack of structuring of mentoring programs restricts the

sharing of experienced teacher experiences. Uslan et al. (2024) emphasize the importance of teacher education programs focusing on innovative pedagogy. In addition, Alshahrani and Ally (2016) draw attention to cultural resistance experienced in technology adaptation in regional application examples, and Pandey et al. (2023) state that the complexity of material preparation processes weakens teacher motivation. In this context, lack of classroom management skills threatens the sustainability of student-centered methods, and knowledge gaps about educational technologies limit the effective use of digital tools. On the other hand, Donovan et al. (2014) state that supporting learning analytics-based feedback mechanisms is critical in overcoming these obstacles, and Petrenko (2024) suggests that professional development programs should focus on technology integration.

Teacher perceptions determine the level of openness to pedagogical innovations, and this directly affects student engagement. While Peterson et al. (2018) pointed out that perceptions play a critical role in the adoption of innovative pedagogical approaches, Pandey et al. (2023) demonstrated the impact of these perceptions on the sustainability of innovative strategies with quantitative data. Thus, perceptions shape not only the individual attitude level but also the institutional innovation culture. The new generation of beginning teachers experiences innovative pedagogical approaches in different ways due to their technological competencies and pedagogical knowledge. According to Joseph and Mathew (2019), the attitudes of administrators shape the new teachers' perceptions of innovative pedagogy. In this context, different variables affect the perceptions of innovative pedagogy.

Professional Competencies of Beginning Teachers

Professional competence represents one of the indispensable components of the teaching profession and forms the basis of effective teaching practices at both individual and institutional levels. This concept aims to increase the quality of classroom interaction by integrating teachers' knowledge, skills, attitudes, and values (Huntly, 2008). At the same time, educational policies, professional development programs, and leadership approaches play a critical role in defining professional competence (Avalos, 2016). While Huntly (2003) defines professional competence as the functional competencies of teachers, Kagan (1992) evaluates this concept within the framework of a continuous development process. He defines the increase in professional competence as the process by which teachers first acquire basic professional knowledge and then

enrich it with experience. Goh and Wong (2014) state that cultural sensitivity and contextual factors should be included in professional competence. They argue that professional competence is a multidimensional structure that is not limited to individual skills but also includes cultural sensitivity and contextual factors. Professional competence defines the set of knowledge, skills, and attitudes that teachers should acquire at the beginning of their careers, and this competence enables the development of effective teaching strategies in classroom practices (Chong, 2011). These definitions show that professional competence requires a framework that simultaneously includes both theoretical knowledge and practical skills. In addition, professional competence includes the dimensions of instructional design, classroom management, evaluation, and professional ethics (Strohmer and Mischo, 2018). The harmony between these dimensions strengthens teachers' interaction with students. In addition, the perception of professional competence increases teachers' self-confidence and encourages their tendency to take pedagogical risks (Avalos, 2016). For this reason, it has become necessary for teacher education programs to include experience-oriented components such as practical internships and workshops.

Professional identity formation constitutes a critical turning point in the professional journey of beginning teachers, and this process is shaped through both personal experiences and community-based learning mechanisms. Cognitive and affective components in identity formation shape teachers' pedagogical strategies and enable them to internalize their professional roles (Strohmer and Mischo, 2018). Therefore, mentoring programs and professional learning communities serve as critical tools to support professional identity development. In this way, teachers can adapt to their professional roles more quickly and design interactive learning environments (Julia et al., 2020).

Factors affecting professional competence acquisition are shaped by the interaction of individual, institutional, and cultural dynamics, and these dynamics include school leadership practices as well as teacher education programs (Kozikoğlu & Senemoğlu, 2021). Higher education programs provide theoretical knowledge bases for beginning teachers. According to Dewalt and Ball (1987), practical trainings develop instructional design skills. According to Chong (2011) supportive leadership approaches increase competence development. While Julia et al. (2020) were revealing the effectiveness of preparation programs with quantitative and qualitative methods, Goh and Wong (2014) stated that professional learning communities increase knowledge sharing. The leadership style of school administrators directly affects teachers' access to professional

development opportunities. Besides, in-house training programs play an important role in the development of pedagogical skills. The structured nature of mentoring programs contributes to teachers' self-confidence (Strohmer & Mischo, 2018). On the other hand, resource deficiencies, material shortages, and time constraints hinder development processes (Goh, 2013).

Self-efficacy belief constitutes one of the most important psychological dynamics that determines the professional performance of beginning teachers, and this dynamic shapes teachers' pedagogical risk-taking tendencies (Lekhu, 2023). In line with Bandura's theoretical framework, self-efficacy is explained as individuals' personal beliefs about successfully completing certain tasks. Chong (2011) emphasizes the effect of self-efficacy perception on professional identity formation in beginning teachers and shows that this perception contributes to the adoption of innovative pedagogical approaches. Reflective practice provides teachers with the opportunity to analyze their experiences and deepen their professional knowledge. Avalos (2016) considers reflective practice a critical component of professional learning processes and indicates that it guides continuous development processes. Teaching readiness refers to the level at which teachers effectively organize their lesson plans and materials. Goh and Wong (2014) state that teaching readiness develops in parallel with self-efficacy perception. Huntly (2008) evaluated the effectiveness of teacher education programs in developing self-efficacy and readiness. Chong (2011) demonstrated that mentoring and professional learning communities play a critical role in increasing self-efficacy and readiness. Therefore, it becomes essential for teacher education programs to include workshops and feedback mechanisms that develop reflective practice skills.

Digital Competence in the Context of Contemporary Teacher Education

In today's teacher education environments, the need for digital competence is increasing. The diversification of digital tools in education necessitates the restructuring of teaching processes. In this context, studies addressing digital competence focus on teachers' ability to combine technology with pedagogical purposes (Cabezas-González et al., 2024; Caena & Redecker, 2019; Maphoto & Suliman, 2024; Orakova et al., 2024). Differences in digital competence between prospective teachers and new teachers necessitate the updating of education programs (Konyana & Motalenyane, 2022; Simelane & Pillay, 2024).

Redecker (2017) divides digital competence into five main components within the dimensions of information literacy, communication, content creation, security, and problem solving. Pettersson

(2018) discusses the flexibility and contextuality requirements of conceptual frameworks by relating these five components to the pedagogical context. Caena and Redecker (2019) argue that digital competence frameworks overlap with the needs of 21st-century education and explain how they should be reflected in curriculum design. Spante et al. (2018) clarify the boundaries between the concepts of digital literacy and digital competence, emphasizing the impact of this distinction on educational programs. García-Vandewalle et al. (2023) stress the necessity of incorporating cultural context into digital competence measurement tools. Recent studies also highlight that technological readiness significantly predicts pre-service teachers' digital material design competencies, suggesting that readiness-based interventions may strengthen digital competence beyond demographic or access-related factors (Akın Demircan et al., 2025; Magocha et al., 2025; Mosia & Matabane, 2022). In line with this, systematic reviews in chemistry education reveal that robotics tools (e.g., VR2E2C system, AIR-Chem, LEGO-based automation devices), LMS-integrated platforms (Google Classroom, Moodle, Edmodo), virtual laboratories (PhET, ChemVLab+, iMD-VR), and mobile/desktop software (Elements 4D, MoleculAR, MATLAB) are widely used to enhance instructional practices. These findings show how technological advancement has revolutionized 21st-century instruction, making science learning more concrete and interactive (Aliyu & Talib, 2023; Tarman et al., 2019). Taken together, these perspectives demonstrate that digital competence is a multifaceted construct shaped not only by pedagogical frameworks but also by teachers' readiness to embrace and apply technological innovations (Kilinc et al., 2018; Tshelane, 2022; Yelubay et al., 2022).

The DigCompEdu framework developed by the European Union defines teachers' digital competence in six areas, thus providing educators with a clear skill map. These areas are categorized as professional development, preparation of digital resources, teaching and learning processes, student assessment and feedback mechanisms, teacher collaboration and leadership, and digital security and ethics. Redecker (2017) describes this framework in detail and reveals how each area should be integrated into teacher education programs. Amhag et al. (2019) analyzed the needs for digital tool use in Swedish higher education and revealed the strengths and weaknesses of the DigCompEdu application. This framework supports both digital skill development and the spread of innovative pedagogical practices. For this reason, many educational institutions use the framework as a guide in curriculum design. The fact that it has not yet been adopted in some regions slows down digital transformation processes. Therefore, it becomes necessary not only to

update DigCompEdu education programs but also to specialize teacher educators in this area. Thus, the digital competence framework ensures the integration of institutional structures with digital strategies. Continuous updating of the framework increases its ability to respond to technological innovations (García-Vandewalle et al., 2023; Lindfors et al., 2021).

Teachers' perceptions of digital competence play a critical role in determining educational strategies at both individual and institutional levels. This situation reveals the necessity of teacher educators to use both internal and external evaluation tools together. Therefore, educational institutions create mechanisms that regularly evaluate digital competence perceptions. In addition, teachers' access to continuous professional development programs supports the positive change of perceptions (Spante et al., 2018).

Burnout in Early Career Teachers

The concept of burnout among early-career teachers has emerged as a critical issue due to the increasing workload, emotional demands, and uncertainties in the classroom environment. In this context, burnout is defined by the dimensions of emotional exhaustion, desensitization, and decreased personal accomplishment and is measured quantitatively in educational research with the Maslach Burnout Inventory and other similar scales (Gold et al., 1991, 1992; Friedman, 2003; Modna et al., 2023). In particular, the emotional exhaustion dimension directly affects teachers' level of professional satisfaction and weakens the quality of classroom interaction (Goddard & Goddard, 2006). Additional indicators of desensitization reflect cold and distant attitudes towards students, which complicates both teacher-student and teacher-administration relationships (Jones & Youngs, 2012). The decrease in the perception of personal accomplishment undermines teachers' self-efficacy beliefs and reduces their motivation for professional development (Mijakoski et al., 2022).

However, psychological indicators of burnout include chronic fatigue, sleep disorders, and a decrease in the general quality of life, which negatively affect both the professional and personal lives of teachers (Gold et al., 1992; Yli-Pietila et al., 2024). All of these dimensions are considered critical in the context of teacher health and well-being in the organizational behavior literature. Increased workload, classroom management difficulties, and unclear roles stand out as structural determinants of burnout. However, the need for emotional labor makes it difficult to cope with student behavior and rapidly depletes teachers' emotional resources (Friedman, 2003). In addition,

class sizes and insufficient preparation time allocated for lesson planning are primary sources of structural stress, and burnout levels increase significantly when these arrangements are not made (Jones and Youngs, 2012). In addition, limited opportunities for collaboration in school culture weaken social support networks and isolate teachers (Mijakoski et al., 2022). Both administrative and pedagogical uncertainties cause teachers to experience role conflict, and these conflicts increase the risk of burnout in the long term (Friedman, 2003). Therefore, addressing these structural and emotional determinants together is vital in developing effective intervention strategies.

Burnout is intertwined with the dynamics of self-efficacy perception and emotional labor, and this interaction directly shapes teacher performance and job satisfaction. Evers et al. (2002) reported that high self-efficacy beliefs significantly retarded the development of burnout in Dutch teachers implementing innovative education systems. In contrast, Friedman (2003) showed that the need for event-focused emotional labor triggered more severe burnout symptoms in teachers with low self-efficacy perception. Goddard et al. (2006) reported that self-efficacy perception acts as a buffer that balances depersonalization and reduced personal accomplishment in beginning teachers. In parallel, recent findings indicate that collective teacher self-efficacy also plays a protective role, as it positively predicts job satisfaction and negatively predicts burnout, with job satisfaction mediating this relationship (Yurt, 2022). This suggests that fostering both individual and collective efficacy can be a powerful strategy to mitigate burnout among teachers. Therefore, it seems that developing self-efficacy and emotional labor management skills plays a critical role in preventing burnout. Therefore, it seems that developing self-efficacy and emotional labor management skills plays a critical role in preventing burnout.

The effect of innovative pedagogy on professional competence development has been emphasized recently. Openness to student-centered, interactive, and data-driven approaches rapidly enriches teachers' classroom management and instructional design skills (Pellerone, 2021). Innovation efforts carried out without appropriate support mechanisms become an additional source of stress for teachers, increasing the risk of burnout (Evers et al., 2002). In this context, evaluating beginning teachers' perceptions of innovative pedagogy in conjunction with their professional and digital competencies is crucial. Therefore, the detailed analysis of the perspectives of new-generation teachers in this study increases the effectiveness of educational policies and

professional development programs and contributes to the sustainability of innovative pedagogy strategies.

Purpose of the Study

When looking at the existing studies, there are conceptual and methodological gaps regarding the interactions of innovative pedagogy perceptions, digital competence, and burnout. Previous studies generally examine the building blocks, such as innovative pedagogy perceptions, professional competence, digital competence, or burnout, separately. Zhu et al. (2018) analyze the correlation between digital competence and pedagogical perceptions but exclude the burnout dimension. Mijakoski et al. (2022) comprehensively study the long-term effects of burnout but do not model the interactions between pedagogical and digital competence. Pellerone (2021) examines the effects of pandemic-era digital strategies on resilience but does not model pedagogical perceptions and professional development processes. Goddard and Goddard (2006) address the impact of the work environment on burnout but do not comprehensively analyze digital and pedagogical interactions. Therefore, the existing literature cannot offer a holistic model that simultaneously explains innovative pedagogy perceptions, professional and digital competences, and burnout dynamics. In addition, in the context of Kazakhstan, studies that examine in-depth the perceptions and experiences of new-generation expert teachers regarding these interactions are not sufficient in number and method diversity. This deficiency makes it difficult to design teacher education programs and education policies to respond to current needs. Therefore, this study aims to fill the conceptual and practical gaps in the field by revealing the multivariate relationships of the relevant building blocks.

The main purpose of the present study is to examine the effects of innovative behaviors of new teachers (5 years) on digital competence, burnout, and self-efficacy levels and also to reveal the mediating roles of burnout and teacher self-efficacy on digital competence. For this purpose, the following hypotheses were tested.

H1: Innovative behavior positively affects digital competence.

H2: Innovative behavior negatively affects burnout.

H3: Innovative behavior positively affects teacher self-efficacy.

H4: Burnout negatively affects teacher self-efficacy.

H5: Burnout negatively affects digital competence.

H6: Teacher self-efficacy positively affects digital competence.

Method

Research Design

This study was designed as a correlational survey model to examine the structural relationships between the innovative behaviors of new teachers (5 years) and their digital competence, burnout, and self-efficacy levels. Correlational survey models are models that aim to describe an event or situation as it is and to explain the multifaceted relationships between variables. The event or situation and variables in question are defined within their own conditions, as they are (Creswell, 2012). Figure 1 presents the variables and study design.

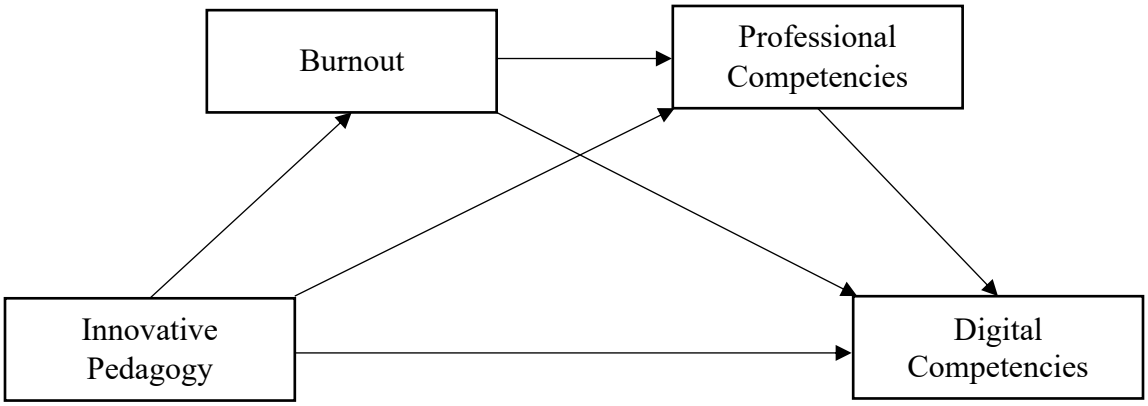

Figure 1. Research Variables and Design

Population and Sample

Since it was possible to reach the entire population, no sampling was used. However, to obtain healthy results, participation in the study was based on volunteering. The participants of this study consisted of 275 new teachers (5 years) who worked in different state schools in the Atyrau Region of Kazakhstan and accepted to participate in the study voluntarily. 58.18% (n = 160) of the teachers who participated in the study were female, and 41.18% (n = 115) were male. It was seen that 61 (22.18%) of the participating teachers had 1 year of experience, 65 (23.63%) had 2, 59 (21.45%) had 3, 57 (20.72%) had 4, and 33 (12.00%) had five years of experience.

Data Collection Process

The scales in the study were applied to volunteer participants in the sample, face-to-face or electronically, after obtaining the necessary permissions of the ethics committee and application. During the data collection process, the purpose of the study was briefly explained to the new teachers, and the volunteers were asked to fill out the scales. The participating teachers individually filled out the scale items. The data collection took 4 weeks.

Data Collection Tools

In this study, data obtained from participants were collected using four different psychometric measurement tools. The scales' validity and reliability have been tested in prior studies, and they have acceptable psychometric properties in Turkish samples.

Innovative Work Behavior Scale: The "Innovative Work Behavior Scale" developed by Çimen and Yücel (2017) was used to determine the innovative behaviors of the participants. The scale is structured as a 5-point Likert type (1 = Strongly Disagree, 5 = Strongly Agree). It consists of four sub-dimensions: idea generation (items 1-2), research (items 3-5), support (items 6-7), and implementation (items 8-10). The internal consistency coefficient of the original form of the scale is quite high (α = .93). This value supports the reliability of the measurement tool.

Digital Competence Scale: The Digital Competence Scale (DCS) was developed by Schwarz et al. (2024) and based on the European Digital Competence Framework, it was used to determine the digital competence levels of the participants. The scale consists of 12 items in total and a 5-point Likert-type response scale is presented to assess the extent to which participants can perform each digital operation. The internal consistency coefficient of the scale was found to be high (α = .939) and the item-total correlations ranged between .686 and .814. These values indicate that the scale has high reliability.

Burnout Scale: The Burnout Scale developed by Pines and Aronson (1988) was used to measure the burnout levels of the participants. Scale items are scored as "1=never" and "7=always." The internal consistency of the Turkish form was found to be high (α = .93), and the test-retest reliability coefficients were reported as .83 for the teacher group and .85 for the textile workshop workers. Besides, criterion-related validity analyses conducted with the Maslach Burnout Inventory-Educator Form showed that there were significant correlations between the total scores of the Burnout Scale and the sub-dimensions at the levels of .57, .30, and –.22, respectively. These findings support the fact that the scale is a valid and reliable tool.

Teacher Self-Efficacy Scale: In the study, a short-form self-efficacy scale developed by Tschannen-Moran and Woolfolk Hoy (2001) was used to determine the level of teacher self-efficacy. The scale has a 5-point Likert-type structure (1 = I cannot do it at all, 5 = I can do it completely) and consists of 12 items in total. Confirmatory factor analysis (CFA) results showed that the three-factor structure of the scale provided a good level of fit in the Turkish sample (CFI = .962, TLI = .950, RMSEA = .067, 90% CI [0.057, 0.076], SRMR = .032). Cronbach's alpha coefficients obtained in the reliability analyses ranged between .84 and .91, and composite reliability (ω) coefficients ranged between .78 and .91. These findings show that the scale exhibits adequate psychometric properties in terms of construct validity and internal consistency.

Data Analysis

In this study, PROCESS macro version 4.2 developed by Hayes (2022) and adapted for SPSS was used to test the direct and indirect relationships between variables. Model 6, which is a sequential mediator model, was preferred in the analyses, and Innovative Behavior was included in the model as the independent variable, Digital Competence as the dependent variable, and Burnout and Teacher Self-Efficacy as the first and second level mediator variables, respectively. 5000 re-samplings were made with the bootstrap method, and all estimates were obtained at a 95% confidence level.

The basic assumptions that must be met for the validity of multivariate analyses were tested before the analysis. First, multicollinearity was checked and it was seen that the correlations between independent variables were below .80. In addition, the highest VIF (Variance Inflation Factor) value was 2.15 and these values being <3 indicate that there is no multicollinearity problem (Yurt, 2023). Within the scope of the normality assumption, the distribution of normalized residuals was evaluated through histograms and P–P plots; it was determined that the skewness and kurtosis values were within acceptable ranges (-1 to +1) (Kline, 2016). These findings show that the residuals were normally distributed.

The linearity assumption was tested with scatter plots to evaluate whether the relationships between dependent and independent variables were linear. It was observed in the obtained plots that the relationships were linear. In order to reduce the effect of outliers, Mahalanobis distance

values were calculated and no observations with extreme values were found. Finally, having a sample above the minimum sample size recommended for reaching sufficient power in mediator models ($n \geq 200$) (Fritz and MacKinnon, 2007) supports the reliability of the results obtained. In line with all these evaluations, it was determined that the data set met the necessary assumptions for multivariate analyses. Thus, it can be said that the conducted model analyses are valid and reliable.

Findings

This section presents the descriptive statistics and correlation results of the main study variables. Before testing the hypotheses, the data were examined in terms of distribution, central tendency, and relationships among the variables to ensure the validity of subsequent analyses. Table 1 includes descriptive statistics and normal distribution test results (Kolmogorov-Smirnov Test) for the four research variables.

Table 1

Descriptive Statistics for Research Variables

	Digital Competence	Innovation	Professional Competencies	Burnout
Mean	3,47	3,69	4,01	1,08
Std. Deviation	0,64	0,69	0,72	0,49
Minimum	1,58	1,50	1,92	0,04
Maximum	5,00	5,00	5,00	2,76
Range	3,42	3,50	3,08	2,72
Skewness	-0,17	-0,16	-0,46	0,41
Kurtosis	-0,14	-0,35	-0,37	0,18
Kolmogorov-Smirnov (Tests of Normality)	0,053	0,050	0,055	0,042
-p-	0,072	0,095	0,060	,200

As seen in Table 1, according to the mean values, the digital competence, innovative behaviors, and professional competence of the participating teacher candidates are at a high level, whereas

their burnout is at a low level. According to the Kolmogorov test results, the data obtained from the four variables show a normal distribution.

Table 2

Correlation Coefficients of Relationships among Research Variables

Variables	Mean	Ss	1	2	3	4
1. Burnout	1.11	0.49	-			
2. Digital competence	3.47	0.64	-.44**	-		
3. Innovative behavior	3.69	0.69	-.38**	.23**	-	
4. Professional Competencies	4.01	0.72	-.62**	.42**	.57**	-

** p < 0,01; N=269

Table 2 shows the Pearson correlation coefficients among the four main variables in the study. According to the findings, there are negative and significant relationships between burnout and digital competence (r = –.44, p < .01), innovative behavior (r = –.38, p < .01) and professional competencies (r = –.62, p < .01). Positive and significant relationships were observed between digital competence and innovative behavior (r = .23, p < .01) and professional competencies (r = .42, p < .01). Besides, there is a strong positive relationship between innovative behavior and professional competencies (r = .57, p < .01). These findings indicate that there are significant structural relationships among the variables and that further analyses can be conducted.

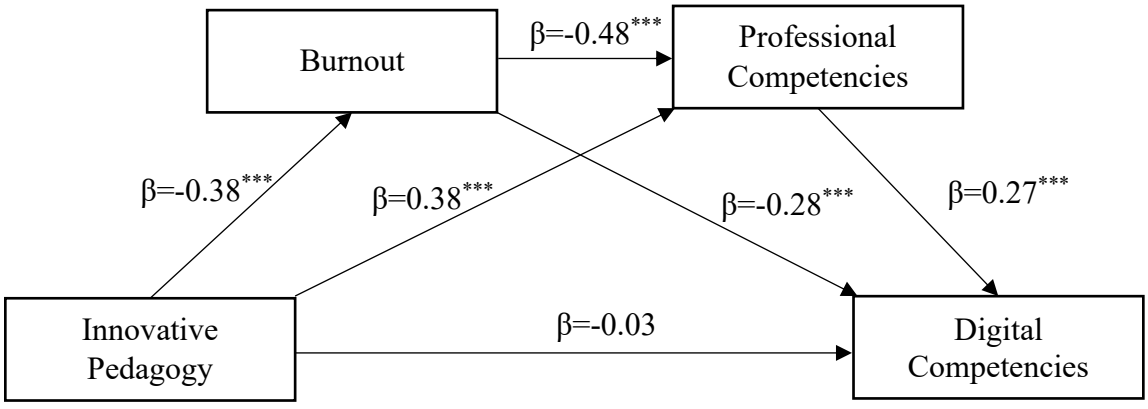

Figure 2. ***Sequential Mediator Model, *** p <.001, N=269***

Table 3

Direct Effects Between Dependent and Independent Variables

Independent Variable	Dependent Variable	B	SE	β	t	p	LLCI	ULCI
IB -->	B	-0,27	0,04	-0,38	-6,73	0,00	-0,35	-0,19
IB -->	TSE	0,40	0,05	0,38	8,30	0,00	0,30	0,49
B -->	TSE	-0,70	0,07	-0,48	-10,36	0,00	-0,83	-0,57
IB -->	DC	-0,03	0,06	-0,03	-0,44	0,66	-0,15	0,09
B -->	DC	-0,37	0,09	-0,28	-4,07	0,00	-0,54	-0,19
TSE -->	DC	0,24	0,07	0,27	3,42	0,00	0,10	0,37

DC= Digital competence, TSE= Teacher self-efficacy, IB= Innovative behavior, B= Burnout, LLCI= Lower limit of confidence interval, ULCI= Upper limit of confidence interval

When the direct effects in Table 3 are examined, the effect of innovative behavior on burnout is statistically significant (B = -0.27, p < .001) and this relationship is negative. In other words, as the level of innovative behavior increases, the level of burnout decreases. Burnout also has a negative effect on teacher self-efficacy (B = -0.70, p < .001). The direct effect of innovative behavior on self-efficacy is positive and significant (B = 0.40, p < .001). When the direct effects on digital competence are examined, it is seen that burnout has negative effects (B = -0.37, p < .001) and self-efficacy has positive effects (B = 0.24, p = .001). However, the direct effect of innovative behavior on digital competence is not significant (B = -0.03, p = .66).

Table 4

Total, Direct and Indirect Effects of Innovative Behavior on Digital Competence

Effect Type	B	SE	β	t/z	p	LLCI	ULCI
Total Effect (c)	0,21	0,06	0,23	3,82	0,00	0,10	0,32
Direct Effect (c')	-0,03	0,06	-0,03	-0,44	0,66	-0,15	0,09
Total Indirect Effect	0,24	0,04	0,26	-	-	0,15	0,33

Indirect Effects							
IB --> B --> DC	0,10	0,03	0,11	-	-	0,04	0,17
IB -->TSE -->DC	0,09	0,03	0,10	-	-	0,04	0,16
IB --> B --> TSE --> DC	0,05	0,02	0,05	-	-	0,02	0,08

DC= Digital competence, TSE= Teacher self-efficacy, IB= Innovative behavior, B= Burnout, LLCI= Lower limit of confidence interval, ULCI= Upper limit of confidence interval

The significance level of the indirect effects presented in Table 4 was assessed according to whether the confidence intervals (CI) included the zero value. The 95% confidence intervals obtained with the bootstrap method did not include the zero value, indicating that the relevant indirect effect is statistically significant (Yurt, 2023). Accordingly, the total indirect effect of innovative behavior on digital competence was found to be significant (B = 0.24, 95% CI [0.15, 0.33]). This result reveals that the mediating variables play an important role in the model.

When the indirect effects were examined separately, the effect of innovative behavior on digital competence through burnout was significant (B = 0.10, 95% CI [0.04, 0.17]). Similarly, the indirect effect observed through teacher self-efficacy was also found to be significant (B = 0.09, 95% CI [0.04, 0.16]). In addition, the effect of innovative behavior on digital competence was statistically significant when burnout and teacher self-efficacy were mediated together (B = 0.05, 95% CI [0.02, 0.08]).

The findings generally show that innovative behavior has a direct positive effect on digital competence. However, when burnout and teacher self-efficacy are included in the model, it is understood that this direct effect loses its significance and the entire relationship is mediated by these two variables. In this context, teacher self-efficacy plays a positive mediating role, while burnout acts as a negative mediating variable. This indicates that in order for teachers' innovative behaviors to increase their digital competence levels, their self-efficacy beliefs should be strengthened and their burnout levels should be reduced.

Discussion

The rapid spread of digital technologies in educational environments today necessitates the redefinition of teachers as individuals equipped not only with pedagogical but also with digital and

emotional competencies. In this context, how teachers' innovative behaviors are reflected in their professional competencies has become a critical area of research regarding teaching quality and student success. This study examines the effects of innovative pedagogy tendencies of teachers in the first five years of their professional lives on their digital competencies, burnout levels and self-efficacy beliefs with a multidimensional model. In the research model, innovative behaviors are considered as the independent variable; digital competence is positioned as the dependent variable, and burnout and self-efficacy are positioned as sequential mediating variables. This structure explained how pedagogical creativity intersects with digital skill development, professional well-being indicators and psychological resilience. The study conducted in the Turkish sample is the first holistic model attempt to test these four structures simultaneously.

In the study, firstly, the hypothesis "*H1: Innovative behavior positively affects digital competence*" was tested. The findings show that as teachers actively participate in the processes of generating and implementing creative ideas, their capacity to use digital tools for pedagogical purposes increases significantly. This confirms the relationship between creative digital content production and pedagogical creativity stated in the DigCompEdu framework by Redecker (2017). Similarly, it is consistent with the findings emphasized by Zhu et al. (2018) that innovative attitudes accelerate digital skill acquisition. Lammassaari et al.'s (2022) findings that epistemic approaches that nurture teacher beliefs diversify digital practices are also consistent with the research results. Deroncele-Acosta et al. (2022) showed that innovative strategies increase digital tool use in the Latin American context; in the present study, this relationship was empirically confirmed for the first time in the Kazakhstani context. Furthermore, the study's results align with Caena and Redecker's (2019) recommendations to integrate digital competence frameworks with innovative pedagogies. While Amhag et al. (2019) stated that digital tool trainings support creative instructional design in the Swedish sample, Pettersson (2018) emphasized that digital literacy alone is not sufficient and that a creative approach is also necessary for pedagogical competence. In contrast, Portillo et al. (2020) reported in their data regarding the COVID-19 process that skill development remained limited in teachers who saw digitalization as a necessity. The research results reveal that innovative behaviors play a driving role in digital competence development, but they draw attention to the importance of institutional support and professional development opportunities in terms of the sustainability of this effect. Teachers involved in creative problem-solving processes analyze digital data more effectively, in line with the technology-supported

classroom practices defined by Donovan et al. (2014), and this strengthens instructional design. Therefore, the hypothesis has received validation from various theoretical frameworks and empirical evidence.

Secondly, the hypothesis "*H2: Innovative behavior negatively affects burnout*" was tested in the study. The findings show that teachers who adopt creative pedagogical approaches experience significant reductions in burnout symptoms such as emotional exhaustion, depersonalization, and decreased personal accomplishment. This result is consistent with the findings of Evers et al. (2002) regarding the positive effects of innovative practices on teacher well-being. Pellerone (2021) stated that psychological resilience increases in teachers who use digital strategies, while Jones and Youngs (2012) revealed that daily stress levels are lower in teachers who work with creative methods. Goddard Goddard's (2006) suggestions regarding the interaction between organizational support and innovative pedagogy add a structural dimension to this relationship. Friedman's (2003) warning reminds us that, without support, creative initiatives may increase the stress load and highlights the necessity of preparation and support mechanisms. Deroncele-Acosta et al. (2022) found an inverse relationship between digital innovation and burnout while reinforcing the consistency of the study with the international literature; the supportive effect of epistemic beliefs on professional well-being emphasized by Lammassaari et al. (2022) explains the cognitive connection between innovative attitude and psychological well-being. In addition, Mijakoski et al. (2022) indicated professional learning communities among the stress-reducing factors, and Richardson et al. (2013) stated that emotional coping strategies can reduce burnout when used together with innovative methods, reinforcing this relationship. On the other hand, Schwab, Jackson, and Schuler's (1986) findings on the early career adaptation process draw attention to the fact that insufficiently structured creative initiatives can create stress, revealing the necessity of systematic planning. All this evidence reveals that innovative behaviors have a protective effect on burnout and that their sustainability is directly related to organizational support, mentoring, and access to resources. The hypothesis has been confirmed in consistency with multidimensional theoretical and empirical data.

Thirdly, the hypothesis "*H3: Innovative behavior positively affects teacher self-efficacy*" was tested in the study. The analyses show that the self-efficacy perceptions of teachers who developed creative pedagogical strategies increased significantly in the areas of classroom management, content presentation, and evaluation. This result is consistent with Bandura's (2011) mastery

experience principle. It indicates that teachers' self-confidence increases as they gain success experience through creative practices (Chong, 2011). Julia et al. (2020) and Evers et al. (2002) emphasized that innovative practices strengthen self-efficacy beliefs. Peterson et al. (2018) reported that teachers who adopt a creative approach experience positive changes in their self-evaluations. Creative digital content production suggested by Redecker (2017) within the DigCompEdu framework explains this relationship by providing successful experience opportunities that reinforce self-efficacy. Instefjord and Munthe (2017) observed significant increases in self-efficacy in pre-service teachers who participated in digital projects. However, Huntly (2008) pointed out that this increase could be limited without supportive mentoring; Avalos (2016) emphasized the positive effect of research-based professional learning on self-efficacy. Additionally, Caena and Redecker (2019) argued that the systematic promotion of creative pedagogy contributes to developing strategic self-efficacy, while Portillo et al. (2020) demonstrated that digital creativity can enhance self-efficacy levels even in crisis environments. All this evidence suggests that innovative behaviors serve as a powerful psychosocial resource that increases teacher self-efficacy, and this hypothesis is clearly confirmed by theoretical and empirical foundations.

Fourthly, the hypothesis "*H4: Burnout negatively affects teacher self-efficacy*" was tested in the study. The findings show that as the level of emotional exhaustion increases, teachers' beliefs about successfully completing classroom tasks weaken. This relationship is consistent with Friedman's (2003) findings that reveal the destructive effect of emotional labor on low self-efficacy. Goddard et al. (2006) pointed out that lack of organizational support both increases burnout and decreases the level of self-efficacy. Similarly, Jones and Youngs (2012) stated that teachers' self-efficacy scores decline on stressful days. Mijakoski et al. (2022) revealed that long-term stress negatively affects psychological resilience and self-efficacy perception. Evers et al. (2002) emphasized that chronic burnout can prevent the increase in self-efficacy even within innovative systems. Lauermann and König (2016) stated that burnout causes loss of self-efficacy even in teachers with high levels of pedagogical knowledge. Dworkin (1987) stated that structural stress factors (workload, role ambiguity) reinforce this relationship. The results of the model show that burnout erodes self-efficacy more when support mechanisms such as mentoring and professional learning communities remain weak. Teachers under emotional load have a lower tendency to take pedagogical risks, their openness to innovations in the classroom decreases, and this creates a

vicious circle in the perception of self-efficacy, limiting professional development. Therefore, the hypothesis has been confirmed with multidimensional theoretical and empirical data. It has been revealed that burnout is a basic psychological stressor that weakens teacher self-efficacy.

Fifthly, the hypothesis "*H5: Burnout negatively affects digital competence"* was tested in the study. According to the model outputs, it is seen that teachers with high emotional loads are reluctant to integrate digital tools into the teaching-learning processes, and this negatively affects their digital competence levels. This finding is consistent with the findings of Portillo et al. (2020) that teachers with high stress levels limit the use of online tools. Deroncele-Acosta et al. (2022) stated that digital innovation fails in institutions where burnout is common. Lammassaari et al. (2022) emphasized that burnout can undermine digital motivation even if epistemic beliefs are strong. While Spante et al. (2018) demonstrate the necessity of a positive attitude for digital competence, they argue that emotional exhaustion weakens this attitude. Pellerone (2021) found that teachers with low psychological resilience remain distant from digital strategies. Goddard et al. (2006) reported that stress indirectly prevents technology use. On the other hand, Amhag et al. (2019) emphasized that digital training supported by stress management can increase teacher interest and pointed out the reversibility of this relationship. Redecker's (2017) professional development component in the DigCompEdu framework remains ineffective when emotional well-being is not taken into account. According to Lindfors et al. (2021), low institutional readiness strengthens the relationship between burnout and digital skills. All these findings show that when teachers direct their energy to emotional coping, they cannot allocate time and motivation to digital skill development. This situation reduces the quality of technology integration and negatively affects the student learning experience. Therefore, the hypothesis has been confirmed with multiple theoretical and empirical data. It has been revealed that burnout is a fundamental psychological barrier that prevents digital competence development.

Finally, the hypothesis "*H6: Teacher self-efficacy positively affects digital competence"* was tested in the study. The analyses reveal that teachers who believe that they will successfully complete their classroom duties have a higher tendency to produce digital materials and use online platforms. Redecker's (2017) DigCompEdu framework predicts that teachers with high self-efficacy are more active in digital content production. The high professional readiness-technology integration relationship reported by Julia et al. (2020) and Evers et al. (2002) supports this result. Instefjord and Munthe (2017) showed that as pre-service teachers' self-efficacy levels increase, their digital

tool use competence increases. Caena and Redecker (2019) stated that this situation increases success rates at the policy level. Amhag et al. (2019) found a positive relationship between teacher educators' self-efficacy levels and their participation in digital design activities. Portillo et al. (2020) stated that teachers with high self-efficacy levels used innovative tools in online courses even under pandemic conditions. Lammassaari et al. (2022) emphasized the complementary structure between epistemic belief development and digital experience seeking, while Spante et al. (2018) reported that teachers with low self-efficacy tend to avoid digital development. These findings show that as teachers' self-efficacy increases, they are more willing to try, adapt, and use digital tools, and this enriches the instructional design. In addition, high self-efficacy facilitates the adoption of new technologies by reducing the anxiety of making digital mistakes. The hypothesis has been consistently confirmed with both the theoretical framework and multi-context empirical data. It has been clearly demonstrated that self-efficacy creates a leverage effect in the acquisition of digital competence. Nevertheless, some limitations should be acknowledged. The reliance on cross-sectional data restricts causal inferences, the use of self-report measures may have introduced response bias, and the focus on two cities in Kazakhstan limits generalizability. Future studies could adopt longitudinal designs, incorporate qualitative methods, and replicate the model in different cultural contexts to enhance the robustness and applicability of the findings.

Although this study explains the relationships between teachers' innovative attitudes and digital competence, self-efficacy, and burnout levels within the framework of a multivariate model, some methodological limitations should be taken into account. First of all, the data set is limited to volunteer teachers working in only two major cities of Kazakhstan. This makes it difficult to reflect geographical and cultural diversity and limits the generalizability of the findings. Second, the fact that the data were collected through self-report scales may have caused biases due to the participants' social desirability tendencies. Third, the cross-sectional design of the study limits the determination of causal relationships between variables. Sequential mediation analyses were limited to correlation-based interpretations. Therefore, longitudinal studies are necessary to monitor processes such as the course of burnout over time or the development curve of self-efficacy. In addition, environmental factors such as the socioeconomic level of the school, the administrative environment, or parental expectations that may affect teacher well-being could not

be controlled in this study. These limitations require careful interpretation of the results and a more comprehensive design of future studies.

Conclusion and Recommendations

As a result, the present study has made an original contribution to the field of pedagogical innovation by presenting a holistic model that explains the relationship between teachers' innovative behaviors and digital competence, self-efficacy, and burnout. The findings indicate the necessity of addressing teacher well-being and psychological empowerment together with digital skill development. Nevertheless, the study has certain limitations, including its cross-sectional design, reliance on self-report data, and focus on teachers from two major cities in Kazakhstan. Future research should therefore consider longitudinal designs, include qualitative methods, and replicate the model in different cultural contexts. This approach can provide a sustainable basis not only for individual professional development but also for the digital transformation of education systems. The model proposed by the study contributes to data-based decision-making processes for policy makers and education leaders while providing an expandable ground for further research in the areas of cross-cultural validity, longitudinal monitoring, and artificial intelligence-supported application.

This study reveals the relationships between teachers' innovative pedagogical attitudes and digital competence, burnout, and self-efficacy levels, while providing multidimensional expansions for future research. It is recommended that variables such as job satisfaction, organizational commitment, and professional identity be included in the model. Longitudinal designs can monitor the temporal variability of burnout and self-efficacy processes. Multi-center studies conducted with teachers from different cultural contexts will increase the generalizability of the model. The effects of innovative attitudes on classroom practice can be examined in more depth with qualitative methods such as focus group interviews or in-class video analyses. Experimental studies testing the effects of AI-supported tools on burnout and holistic analyses evaluating the reciprocal relationship between student learning data and teacher digital competence will contribute to the literature.

At the implementation level, it is important to support innovative pedagogy in teacher training programs with self-efficacy-based workshops, organize online digital innovation events, and support new teachers with structured mentoring systems. Transforming data-based feedback

sessions into regular practice in professional learning communities can accelerate digital skill development. It is recommended to establish micro-credit systems that encourage digital practices at the national level, to expand welfare support packages for teachers at risk of burnout, and to integrate educational technology investments with technical support. In addition, encouraging teacher candidates to produce digital content, adding innovation and emotional labor criteria to performance evaluation systems, and developing standard platforms that support the sharing of open-source content are practices that will strengthen the sustainability of the proposed model.

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