BMC Psychology

RESEARCH

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# Digital transformation in physical education: chain mediator model of self-efficacy burnout and professional development

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## Abstract

**Background** This study examined the relationship among burnout, professional development, and self-efficacy among physical education teachers in universities.The focus is on issues such as teachers' self-efficacy and general efficacy, professional burnout, and professional development in the digital age. Physical education teachers in higher education may experience reduced self-efficacy and professional well-being in digital environments, leading to professional burnout and diminished motivation for professional development. Although this issue holds significant implications for professional development, research evidence specifically targeting physical education teachers remains limited.

**Methods** March to April 2025, a total of two hundred and fifty-eight physical education teachers from public universities in Henan Province, China, voluntarily participated in this survey. Data were collected via an online survey including the Burnout Self-Assessment Scale(BSAC), the General Self-Efficacy Scale(GSES),, and the Professional Development Questionnaire(PDQ). Descriptive statistics and SEM were employed for analysis. along with Pearson correlation to assess relationships between variables.

**Results** Physical education teachers' burnout showed a significant negative correlation with personal teaching efficacy ($r=-0.186$, $p<0.01$), general teaching efficacy ($r=-0.197$, $p<0.01$), and professional development ($r=-0.151$, $p<0.05$) in the digital.Among the self-efficacy variables, personal teaching efficacy ($r=0.674$, $p<0.01$) and general teaching efficacy ($r=0.717$, $p<0.01$) both showed significant positive correlations with professional development. Personal and general teaching efficacy showed a positive correlation ($r=0.745$, $p<0.01$). Personal teaching efficacy significantly fully mediated the relationship between professional burnout and general teaching efficacy ($\beta=-0.186$, $p<0.01$). General teaching efficacy fully mediated the relationship between personal teaching efficacy and professional development ($\beta=0.566$, $p<0.001$). In the chain-mediated model, Personal and general teaching efficacy together formed a significant chain-mediating pathway between professional burnout and professional development ($\beta=-0.106$, $p<0.01$). These findings indicate that self-efficacy plays a significant role in burnout and professional development among physical education teachers.

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**Conclusion** This study indicates that self-efficacy and occupational burnout are key factors influencing the professional development of university physical education teachers. Higher levels of self-efficacy enhance teachers' professional development, while higher levels of occupational burnout diminish it.

**Keywords** Digital, Physical education, Self-Efficacy, Burnout, Professional Development

## Introduction

In recent years, the rapid advancement of digital technology has been transforming education worldwide, reshaping teaching methods, learning environments, and educators' roles. Cutting-edge technologies such as big data, artificial intelligence, virtual technologies, and online learning platforms have been integrated into the educational landscape [1–3]. It has given rise to new teaching models while simultaneously presenting fresh demands for teachers' professional development. Digital professional development represents an inevitable direction for teachers' future career growth [4]. Every year, many countries invest substantial resources in professional development (PD) to improve teaching quality and classroom effectiveness [5]. While digital transformation presents opportunities for pedagogical innovation and teaching efficiency, it also poses significant challenges for educators. It is particularly true in physical education disciplines, which heavily rely on the instructor's skills, contextual interaction, and real-time feedback [6, 7]. Therefore, teacher professional development remains an important topic in educational research. Giving priority to professional development can greatly enhance teachers' motivation to learn.

### Factors related to professional development

Compared to other subjects, physical education emphasizes physical activity, mastery of athletic skills, and direct interaction with teachers in the classroom. Therefore, integrating digital technology requires physical education teachers to possess not only traditional teaching skills but also advanced digital competencies. It increases teachers' workload and the pressure to continuously learn new technologies, thereby heightening the risk of professional burnout. Effective digital professional development can strengthen teachers' knowledge and instructional competencies [8], thereby positively influencing student learning. Additionally, teacher professional development influences their sense of self-efficacy. Qualitative research based on RORAIMA emphasises that self-efficacy positively affects the professional development of physical education teachers [9]. Despite differences among school subjects, the relationship between self-efficacy and teacher professional development remains consistent across disciplines [10]. Examining the relationship between burnout and professional development among university physical education teachers can yield valuable insights for educators and researchers in PE teaching. This research also establishes a foundation for enhancing the quality of school teaching environments and strengthening teachers' professional competence.

Scholars widely recognize professional development as a crucial factor in enhancing teaching quality and driving educational innovation. Against the backdrop of advancing digital technologies, professional development enables teachers to master emerging instructional skills and adapt to evolving teaching environments. However, teachers' participation in professional development is not solely determined by external circumstances; internal psychological mechanisms also influence it. Self-efficacy, a core concept in Bandura's social cognitive theory, has been repeatedly identified as a key factor in teachers' motivation, persistence, and professional commitment [11, 12]. Self-efficacy refers to an individual's belief in their ability to perform the necessary behaviours required to achieve specific performance outcomes [13]. Among university physical education teachers, expectancy self-efficacy is associated with professional development; however, studies exploring this relationship in this population remain limited. For teachers experiencing low levels of burnout, high self-efficacy may further promote professional development. Self-efficacy also serves as an important mediator between teacher burnout and professional development [14, 15]. Furthermore, structural equation modelling (SEM) results show that self-efficacy mediates the relationship between teachers' professional development and the two main dimensions: professional attitudes and the application of teaching strategies [16]. Therefore, future research should place greater emphasis on exploring the relationships among physical education teachers' self-efficacy, burnout, and the effects of self-efficacy on their professional development.

### Chain mediation of self-efficacy

Previous research has confirmed that high levels of professional burnout are typically associated with reduced self-efficacy, which in turn leads to decreased engagement in professional development. However, existing studies primarily examine self-efficacy as a single, isolated factor. According to Bandura's theoretical framework [11], self-efficacy operates across multiple levels, from specific contexts to broader professional development. In teaching contexts, occupational stress and emotional exhaustion may undermine teachers' Personal Teaching Effectiveness (PTE). In turn, erodes their General Teaching Effectiveness (GTE) and ultimately limits

their willingness to engage in continuous professional development (PD). It suggests a chain-mediated mechanism through which burnout influences PD by affecting different dimensions of self-efficacy. Additionally, the primary theoretical framework explaining burnout is the Job Demands–Resources (JDR) model [17, 18]. According to Maslach's classic definition, burnout comprises three dimensions: emotional exhaustion, depersonalization, and reduced personal accomplishment [19]. It has identified numerous variables associated with burnout, such as stress [20], teacher well-being [21], job satisfaction [22, 23], and work engagement [24]. These dimensions can also influence teachers' work behaviours, psychological needs, and professional development, as reflected in issues such as low motivation, early retirement, job turnover, and changes in self-efficacy [25]. Therefore, it is essential to consider multiple factors comprehensively in order to establish supportive work environments and effective professional development mechanisms that can alleviate teachers' occupational burnout.

Although this chained mediation process is theoretically plausible, empirical evidence remains limited, especially among physical education instructors in Chinese universities. Most existing studies focus on elementary and secondary school teachers in other disciplines, with few examining the unique professional context of university-level physical education instructors. In China, these teachers face distinctive challenges, including curriculum reform and the digitization of teaching, and these multifaceted pressures may interact in complex ways to shape their professional burnout, self-efficacy, and professional development.

At present, few studies have examined the relationship between self-efficacy and occupational burnout among university physical education teachers, nor have they explored how burnout interventions might influence professional development through self-efficacy. Thus, investigating these relationships holds significant value for promoting the professional development of university physical education teachers.

## Theoretical background and assumptions

This study examines the relationship between occupational burnout and professional development by considering the mediating role of self-efficacy. A review of existing literature has been conducted to establish a theoretical foundation and clarify the interactions among these variables.

### Theoretical framework

Social Cognitive Theory [26, 27] and Job Demands–Resources (JD-R) theory [28, 29] both emphasise the role of cognition in shaping professional development and attitudes. Additionally, Desimone proposed a preliminary conceptual framework for teacher professional development (TPD), focusing primarily on two core components: the key characteristics of effective professional development and the operational theories underlying TPD [30]. Philipsen et al. further synthesised a conceptual framework for TPD in Online and Blended Learning (OBL), comprising six core elements: programs and environments, existing contexts, teacher mobility, overall goals and relevance, TPD strategies, and assessment of OBL-related knowledge, skills, and attitudes [31]. Social Cognitive Theory highlights the interaction among individual, behavioural, and environmental factors, underscoring the relationships among self-efficacy, job performance, and professional development. The JD-R theory remains one of the leading conceptual models for explaining factors influencing employee burnout during work processes [28]. Burnout and stress may arise from two primary dimensions: job demands and job resources [32]. Extensive research has demonstrated the JD-R model's relevance for studying burnout, self-regulation, job satisfaction, and professional development [33–36].

Digital professional development serves as the central theme of this study, while the TPD theoretical framework represents a mainstream paradigm within the teaching profession. Personal teaching efficacy serves as an individual teacher's psychological resource. At the same time, professional burnout reflects personal psychological emotions, both of which align with the personal resources component of the JD-R model. General teaching efficacy refers to a teacher's overall belief during instruction, and professional development represents the growth-oriented demand within teaching resources. Enhanced by social cognitive theory and teacher professional development theory, the multifaceted integrated JD-R model better adapts to the digital education era. Personal resources, through the replenishment and regulation of work resources, facilitate the fulfillment of work demands. Although the JD-R framework for occupational burnout is well established, it has not yet been applied to digital professional development. Moreover, research examining how occupational burnout influences professional development through self-efficacy among university physical education teachers remains insufficient, underscoring the need for further exploration—a gap this study seeks to address. This study hypothesises that self-efficacy mediates the relationship between occupational burnout and professional development: higher self-efficacy enhances professional development and, in turn, reduces occupational burnout. Therefore, by integrating and extending emerging digital perspectives, this research investigates how self-efficacy and occupational burnout affect the professional development of university physical education teachers. Collectively, this study constructs a chain mediation model, as shown in Fig. 1:

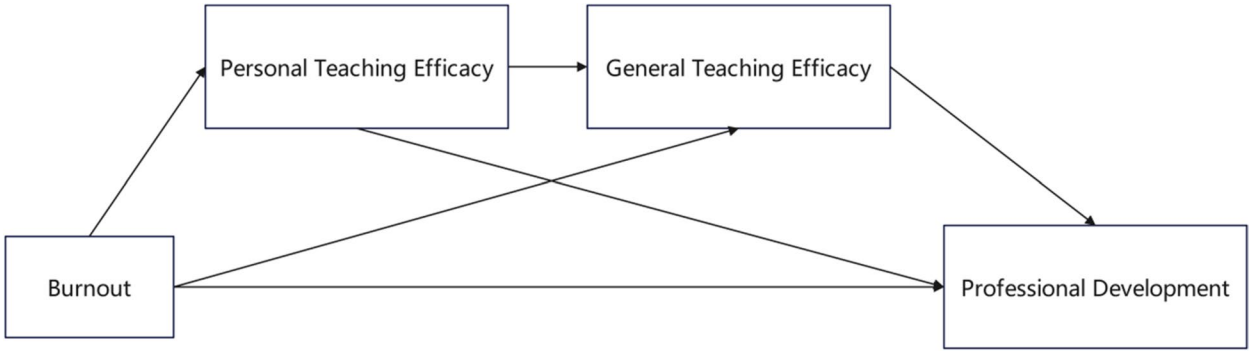


**Fig. 1** Chain mediation hypothesis model

### Relationship between teacher burnout and professional development

Burnout is commonly discussed in relation to teachers' professional development. Fessler and Christensen surveyed 160 teachers and found that those experiencing professional frustration and burnout reported more positive attitudes toward professional growth, suggesting that burnout may in some cases be short-lived or situational [37]. Furthermore, vocational training and professional education have been examined within the JD-R resource model as interventions aimed at reducing teacher burnout through job remodelling and adaptive regulation [17, 38, 39]. Although some evidence indicates that burnout may coexist with professional engagement under certain conditions, the predominant body of research suggests that sustained professional burnout is more likely to hinder teachers' long-term professional development. Accordingly, this study hypothesises that professional burnout is negatively associated with the professional development of physical education teachers, while acknowledging that this relationship may vary across contexts.

> $H_a1$ There is a negative correlation between burnout and digital professional development.

### Teacher burnout, professional development, and self-efficacy

Although the relationship between professional burnout and teacher professional development has been widely studied, research examining the mediating role of self-efficacy in this context remains limited. Existing evidence suggests that self-efficacy not only mitigates professional burnout but also fosters professional development, pointing to its potential role as a mediator between these two variables. For example, Brown found a significant effect between teachers' professional development and self-efficacy [40]. Teachers need to be confident enough to design and implement online or hybrid courses. Italian scholars define it as the teacher's belief in his or her ability to perform professionally relevant tasks (teaching tasks, managing students and classroom discipline issues, etc.) and challenges (professional competence, innovation) [41]. Teacher self-efficacy is defined as the teacher's belief in his or her ability to accomplish teaching tasks and to develop professionally and effectively [42]. Given these findings, this study hypothesizes that self-efficacy mediates the relationship between burnout and professional development among physical education teachers in higher education institutions.

> $H_a2$ There is a negative correlation between self-efficacy and burnout.
> $H_a3$ There is a positive correlation between self-efficacy and digital professional development.

### Personal teaching efficacy and general teaching efficacy

Building on Rotter's theory, Bandura posited that individual behavior is influenced not only by reinforcement in a broad sense but also by personal self-perception and self-efficacy [43]. Guskey et al. distinguished between extrinsic and intrinsic factors in personal efficacy and teaching efficacy [44]. An individual's confidence in teaching depends on the teacher's personal capabilities, such as student management skills and computer proficiency [45]. Working conditions, workload, and instructional tasks form the core of teaching practice [46]. A teacher's general teaching confidence reflects the sense of accomplishment gained while performing these duties. Personal teaching efficacy, rooted in self-efficacy, not only fulfills individual needs but also strengthens educators' pedagogical convictions. Teachers with strong PTE are more likely to experience instructional success, accumulate mastery experiences, and develop a stable sense of professional competence. These positive experiences reinforce generalized beliefs about the power of teaching as a whole, thereby enhancing GTE. Conversely, persistent doubts about one's instructional capabilities may erode confidence in the broader educational mission, thereby weakening GTE. Empirical evidence supports a positive association between PTE and GTE, indicating a sequential belief transmission mechanism. The interaction

between personal and general teaching efficacy has not been investigated; therefore, Hypothesis 4 of this study also examines the two dimensions of self-efficacy and their joint mediating effects.

> $H_a4$ The mediating role of Self-efficacy on the relationship between burnout and digital professional development.

## Methodology

### Study design

This study employed a cross-sectional and quantitative correlational research design. Perceived burnout was measured using the Burnout Scale for Physical Education Teachers (BSPET) [47]. Participants' professional development was assessed using the Scale for Teachers' ICT Integration Proficiency (STICTIP) [48]. Self-efficacy was measured using the High School Physical Education Teachers Self-Efficacy Scale (HSPETSS) [49]. Pearson correlation analysis and multiple linear regression analysis were conducted to examine the relationships among professional burnout, professional development, and self-efficacy. The questionnaire survey also collected demographic information, including gender and age. Given the Likert-type nature of the data, nonparametric tests were used to examine gender and age differences in professional development. The Ethics Committee of Universiti Putra Malaysia granted ethical approval for this study, with approval documented in Letter No: JKEUPM-2023–701.

### Participants sampling

This study employed quantitative research methods and used written self-assessment questionnaires as the primary data collection tool. Participants included physical education teachers from 17 public universities in Henan Province, China. In Structural Equation Modeling (SEM) research, Monte Carlo simulations indicate that samples of approximately 200–250 provide sufficient statistical power (≥ 0.80) for detecting mediation effects, particularly when bootstrap techniques are applied [50–52]. Power analysis (e.g., via G-Power) may suggest a much lower number; in a linear multiple regression, the $R^2$ increase model sample size was 77 (Power > 0.8). The research team used a stratified, proportional random sampling method to survey 260 teachers. After excluding two teachers who declined to provide informed consent, 258 valid data questionnaires were collected.

### Data collection

Data collection was conducted from March to April 2025 using an online questionnaire administered via the WJX.CN platform (https://www.wjx.cn/). First, from among the 178 higher education institutions in Henan Province, private schools were excluded, selecting only 122 public institutions. Subsequently, based on institutional ranking tiers, the sample included 2 key universities, 8 comprehensive universities, and 7 general vocational colleges. The research team generated QR codes and distributed them through WeChat groups managed by the physical education departments of participating institutions. Faculty members from 17 general universities, key colleges, and vocational and technical colleges were invited to participate anonymously and complete the questionnaire at random.

All participants provided informed consent prior to participation. The consent procedure clearly outlined the study objectives, procedures, and confidentiality measures, ensuring that respondents fully understood their rights and that their data would remain anonymous and be used solely for research purposes. Only participants who provided consent could access the questionnaire. To reduce common method bias, anonymity was ensured, and respondents were encouraged to answer honestly. All questions must be completed sequentially; respondents cannot proceed to the next question until the current one is finished. The average completion time is approximately 235 s. A total of 258 valid questionnaires were obtained from physical education teachers in higher education institutions across Henan Province.

### Measures

#### *Burnout scale for physical education teachers*

It measures burnout among college physical education teachers in the context of digital technology. It is primarily based on the recognised Maslach Burnout Inventory (MBI), which has three dimensions: emotional exhaustion, depersonalisation, and personal accomplishment [19]. Building on this, scholars Li & Wang adapted it for use with university physical education teachers, creating the Burnout Scale for Physical Education Teachers [53]. The revised burnout scale has 13 items, and the Cronbach's alpha of the total scale is 0.925.

#### *Scale for Teachers' ICT Integration Proficiency*

Professional Development for Physical Education Teachers, revised by the Scale for Teachers' ICT Integration Proficiency by Valverde-Berrocoso et al. [48]. This scale consists of 20 items, each rated on a 5-point Likert scale ranging from "Strongly disagree" to "Strongly agree." For example, items include "I feel the need for more training and education regarding digital physical education," and "In the digital context, I feel significant improvement in my teaching abilities." These items help measure physical education teachers' professional development levels and provide valuable insights into their current professional development status. The Cronbach's alpha for the scale was 0.934.

**Table 1** Reliability and validity for this construct

| Construct | Cronbach's α | Omega | AVE | CR | FL |
|---|---|---|---|---|---|
| Bur (9 items) | 0.912 | 0.908 | 0.625 | 0.830 | 0.779–0.921 |
| PTE (4 items) | 0.883 | 0.883 | 0.553 | 0.832 | 0.730–0.856 |
| GTE (5 items) | 0.840 | 0.840 | 0.520 | 0.811 | 0.672–0.759 |
| PD (9 items) | 0.936 | 0.936 | 0.517 | 0.864 | 0.878–0.970 |

*Bur* burnout, *PTE* personal teaching efficacy, *GTE* general teaching efficacy, *PD* professional development

#### *High school physical education teachers' self-efficacy scale*

It measures the level of self-efficacy among college physical education teachers in the context of digital technology. It is primarily based on Bandura's self-efficacy theory [54], and the scholar Pan [49] adapted it for use with High School Physical Education Teachers, creating the Self-efficacy Scale. The self-efficacy scale has 14 items, and the Cronbach's alpha of the total scale is 0.91. Personal teaching efficacy includes seven items, such as "I am good at physical education curriculum design", and Cronbach's alpha is 0.84. General teaching efficacy includes seven items, such as "Even though I spend much time, I still cannot motivate students who lack interest in physical education", and Cronbach's alpha is 0.928.

#### *Data analysis*

This study used SPSS 29.0 and Amos 29.0 for data analysis [55]. The data analysis proceeded in three stages. In the first stage, descriptive analysis summarized participants' demographic characteristics. The data met the assumptions of normality, thereby strengthening the validity of the measurement models and supporting the accurate interpretation of the results [56]. Skewness values ranged from −0.150 to 0.271, and kurtosis values ranged from −0.182 to 0.854. All values fell within the acceptable range of ± 2 [57, 58], indicating that the data followed a normal distribution. The sample comprised 155 male and 103 female teachers. Regarding age distribution, 17 participants were younger than 29 years, 86 were aged 30–39 years, 118 were aged 40–49 years, and 36 were aged 50–59 years, indicating that the majority of the sample (79.1%) fell within the 30–49-year age range. The mean age category score was 2.68 (SD = 0.81), and the mean gender score was 1.40 (SD = 0.49). In the second stage, Pearson correlation analysis examined the relationships among professional burnout, the two dimensions of self-efficacy (personal teaching efficacy and general teaching efficacy), and professional development in the digital era. In the third stage, the study applied structural equation modeling (SEM) to evaluate how self-efficacy and occupational burnout predicted professional development, including the mediating role of self-efficacy in the relationship between occupational burnout and professional development [50]. The study used bootstrap analysis to validate the mediating effect of self-efficacy, setting the parameters as follows: bootstrap sample size of 5000, bias-corrected 95% confidence intervals [59–61], with statistical significance set at $p < 0.05$.

#### *Reliability and validity*

To ensure the scale demonstrated objective reliability, this study used two measurement approaches: internal consistency and composite reliability. Table 1 shows that the values for Cronbach's alpha, McDonald's omega, and composite reliability (CR) all exceed 0.8, demonstrating strong reliability [62, 63]. Following SEM-based criteria for convergent validity, both the average variance extracted (AVE) and factor loadings were greater than 0.5 [64, 65], supporting good convergent validity. The research team conducted a confirmatory factor analysis to assess the measurement model, and the results indicated good model fit.

#### *Common method bias test*

The Harman's one-factor test is a commonly used method for examining common method bias in data [66]. In addition, the Common Latent Factor (CLF) approach was applied [67, 68]. In the predictive model, the unrotated cumulative variance for a single factor reached 37.884%, which remains below the 40% threshold. Furthermore, the chi-square difference between the baseline model (497.792, df = 311) and the control model (492.579, df = 308) was not statistically significant ($\Delta\chi^2 = 5.213$, $\Delta df = 3$, $p > 0.05$). These findings indicate that common method bias is unlikely to substantially influence the study findings.

## Result

### Descriptive analysis and pearson correlation matrix

Table 2 reports the descriptive statistics and correlation matrix for all variables. On the 5-point Likert scale,

**Table 2** Mean, standard deviation, and Pearson correlations

| Construct | M | SD | Bur | PTE | GTE | PD |
|---|---|---|---|---|---|---|
| Bur | 2.712 | 0.726 | 1 | | | |
| PTE | 3.496 | 0.652 | −0.186** | 1 | | |
| GTE | 3.630 | 0.583 | −0.197** | 0.745** | 1 | |
| PD | 3.521 | 0.643 | −0.151* | 0.674** | 0.717** | 1 |

*Bur* burnout, *PTE* personal teaching efficacy, *GTE* general teaching efficacy, *PD* professional development

*$p < 0.05$, **$p < 0.01$

a mean score of 2.5 serves as the reference level point. The professional burnout level among physical education teachers at universities in Henan Province (M = 2.712, SD = 0.726) was slightly above the moderate level, and teachers show substantial variability in their burnout scores. In contrast, the mean scores for personal teaching efficacy, general teaching efficacy, and professional development (all components of self-efficacy) were significantly greater than 2.5, with SD values ranging from 0.583 to 0.652, reflecting moderate dispersion. These results suggest that teachers' burnout varies considerably. In contrast, differences in self-efficacy (personal and general teaching efficacy) and in professional development are minor, reflecting a degree of consistency across teachers.

Table 2 also shows significant correlations among professional burnout, self-efficacy (personal teaching and general teaching self-efficacy), and professional development. Job burnout showed a significant negative correlation with personal teaching efficacy ($r = -0.186$, $p < 0.01$) and general teaching efficacy ($r = -0.197$, $p < 0.01$). In comparison, the negative correlation between professional burnout and professional development was also significant but relatively weaker ($r = -0.151$, $p < 0.05$). Among the self-efficacy variables, personal teaching efficacy ($r = 0.674$, $p < 0.01$) and general teaching efficacy ($r = 0.717$, $p < 0.01$) both showed significant positive correlations with professional development. Moreover, personal and general teaching efficacy showed a strong positive correlation ($r = 0.745$, $p < 0.01$).

Figure 2 shows that $x^2/df = 1.601$ (< 5.0), CFI = 0.960 (≥ 0.9), GFI = 0.883 (≥ 0.9), IFI = 0.961 (≥ 0.9), TLI = 0.955 (≥ 0.9), and RMSEA = 0.048 (≤ 0.08). The mediation model demonstrated good fit, indicating the validity of this chained mediation model. The structural equation model accounted for 68.1% of the variance in professional development ($R^2 = 0.681$), indicating moderate to strong explanatory power. In addition, the model explained 4.8% of the variance in personal teaching efficacy and 74.4% of the variance in general teaching efficacy. Consistent with the SEM results, additional multiple regression analysis confirmed the model's strong predictive power for teachers' professional development ($F = 106.619$, $p < 0.001$), explaining 55.7% of the variance ($R^2 = 0.557$). These two methods have significant explanatory power, further indicating that general teaching efficacy exerts a greater influence on teachers' professional development than personal teaching efficacy. Compared to confidence in personal teaching abilities, teachers' belief in actively participating in collective teaching activities and their broad belief in routine teaching practices appear to stimulate teachers' digital professional development. This finding underscores the importance of collective efficacy and teamwork in digital professional development. Differences between bivariate correlations and structural path coefficients reflect the multivariate nature of SEM, where shared variance among predictors is controlled.

The mediating role of self-efficacy between professional burnout and professional development. The structural equation model specified job burnout as the independent variable, teachers' digital professional development

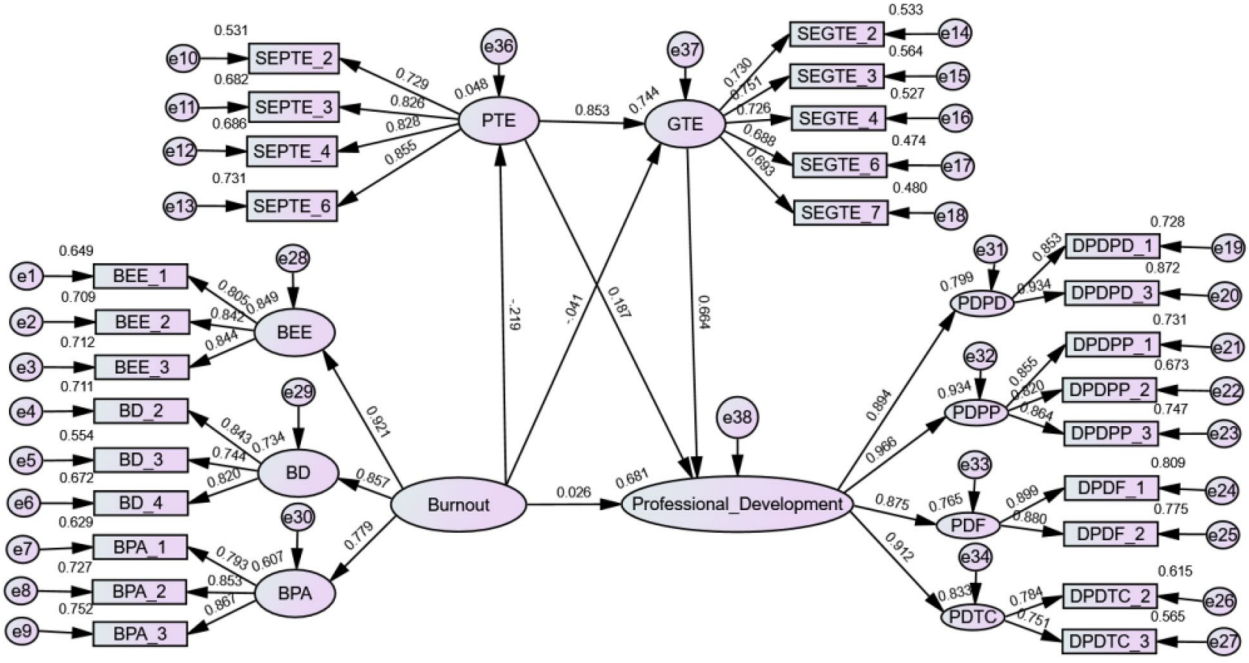


**Fig. 2** Structural equations and standardized path coefficients

**Table 3** Path Coefficient Results

| Parameter path | Estimate | S.E | C.R | P |
|---|---|---|---|---|
| Bur → PTE | −0.219 | 0.058 | −3.008 | ** |
| Bur → GTE | −0.041 | 0.040 | −0.806 | 0.420 |
| PTE → GTE | 0.853 | 0.083 | 10.042 | *** |
| GTE → PD | 0.664 | 0.149 | 4.843 | *** |
| Bur → PD | 0.026 | 0.042 | 0.526 | 0.599 |
| PTE → PD | 0.187 | 0.135 | 1.482 | 0.138 |

*Bur* burnout, *PTE* personal teaching efficacy, *GTE* general teaching efficacy, *PD* professional development

**$p < 0.01$;***$p < 0.001$

as the dependent variable, and self-efficacy as the mediator, with personal and general teaching efficacy included as chain-mediating variables. First, the model examined how job burnout and self-efficacy influenced teachers' digital professional development. Figure 2 and Table 3 report the standardized path coefficients, standard errors, and significance levels.

Results indicate that job burnout did not directly or significantly predict professional development (β = 0.026, $p = 0.559$) and general teaching efficacy (β = −0.041, $p = 0.42$). In contrast, job burnout had a significant negative effect on personal teaching efficacy (β = −0.219, $p < 0.01$). Personal teaching efficacy, in turn, strongly predicted general teaching efficacy (β = 0.853, $p < 0.001$). Of the two self-efficacy dimensions, personal teaching efficacy did not significantly predict digital professional development (β = 0.187, $p = 0.138$), whereas GTE showed a strong positive effect on PD (β = 0.664, $p < 0.001$). The findings suggest that teachers' professional development is more effectively promoted through collective or general teaching activities. Personal teachers' confidence in their instructional abilities does not directly enhance their professional growth. Instead, it may affect professional development indirectly through multiple pathways, including general teaching efficacy, collaborative interactions among teachers, adaptive strategies, and administrative support (all of which together shape the broader teaching environment).

Bootstrap Mediating Result. Table 4 presents the mediating role of self-efficacy in the relationship between professional burnout and teachers' digital professional development. The results identify five mediating paths. Personal teaching efficacy significantly mediated the relationship between professional burnout and general teaching efficacy (β = −0.186, $p = 0.008$, 95% CI [−0.324, −0.047]). Research indicates that the higher the level of teacher burnout, the lower the personal teaching effectiveness, which in turn further reduces overall teaching effectiveness. The total effect of burnout on general teaching efficacy is significant (β = −0.227, $p = 0.018$), but the direct effect is not significant (β = −0.041, $p = 0.491$). Therefore, personal teaching efficacy fully mediates the relationship between burnout and general teaching efficacy, accounting for 81.9% of the effect Proportion.

General teaching efficacy fully mediated the relationship between personal teaching efficacy and professional development (β = 0.566, $p < 0.001$, 95% CI [0.335, 0.903]), whereas the direct effect of personal teaching efficacy on professional development was not significant (β = 0.187, $p = 0.219$). Effect Proportion is 75.1%. This indicates that personal teaching efficacy contributes to professional development primarily by influencing general teaching efficacy.

In the chain-mediated model, the total indirect effect of the three self-efficacy pathways is significant (β = −0.164, $p = 0.011$). Including neither personal teaching efficacy nor general teaching efficacy alone significantly mediated the relationship between burnout and professional

**Table 4** Bootstrap Mediating Role of Self-Efficacy in the Relationship Between Professional Burnout and Digital Professional Development

| Effect | path | Beta | SE | P | 95% CI | | EP |
|---|---|---|---|---|---|---|---|
| | | | | | Lower | Upper | |
| SDE | Bur → GTE | −0.041 | 0.055 | 0.491 | −0.145 | 0.071 | 81.9% |
| SIE | Bur → PTE → GTE | −0.186 | 0.071 | 0.008 | −0.324 | −0.047 | |
| STE | Bur → GTE | −0.227 | 0.094 | 0.018 | −0.404 | −0.039 | |
| SDE | PTE → PD | 0.187 | 0.158 | 0.219 | −0.146 | 0.468 | 75.1% |
| SIE | PTE → GTE → PD | 0.566 | 0.145 | *** | 0.335 | 0.903 | |
| STE | PTE → PD | 0.753 | 0.043 | *** | 0.667 | 0.831 | |
| SDE | Bur → PD | 0.022 | 0.048 | 0.676 | −0.085 | 0.137 | 74.6% |
| SIE | Bur → PTE → PD | −0.035 | 0.035 | 0.122 | −0.128 | 0.014 | |
| | Bur → GTE → PD | −0.023 | 0.035 | 0.452 | −0.103 | 0.035 | |
| | Bur → PTE → GTE → PD | −0.106 | 0.054 | 0.006 | −0.240 | −0.025 | |
| | Tot indirect effect | −0.164 | 0.073 | 0.011 | −0.325 | −0.037 | |
| STE | Bur → PD | −0.142 | 0.087 | 0.074 | −0.328 | 0.013 | |

*SE* standard error, *SDE* Standardized Direct Effects, *SIE* Standardized Indirect Effect, *STE* Standardized Total Effect, *EP* Effect Proportion, *Bur* burnout, *PTE* personal teaching efficacy, *GTE* general teaching efficacy, *PD* professional development

***$p < 0.001$

development (β = –0.035, $p = 0.122$; β = –0.023, $p = 0.452$, respectively). However, personal and general teaching efficacy together formed a significant chain-mediating pathway between professional burnout and professional development (β = –0.106, $p = 0.006$, 95% CI [–0.240, –0.025]), accounting for 74.6% of the effect proportion. Collectively, these results confirm that self-efficacy plays a meaningful mediating role in the relationship between burnout and digital professional development among physical education teachers, primarily through a sequential mediation mechanism.

## Discussion

This study examines the relationship between job burnout and professional development, with a particular focus on the chained mediating effects of the individual and general teaching dimensions of self-efficacy. The correlation analysis shows significant relationships among burnout, professional development, and self-efficacy. The findings extend existing literature by revealing that general teaching efficacy (GTE), rather than personal teaching efficacy (PTE), plays a central mediating role, and that a sequential pathway from burnout to professional development via PTE and GTE provides a more nuanced explanatory mechanism. Physical education teachers in higher education institutions in Henan Province can reduce job burnout by strengthening their self-efficacy and improving their professional development.

### Relationship between teacher burnout and professional development

The correlation analysis shows a significant negative relationship between teachers' professional burnout and their professional development. This finding is generally consistent with previous research suggesting that professional burnout may constrain teachers' professional development. Digital physical education programs impose greater expectations on physical education teachers, potentially increasing their stress levels and the likelihood of professional burnout. Burnout has been associated with reduced teaching quality, slower improvements in instructional standards, and challenges in advancing school physical education. Professional development can be understood either as a key pathway for enhancing individual competence or as a process that requires considerable resources to improve the overall capability of the teaching workforce. Consistent with these results, a moderate positive correlation was found between teachers' personal sense of accomplishment and professional development, whereas depersonalization showed a slight negative correlation [69, 70]. Physical education teachers report concerns about limited professional development opportunities, which may further relate to occupational burnout. Experimental research shows that providing teachers with online stress management programs, including coping strategies and social-emotional skills training, can reduce burnout while enhancing teaching efficacy and professional satisfaction [71].

In contrast, in the structural equation model, professional burnout did not directly predict professional development. Instead, its influence operated through a chain-mediated pathway involving self-efficacy, including both personal and general teaching efficacy. This finding adds nuance to prior research, suggesting that although burnout is correlated with professional development, its effect may not be directly exerted at the behavioral level. Professional development is a continuous and cumulative process, whereas professional burnout may represent a relatively short-term psychological state. Consequently, transient experiences of burnout may not directly or persistently determine engagement in professional development. In digital teaching contexts, physical education teachers' burnout may relate to lower professional confidence and reduced readiness to adapt to new tools, upgrade skills, and participate in continuous learning [72, 73].Teachers with higher burnout levels tend to report lower willingness and participation in school-based and external professional learning activities, such as workshops, teaching research, and curriculum studies [74]. Additional evidence confirms that burnout is a significant negative predictor of motivation and participation in professional activities [75]. Teachers with low engagement and high burnout often lag behind other groups in career development involvement, training absorption, and contributions to teaching research [76]. However, some contrasting perspectives exist. Analyses based on personality and relational stress reveal that the “high stress/high burnout” group shows the highest engagement in professional development activities, suggesting that burnout does not necessarily inhibit professional growth and that individual coping mechanisms may play a critical role [77, 78]. Overall, substantial empirical evidence suggests that burnout may reduce teachers' willingness and effectiveness in professional development under certain conditions. At the same time, contextual and individual factors may alter this relationship, offering new avenues for future research.

### Relationship between self-efficacy and professional development

This study found a significant positive correlation between self-efficacy and professional development in university physical education teachers, indicating that teachers with high self-efficacy can promote their own professional development. Existing research indicates that self-efficacy motivates teachers to engage more actively and effectively in professional development (PD)

[79]. Compared to teachers with lower general teaching efficacy, those with higher efficacy adopt more comprehensive and inclusive approaches to understanding students' needs and demonstrate more decisive leadership in their professional growth, rather than acting as passive recipients [80]. At the same time, the importance of self-efficacy beliefs in teacher professional development has been confirmed, as these beliefs significantly shape teachers' attitudes toward research [81].

A key finding of this study is that individual teaching beliefs do not directly drive professional development; instead, they must be transformed into higher-order beliefs about overall teaching effectiveness to promote teachers' digital professional growth. From a social cognitive theory perspective, self-efficacy provides the psychological foundation for action, but it does not automatically translate into tangible behaviors, particularly in the context of digital teaching. Bandura [11] emphasized that personal self-efficacy requires shaping and amplification within social contexts, collective goals, and institutional support to guide behavior effectively. In the organizational culture of Chinese universities, factors such as peer collaboration, leadership support, and institutional incentives are especially critical. Empirical evidence shows that faculty professional development in Chinese higher education is strongly influenced by organizational culture, including collective objectives, team-based initiatives, evaluation systems, and administrative guidance [82]. Consequently, when individual beliefs remain isolated from organizational practices, their capacity to directly foster professional development is limited.

In the present study, personal teaching efficacy significantly predicted general teaching efficacy, which in turn had a substantial effect on faculty professional development. This finding aligns with the multi-level structure theory of teacher efficacy: personal teaching efficacy reflects confidence in one's instructional skills, while general teaching efficacy encompasses broader professional beliefs about teaching quality, student outcomes, and the overall value of teaching [83]. At the micro level, personal teaching efficacy involves mastery of subject knowledge, instructional techniques, and classroom management. In the context of China's rapidly developing digital education landscape, teachers must not only possess strong domain expertise but also develop advanced competencies in digital instructional design, cross-disciplinary collaboration, and reflective practice to effectively engage in professional development [84]. In summary, although multiple studies support the relationship between teacher professional development and self-efficacy, its effectiveness depends on factors such as the professional development itself, the implementation context, and individual differences. Further validation and deeper exploration of this relationship across diverse educational contexts remain necessary.

### Mediating role of self-efficacy in the relationship between teacher burnout and professional development

The outcomes of this study suggested that self-efficacy mediated the relationship between teacher burnout and professional development, extending the Job Demands-Resources (JD-R) model in the context of digital teaching. This finding indicates that professional burnout among physical education teachers reduces motivation and behaviours related to professional development by lowering self-efficacy (indirect path) and directly suppressing professional development [72]. Consistent with prior research, teachers' self-efficacy negatively correlates with three dimensions of burnout: emotional exhaustion, depersonalization, and reduced personal accomplishment [70, 85]. Higher self-efficacy is associated with lower susceptibility to burnout, whereas lower self-efficacy is associated with greater vulnerability [35, 86, 87]. Moreover, self-efficacy demonstrates protective and mediating effects across various professional fields. However, a complex interplay of psychological, organizational, and environmental factors influences professional development. Therefore, relying solely on a single mediating factor, such as self-efficacy, cannot fully explain all observed variations [88, 89]. Consequently, although the indirect effects were statistically significant, they should be interpreted within a broader contextual framework that acknowledges additional influencing factors.

From the JD-R model perspective, occupational burnout reflects psychological resource depletion caused by excessive job demands and insufficient personal resources. This negative emotion impedes the optimal utilization of work resources, thereby undermining teachers' professional development. Self-efficacy, as a critical personal resource within this model, mediates the relationship between burnout and professional development. Although the overall direct effect remained non-significant, the chained mediation process significantly clarified how burnout may influence professional development through efficacy beliefs. Li et al. [90] found that teachers' self-efficacy significantly mitigates the negative effects of emotional exhaustion on work outcomes. However, it cannot fully account for the influence of professional burnout on all professional development indicators. It is worth noting that although enhancing self-efficacy among university physical education teachers may partially buffer the negative influence of burnout on professional development, it is unlikely to entirely offset this effect. Professional development activities in digital teaching contexts, such as digital technology training and digital teaching seminars, can strengthen teachers' self-efficacy and reduce the direct inhibitory effect of

burnout on professional development [72]. Within the JD-R model framework, low psychological resources indirectly affect teachers' professional development through the mediating role of self-efficacy. At the same time, sufficient job resources and reasonable job demands can reduce teachers' professional burnout, strengthen their motivation for professional development, and help them realise their teaching value [17, 39, 91, 92].

Based on these research findings, enhancing teachers' self-efficacy and reducing burnout are key pathways to improving the digital professional development of physical education teachers. As university physical education teachers increase their self-efficacy, their level of professional development is also expected to rise. Schools and sports management departments should provide tangible teaching resources along with emotional and professional support, thereby continuously strengthening teachers' self-efficacy and motivating them to engage in professional development. University physical education teachers should likewise recognize the importance of self-efficacy, proactively respond to diverse challenges, continuously acquire new knowledge, and actively work to enhance their own sense of self-efficacy.

## Conclusion

This study found that self-efficacy and job burnout significantly influence teachers' professional development during digital transformation. The integration of digital technologies, such as motion analysis systems, wearable devices, virtual simulation platforms, and online teaching resources, into physical education instruction has heightened teachers' technical, cognitive, and pedagogical demands. These demands have led many educators to experience professional burnout, which may hinder their professional growth. To address these challenges, higher education institutions should implement specialized digital professional development programs for physical education, focusing on enhancing teachers' technology-assisted instructional skills and data-driven performance evaluation capabilities. Additionally, optimizing teaching workloads, strengthening technical support services, and fostering collaborative learning communities among physical education teachers can alleviate burnout and enhance digital self-efficacy, thereby promoting sustainable professional development. Relevant school departments should provide adequate resources for physical education, continuously support the professional development of physical education teachers, and ensure the smooth implementation of physical education programs.

## Limitations and future research

This study offers several strengths, including the identification of key factors influencing the professional development of university physical education teachers and the clarification of the mediating role of self-efficacy. However, it also contains several limitations and suggests important directions for future research. First, the participants came from a single province, which limits the generalizability and broader applicability of the findings and may reflect the influence of regional and cultural contextual factors. Future research should adopt multi-regional sampling, include primary and secondary school physical education teachers, and consider differences in instructional orientations (e.g., skill-based vs. theory-oriented), which may influence teaching demands and professional development needs. Second, the study's cross-sectional design limits causal inference and the understanding of developmental changes over time. Future research should adopt longitudinal or experimental designs to examine the temporal dynamics of the proposed chain mediation mechanism. Third, the reliance on self-report measures may introduce standard-method variance and social desirability bias, thereby reducing objectivity. Future studies should incorporate more objective measurement tools, such as mixed-methods research designs, to obtain more accurate and reliable data. These may include classroom observations, peer evaluations, administrative records, and qualitative interviews to get a more comprehensive and objective assessment of teachers' professional development processes.

**Authors' contributions**
Conceptualization: LM, PL, and CSC; methodology: LM, PL, CSC, and SA; data collection: LM, CSC, SA; formal analysis: LM, PL, and CSC; writing original draft preparation: LM and PL; writing—review and editing: PL and CSC; supervision: CSC.

**Funding**
There is no funding support.

**Data availability**
All data analyzed during this study are included in this published article and its supplementary information files.

## Declarations

**Ethics approval and consent to participate**
This study received ethical approval from the Ethics Committee of Universiti Putra Malaysia (Approval No. JKEUPM-2023–701).All participants provided informed consent for their involvement in the study and for the use of their contributions in publications. All surveys were conducted in accordance with the Declaration of Helsinki and the relevant laws and regulations of the People's Republic of China.

**Consent for publication**
Not applicable.

**Competing interests**
The authors declare no competing interests.

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Received: 27 November 2025 / Accepted: 6 April 2026
Published online: 22 April 2026

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## Publisher's Note