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REGULAR ARTICLE

On the Relationship Between Pre-service Teachers' Sense of Self-efficacy and Emotions in the Integration of Technology in Their Teacher Developmental Programs

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Abstract The integration of technologies might have important effects on language education. There is growing evidence that teachers' self-efficacy beliefs intersect to shape teaching behaviors. However, due to the emergence of technology-enhanced instructions in language classrooms, the strength of the relationship between teachers' self-efficacy beliefs and the integration of technology in their teacher developmental programs may be less clear. Therefore, this study was to investigate the relationships between teachers' self-efficacy emotions and attitudes toward the implementation of technologies in EFL pre-service teacher developmental programs. This study surveyed 250 pre-service teachers' concerns on teaching with technology-based instructions and investigated the role of individual differences such as self-efficacy, knowledge, and other demographics in their teacher developmental programs. Structural equation modeling was conducted using data from Chinese pre-service EFL teachers. The results showed that teachers' self-efficacy mediated the relationship between their emotion (joy, pride, love, anger, exhaustion, hopelessness) and their technologies implementation attitudes. The independent variables were significant moderators between age, teaching experience, and self-efficacy. Process-focused self-efficacy as one the sub-scales of the self-efficacy was found to be significantly related to teachers' positive attitudes toward the implementation of technologies in teacher developmental programs, whereas product-focused self-efficacy as the other sub-scale of self-efficacy was not. The findings proposed implications for teacher educators and teacher education programs in modification of curriculums and instructions. They also will prepare teachers for teaching effectively in language classrooms.

Keywords Self-efficacy · Pre-service teachers · Emotions · Technology integration · Teacher developmental programs

Introduction

As one of the essential components of the educational plan, teachers assume a viable part in making training more compelling and working with learning (Johnson, 2022). The nature of teachers' work is the main variable influencing the nature of students' learning and the outcome of educational frameworks (Derakhshan et al., 2022; Han & Wang, 2021; Lazarides et al., 2023; Sivaci & AltaŞ, 2023; Wang et al., 2022). Teachers, as one of the mind-boggling parts of the school environment, should have the option to satisfy the assumptions and needs of different authorities and partners and have a profound comprehension of social turns of events and future changes (Alhadabi & Karpinski, 2020). Therefore, in terms of personality, teachers should be such that learners take them as an educated, kind, and legit pioneer and set them as their social model (Chang et al., 2022; Metsala & Harkins, 2020; Woodcock et al., 2022). Thus, teachers should continuously look to refresh their insight and abilities and work on their professional development (Derakhshan & Nazari, 2022; Finch et al., 2023; Greenier et al., 2021; Mehdizadeh et al., 2023; Wang et al., 2023a, 2023b). Teachers' professional development includes several

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features, such as ideas (George et al., 2018), educational beliefs (Anderman et al., 2011; Gao et al., 2022), epistemological, and all intellectual, behavioral, and practical dimensions (Chang et al., 2022) related to education and teaching (Gröschner, 2023).

Hooper (2022) considers professional development related to teachers' learning, learning how to learn, and turning knowledge into action for the development of students. According to Ryan and Mathews (2022), professional development means processes and activities designed to increase teachers' professional knowledge, skills, and attitudes so that they can help improve students' learning. In addition, Symes et al. (2023) have paid attention to the development of words as a process of continuous mental and experiential growth of in-service teachers before and during the teacher education programs. Teachers in most educational systems acquire the necessary qualifications for teaching through pre-service and in-service courses. The task of preparing teachers through pre-service courses is the responsibility of teacher educators, and in-service courses are designed and implemented by the curriculum designers (Ansyari et al., 2022; Derakhshan et al., 2023; Dunst & Bruder, 2014; Fan & Wang, 2022; Michos et al., 2022; Senler, 2016; Wang et al., 2022). Most of these training courses are conducted in a traditional and face-to-face manner, methods such as participating in conferences, seminars, training workshops, learning from team members, passing a training course at the university are formal, and traditional methods of professional development (Choi, 2023; Holzberger & Prestele, 2021; Mellati & Khademi, 2020; Michos et al., 2022; Wang et al., 2023a; Xu & Jia, 2022).

Today, the increasing growth of information and communication technology has undeniably affected the daily life of different societies (Finch et al., 2023; Fu & Wang, 2022; Teo et al., 2022; Wang et al., 2021). Information and communication technology as a new substructure have engrossed much consideration for its impact in educational environments (Berg et al., 2023; Cerit, 2013; Choi, 2023; Wang, 2023). This foundation, which is, for the most part, characterized as the aggregate double dealing of electronic gadgets, far off the correspondence, programming, decentralized PC stations, and incorporated media profoundly affects the association of spatial distances and, essentially, on educational frameworks (Derakhshan et al., 2021; Dunst & Bruder, 2014).

One of the best ways to maintain teachers and students in educational environments is to provide them with appropriate and quality educational programs, and the implementation of such programs has a very important effect on increasing teachers' commitment and preventing the depletion of knowledge and skills (Fischer et al., 2021; George et al., 2018; Schwarzenthal et al., 2023; Yuan, 2020). On the other hand, one of the factors influencing the use of information and communication technology is the individual psychological characteristics of teachers. Among the psychological characteristics, teachers' self-efficacy and emotions have received much attention (Han & Wang, 2021; Kwon et al., 2019; Menon & Sadler, 2016; Subramaniam et al., 2022; Yin et al., 2023). Of course, the role of the teachers as the axis and circuit of science and knowledge and the beacon of guidance is more conspicuous than others. As a matter of fact, the authority representing things to the coming generation of each and every college is in the possession of the teachers of that society, thusly, teachers ought to be such as far as the character that the students know them as a trustful pioneer (Anderman et al., 2011; Holzberger & Prestele, 2021; Johnson, 2022).

It is obvious that teachers can satisfy their educational mission and live up to social assumptions when they have adequate and essential qualities. One of these qualities that is connected with the achievement or disappointment of teachers is self-efficacy (Pereira & Tay, 2023). According to the theory of social cognition, self-efficacy and emotions refer to the beliefs and judgments of the individual or the abilities of the individual in performing tasks and responsibilities (de Vries et al., 2022; Gao et al., 2022). The theory of social cognition depends on the three-sided model of conduct, climate, and person. This model accentuates the interrelationship between conduct, ecological impacts, and individual elements (mental, profound, and organic variables) which alludes to the singular's discernment to depict mental capabilities. As per this theory, individuals impact their inspiration and conduct in a three-manner causality framework. Self-efficacy and emotions are teachers' judgments about their abilities to perform a task or adapt to a particular situation (Chang et al., 2022; George et al., 2018; Guo et al., 2023; Hooper, 2022; Kong et al., 2023; Michos et al., 2022; Wang & Hemchua, 2022).

Researchers believe that self-efficacy refers to teachers' confidence that they have the ability to perform certain behaviors (Oppermann & Lazarides, 2021). Self-efficacy beliefs are determinants and strong predictors of performance levels. Based on these reasons, Bandura has argued that self-efficacy beliefs play a key role in teachers' lives. Teachers with high self-efficacy will exert a lot of effort on challenging tasks to achieve success, while teachers with low self-efficacy will not exert significant effort or will stop trying after starting any task (Pereira & Tay, 2023). Teachers' self-efficacy and emotions have an effect on their performance in technology-oriented environments and ultimately on professional development. In fact, professional development plays a very prominent role among theorists and thinkers of the educational environment (Vidergor, 2023). The professional development of teachers has a fundamental and vital role for educational

centers to achieve their goals, and it is also very important from the point of view of center managers (Senler, 2016).

Considering the variety of needs and new conditions in the era of information technology, traditional educational programs cannot be a suitable answer for teachers' professional needs (Schwarzenthal et al., 2023). The use of information and communication technology can solve many problems and obstacles in the traditional way of teaching teachers and pave the way for the emergence of informal methods of professional development, such as discussions with colleagues, independent research, observation of colleagues' work, and learning from colleagues (Rinne et al., 2023). In the past, the focus of teachers' development before and during service was around acquiring knowledge, skills, and attitudes in educational and subject areas. However, with the development of information and communication technology and the spread of virtual space, along with subject and educational knowledge, it has become necessary for teachers to acquire technological knowledge (Subramaniam et al., 2022).

The necessity of acquiring technological knowledge and using the facilities of modern technologies in line with the development of teachers' skills is evident in the studies of this field (Alhadabi & Karpinski, 2020; Choi, 2023; Lazarides et al., 2023; Schwarzenthal et al., 2023). They believe that today's teachers need a proper combination of three basic knowledge, i.e., content, pedagogical, and technological knowledge. In the form of a model, they show the interactions between the three fields in the form of content-technological knowledge, content-pedagogical knowledge, pedagogical-technological knowledge, and content-pedagogical-technological knowledge. The framework of this model emphasizes the integration of technology throughout the learning and teaching process (Yin et al., 2023).

According to Ansyari et al. (2022), the development of teachers' speech is influenced by personal, organizational, technological factors, as well as social-psychological factors. According to Chaipidech et al. (2022), nowadays information and communication technology is very effective on the knowledge framework of teachers and helps them to gain a better understanding of technological-pedagogical-content knowledge. Therefore, technology can provide the basis for the development of teachers' skills. In cyber space, there are many opportunities to access scientific resources and materials, to collaborate with other teachers and specialized groups, and to represent ideas for creating content, and teachers can use these resources and facilities to develop their professions. Domínguez (2019) sorted these tools and facilities into four categories. The study has classified information resources into access tools, collaborative and communication tools, content production and presentation tools, and publishing tools and presence in the virtual environment. Kong et al. (2023) categorizes internet tools into four categories of argumentative, adaptive, interactive, and reflective tools, and Lazarides et al. (2023) categorize them into communication, support, design and production, and information tools. Pereira and Tay (2023) divides these tools into two general categories of presentation and collaborative tools, then presentation tools into synchronous and asynchronous tools, and collaborative tools into conversation tools and knowledge building tools. Rinne et al. (2023) put them into two categories of information and communication tools. Michos et al. (2022) have also categorized tools into tools for facilitating understanding, communication, collaboration, and knowledge creation. It can be said that the tools available in the virtual space allow access to information sources, representation of messages and ideas in the form of multimedia, text, sound, image and animation, communication, and participation with teachers, students, and specialized groups, and deep reflection on previous learning and rethinking experiences.

To develop their skills, teachers can access subject materials, scientific publications, newspapers, and study about educational ideas and teaching methods (Pereira & Tay, 2023), get involved in practical experiences such as helping to improve students' study skills, prepare lesson plans, get involved in the implementation of new teaching methods, prepare teaching materials (Ryan & Mathews, 2022), preparing tests (Senler, 2016), revising educational methods (Berg et al., 2023), monitoring the activities of other teachers (Chang et al., 2022), receiving guidance, providing feedback to colleagues and receiving feedback from students (Fischer et al., 2021), expressing experiences and narratives, asking for help, providing assistance, sharing and exchanging educational materials (Lazarides et al., 2023), exchanging innovative ideas in the field, and using virtual and face-to-face facilities for educational issues, providing and receiving advice, working groups, and cooperation and formation of specialized communities (Rinne et al., 2023).

Reviewing the literature reveals that the relationship between teachers' self-efficacy beliefs and their professional development has received the attention of the researchers. Metsala and Harkins (2020) classify the fields of professional development of teachers into studying scientific sources and gaining practical experience, reflection, and participation. In a study, Vidergor (2023) investigated the evaluation of the model of teachers' self-efficacy beliefs as a determinant of their professional development in the academic progress of students. He reached the conclusion that teachers self-efficacy has a direct effect on their professional development, as well as the level of self-efficacy in teachers. It also has a positive and strong relationship with the academic progress of students. The results of Symes et al. (2023) research show that there is a significant relationship between teachers' professional qualifications and self-efficacy components. The results of Woodcock et al. (2022)

show that the attitude of student teachers toward the teaching profession is not significantly different based on variables, such as gender, religion, social class, region, and field of study. However, in the field of university degrees, this difference is significant. In contrast, the results of Michos et al. (2022) showed that there was a significant difference between the attitudes of student teachers regarding the level of education, the satisfaction with the educational program, and the experience of practical education.

In general, the conducted studies revealed that the characteristics of teachers, such as professional attitude and self-efficacy, play a significant role in increasing their productivity, which causes them to fulfill their educational mission and meet social expectations. These factors can affect teachers' professionalism and self-motivation. In addition, the results of a number of researches showed that the emotions of teachers can affect their self-efficacy as well as their professional development, but it seems that due to the difference in the results of these researches, more studies are needed to confirm or reject them. Considering the importance of teachers' self-efficacy and emotions in their professional development, the current study aims to explore the impact of using technology as one of the factors affecting teachers' self-efficacy and emotions in teacher development process.

Research Question

How much variance in the EFL teachers' development in technology-integrated teaching environments can be predicted by their demographic factors, self-efficacy, and emotions?

Method

Participants

The participants in this study were 250 (189 females and 61 males) from several universities in China. Their ages ranged from 18 to 55 years. Participants were recruited through convenience sampling from various universities in different regions of China. The study obtained ethical clearance from the relevant ethics committee of the participating universities, and all members gave informed consent prior to taking part in the research.

Instruments

In this study, the researchers used the following instruments to collect the required data:

Computer Technology-Integrated Survey

This survey has 23 items. The purpose of this survey is to determine how teachers feel about integrating technology into their classroom teaching. For each statement of the questionnaire, teachers indicate the strength of their agreement on a five-item Likert scale. The first form of the questionnaire had 45 items. The items were subjected to expert and face validities. Then, the second version was subjected to PCA analyses. The third version or the last version of the questionnaire consisting 23 items was steered by 50 members of a similar populace. Utilizing Cronbach Alpha coefficient, it showed a reliability file of 0.86 (r = 0.86). These items determine teachers' independence in technology-integrated teaching environments, their beliefs about employing technology-supported materials in language classrooms, and their attitudes toward appropriate classroom activities in technology-integrated learning environments.

Teacher Emotion Scale

Teacher emotion scale has 32 items. These items determine teachers' emotions in language classrooms. These emotions are joy, pride, love, anger, exhaustion, and hopelessness. The last version of the questionnaire after conducting face, expert, and construct validity was directed by 50 members of a similar populace. The consequences of the Cronbach Alpha coefficient showed a reliability record of 0.78 ($r = 0.78$) that is acceptable value.

Teachers' Self-efficacy

Teachers' self-efficacy questionnaire has 23 items that has four subcategories: process-focused self-efficacy, product-focused, social modeling, and psychological modeling. The last version of the questionnaire showed reliability index of 0.91 ($r = 0.91$).

Procedure

Through convenience sampling, the researchers invited 250 EFL teachers from several universities in China. They were educated about the purpose of the study and they were permitted to leave the study at any phase of the study. The questionnaires were attributed in online format. The data collection procedure lasted for three days. Utilizing structural equation modeling, the analysts investigated the gathered information. The after effects of these examinations are introduced in the accompanying tables.

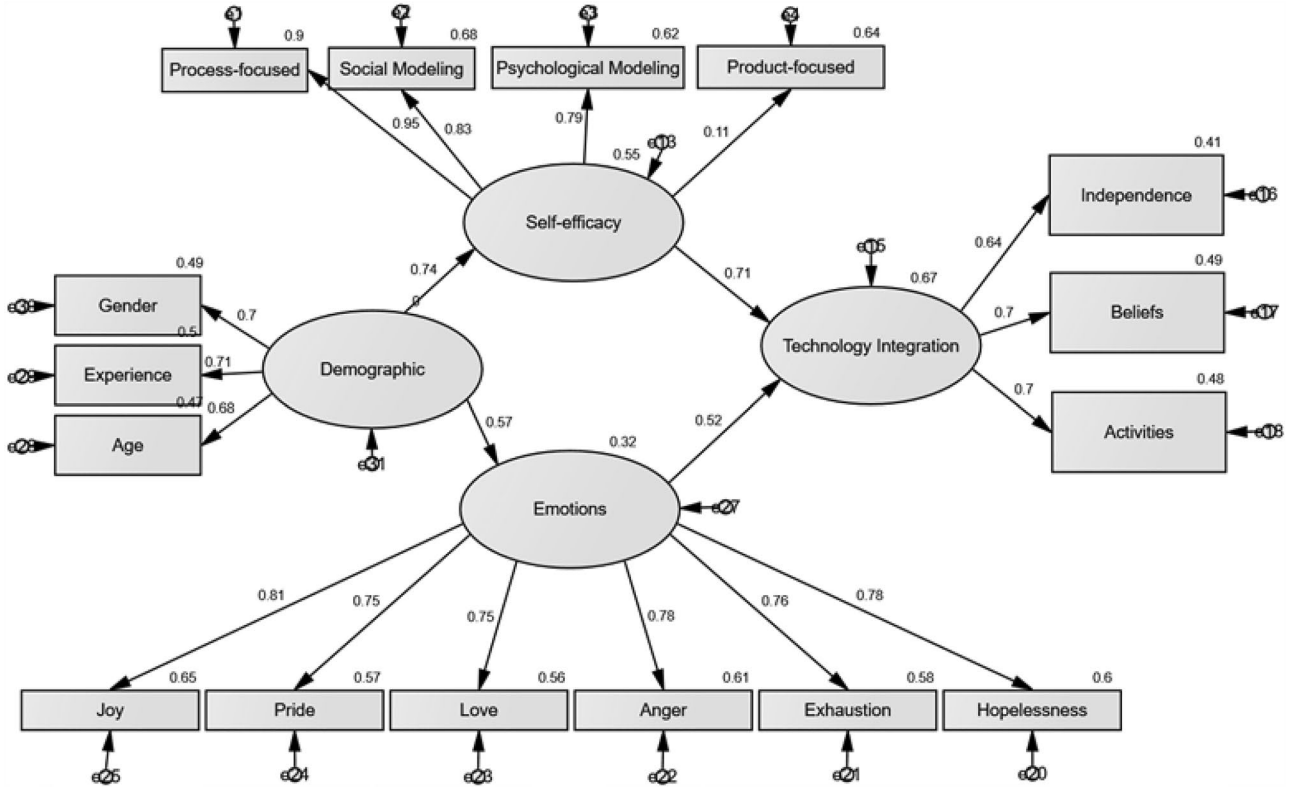

Fig. 1 The research models in the standardized estimation mode for the association between self-efficacy, emotion, and teacher development

Table 1 Result (default model)

Chi-square	225.030
Degrees of freedom	131
Probability level	.000

Table 2 The results of chi-square value

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	58	225.030	131	.000	2.718
Saturated model	189	.000	0		
Independence model	36	2800.486	153	.000	18.304

Results and Discussion

To respond to the examination question, the researchers led SEM investigations.

The values in Fig. 1 show that the hypothesis is rejected and there was a significant difference among the teachers' self-efficacy, emotions, and their teacher development in technology-integrated environments.

According to the software output, Chi-square = 225.030, Degrees of freedom = 131, and Probability level = 0.000, Chi-square test is significant (Sig = 0.000 < 0.05), so it tends to be presumed that there is a massive distinction in the recurrence of factors (see Table 1).

The results of Table 2 reveal that the CMIN value is less than 3, so the model is fitted, and there are significant associations between the variables (Table 3).

Employing a SEM approach, self-efficacy and emotional markers were all altogether connected with the idle builds to which they were relegated with rs going from 0.50 to 0.90, $p < 0.001$. The model sufficiently fits the information, RMSEA = 0.065; CFI = 0.964; and CMIN = 2.718. The results of Tables 4 and 5 show that the CFI value is more than 0.9 and RMSEA is between 0.05 and 0.08 that demonstrate that strong association between the variables.

Table 3 Baseline comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	0.920	0.906	0.965	0.959	0.964
Saturated model	1.000		1.000		1.000
Independence model	0.000	0.000	0.000	0.000	0.000

The results of Table 5 present the standardized regression weights for the variables of the study. The results reveal

Table 4 RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	0.065	0.042	0.066	0.258
Independence model	0.268	0.259	0.277	0.000

Table 5 Standardized regression weights for the variables

			Estimate
Self-efficacy	←	Demographic factors	0.74
Emotions	←	Demographic factors	0.57
Technology integration	←	Self-efficacy	0.71
Technology integration	←	Emotions	0.52
Process-focused	←	Self-efficacy	0.95
Social modeling	←	Self-efficacy	0.83
Psychological modeling	←	Self-efficacy	0.79
Product-focused	←	Self-efficacy	0.11
Independence	←	Technology integration	0.643
Beliefs	←	Technology integration	0.699
Activities	←	Technology integration	0.695
Hopelessness	←	Emotions	0.776
Exhaustion	←	Emotions	0.760
Anger	←	Emotions	0.781
Love	←	Emotions	0.745
Pride	←	Emotions	0.753
Joy	←	Emotions	0.806
Age	←	Demographic factors	0.685
Experience	←	Demographic factors	0.706
Gender	←	Demographic factors	0.698

that there is a strong association between demographic factors and teachers' self-efficacy. In other words, 74 percent of modifications in teachers' self-efficacy can be predicted by their gender, age, and teaching experiences. Likewise, the outcomes showed a strong association between demographic factors and their emotions. It means that teachers' emotions are different based on their age, gender, and teaching experiences. The results also confirmed that there is a strong association between teachers' self-efficacy and their professional development. The values indicate that 71 percent of changes in teachers' professional development can be predicted by their self-efficacy and 52 percent of changes can be predicted by their emotions. Moreover, among the four subfactors of the teachers' self-efficacy *Process-focused, Social Modeling, and Psychological Responses* with more than 70 percent attribution had a strong prediction power. This value emphasized the importance of psychological factors in teachers' professional development. However, the association between product-based self-efficacy and teacher development was not significant. Finally, among the subfactors of teachers' emotions *Joy* with about 81 percent attribution had the strongest prediction power and pride with about 75 percent attribution had the weakest prediction power. These results highlighted the role of teachers' psychology and their pedagogical beliefs in the process of their professional development.

In this research, from the analysis of the findings, it was concluded that there is a significant positive relationship between information and communication technology and self-efficacy and teacher development of EFL teachers. Several reports have shown that in teacher development in technology-integrated environments teachers' self-efficacy and emotions play a vital role (Ansyari et al., 2022; Chaipidech et al., 2022; Holzberger & Prestele, 2021). This research shows that there is a significant difference between the average level of information technology use, self-efficacy, and teacher development among male and female teachers. This finding is contrary to previous studies which have suggested that gender has not a predictable power in teacher development of teacher education programs (Woodcock et al., 2022). While previous studies evaluating gender observed inconsistent results, the results of this study demonstrated the impact of gender in teacher development process. Earlier investigations have noticed the significance of age and teaching experience in teacher development (Michos et al., 2022; Rinne et al., 2023; Senler, 2016). These differences can be seen even in the age of the teachers and their teaching experiences. Comparison of the findings with those of other studies confirms the significance of age and teaching experience in predicting changes in teachers' self-efficacy and development process in technology-integrated teaching environments.

The results of study demonstrated a significant relationship between emotions and teacher performance in technology-integrated teaching environments. The findings showed that more than 70 percent of changes in teachers' performance in technology-integrated environments can be predicted by emotions such as joy, pride, love, anger, exhaustion, and hopelessness. This finding broadly supports the work of other studies in this area linking emotions with teacher development (Berg et al., 2023; Finch et al., 2023; Johnson, 2022; Mohamed Ali El Deen & Aziz, 2023). Although teachers may not know the level of knowledge of all learners, they can obtain information about the learner and their learning level by considering the non-verbal states. The learning process includes mistakes, failures, and emotional responses to these mistakes. Emotions are a natural part of the teaching and learning process (Mackenzie, 2018). Therefore, an appropriate response should be given to these feelings so that the motivation to learn in students does not disappear. The importance of this article is understood when we find out that teachers' emotions directly affect their performance, personal development, and the quality of their education. These factors can directly or indirectly

affect students' academic engagement and learning (Sivaci & AltaŞ, 2023; Wray et al., 2022).

The results of the ranking of self-efficacy factors also showed that process-focused and social modeling are the first priority factors. These factors are related to management styles, culture and atmosphere of educational environment, goals and strategies, and structure of educational environments. However, among self-efficacy factors, no significant difference was observed in product-focused predictive power. Among the factors, cultural and social ones have the highest rank. These results reflect those of Vidergor (2023) who also found that demographic factors play a key role in teachers' professional development. The results of the presentation of the model also showed that the proposed model for the individual development of teachers in the mentioned dimensions has a very good fit. According to this model, the personal and professional development of teachers, on the one hand, directly include the three main dimensions of self-efficacy, emotional, and contextual factors. On the other hand, their relative importance is not the same. In this model, teachers' self-efficacy, which is considered as a normative dimension, has a decisive contribution to the personal and professional development of teachers. This finding has been confirmed in various studies and supports evidence from previous observations (Alhadabi & Karpinski, 2020; Anderman et al., 2011; Cerit, 2013; Chang et al., 2022; Dunst & Bruder, 2014; Holzberger & Prestele, 2021; Lane et al., 2021; Oppermann & Lazarides, 2021). For example, Gondwe (2021) has mentioned these factors under the title of "looking at the progress of teachers in contexts." Paying attention to this group of factors is evident from primary research in the field of teachers' professional development. Environmental support and the opportunity to implement learned skills are the main elements that help teachers to maintain and develop their skills. Many researchers have investigated the effect of these factors under the title of "educational environment on teachers' professional development." The results of these studies have shown the existence of a positive relationship between these factors and teachers' professional development. A systematic and comprehensive look at teachers' beliefs and performance allows to identify factors other than educational interventions that have an impact on professional development (Berg et al., 2023; Choi, 2023; Derakhshan et al., 2023; Gröschner, 2023; Şen & Yildiz Durak, 2022).

Conclusion

The study investigated the relationship between pre-service teachers' sense of self-efficacy and emotions in the integration of technology in their teacher developmental programs. The results of SEM analyses demonstrated that there was a strong association between teachers' self-efficacy, emotions, and demographic factors and their professional development in technology-integrated teaching contexts. The set of factors and environmental conditions that facilitate or hinder the implementation of learned skills in teaching environments and individual and environmental factors directly or indirectly affect the educational results. The need to create an environmental learning culture through emphasizing and paying attention to continuous learning and the use of technology to improve performance is the essential factor for the success of teacher education programs in the teachers' professional development, which will lead to innovation and continuous improvement. Researchers consider the creation of environmental learning culture as an integral part of the process of growth, innovation, effectiveness, and success in educational contexts. Since these factors are culture and context dependent more intercultural studies are required to confirm or deepen the findings of the present study. Future studies can focus on other aspects of teachers' self-efficacy and other emotional factors that might have a predicting power in teachers' professional development.

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Data Availability The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing Interests The authors declare that they have no competing interests.

Consent to Participate Informed consent to participate was obtained from all individual participants included in the study.

Consent for Publication Informed consent for publication was obtained from all individual participants included in the study.

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