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The Influence of Pedagogical and Epistemological Beliefs on Preservice Teachers' Technology Acceptance in Turkey: A Structural Equation Modeling

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Abstract

Epistemological and pedagogical beliefs have a close relationship that affects teacher behaviors regarding technology use in the classroom. A few studies have investigated the effect of pedagogical beliefs on technology acceptance. However, the combined effect of epistemological and pedagogical beliefs on teachers' technology acceptance is still not widely understood. This study investigates the structural relationships between preservice teachers' epistemological and pedagogical beliefs and technology acceptance. Data were collected from 655 preservice teachers and analyzed via path analysis. The research model explained 49 % of the variance in the dependent variable, behavioral intention, with a percentage higher than in previous research on preservice teachers' technology acceptance. Results showed that preservice teachers' constructivist teaching beliefs, perceptions regarding the usefulness of technology, and attitudes toward using it significantly influenced their behavioral intention. Besides, constructivist and traditional teaching beliefs were also significant determinants of perceived usefulness and perceived ease of use. The evidence from this study supports the idea of including various external variables in TAM (Technology Acceptance Model) to account for more considerable variance in behavioral intention.

Key words: *epistemological beliefs; pedagogical beliefs; preservice teachers; structural equation modeling (SEM); technology acceptance model (TAM).*

Introduction

Integrating information and communication technologies (ICT) into education throughout K-12 and teacher education has been an educational objective for many countries (Antonietti et al., 2023; Joo et al., 2018; Sang et al., 2010; Scherer et al., 2019; Teo et al., 2019). Furthermore, the emerging changes in education during the COVID-19 pandemic have also forced the education community to incorporate emerging technologies into teaching practices (Ratten, 2023). Teachers were pushed to adopt digital resources during and after the pandemic, while they were inclined to learn and use these resources for their own sake before the COVID-19 pandemic (Al Mazrooei et al., 2022). Teachers are the critical agents in achieving successful technology integration (Aypay et al., 2012; Chen, 2010; Gyamfi, 2016; Li et al., 2019; Siyam, 2019; Teo, 2010; Teo et al., 2019; Thurm & Barzel, 2022a). Despite the benefits of technology in teaching and learning, much research shows that teachers do not use technology frequently and effectively (Fraillon et al., 2020; Li et al., 2019; Sang et al., 2010; Thurm & Barzel, 2022b). Antonietti and colleagues (2023) found that teachers' technology use was mainly related to activities in which students had a passive role, correlating with presentation software. Therefore, the extent to which teachers integrate technology into their teaching practices is still an interest of research, considering the determining and influencing factors since technology integration is a complex process for educational and professional change (Antonietti et al., 2023; Scherer et al., 2019; Thurm & Barzel, 2022b).

The barriers to technology integration were grouped into two categories: first-order barriers (access to technology, support, etc.) and second-order barriers (beliefs, knowledge, and skills, etc.) (Ertmer, 2005). In the last decade, schools have become increasingly equipped with digital technologies, leading to a shift in research from first-order to second-order barriers (Bahcivan et al., 2019; Schmitz et al., 2022). Therefore, researchers primarily began investigating how particular teacher beliefs shape technology integration into the classrooms. Measuring user acceptance of technology integration in educational contexts is an avenue of revealing hindering and facilitating beliefs and offering insight into teachers' intentions and actual use of educational technologies (Scherer et al., 2019). Factors influencing technology acceptance shape how teachers interpret new information and experiences regarding technology use (Teo, 2009; Thomas & Palmer, 2014; Thurm & Barzel, 2022a). Davis developed the Technology Acceptance Model (TAM) in 1989 to identify the factors influencing the intention to use ICT in organizations. TAM is the most popular model for predicting individuals' technology acceptance and identifying the factors and conditions that contribute to technology integration (Scherer et al., 2019; Teo, 2009; 2010), since it has the potential of transferability to various samples and contexts and a significant contribution to explaining the intention to use (Scherer et al., 2019). It is also the most frequently employed theoretical framework to determine teachers' or preservice teachers' technology acceptance (Baydas & Goktas, 2017; Scherer et al., 2019;

Yurdakul et al., 2014). A recent meta-analysis study confirmed that TAM successfully predicts in-and preservice teachers' behaviors, regardless of teachers' education levels and countries (Scherer et al., 2019).

TAM adopts the idea that teachers' beliefs influence their behavioral intention and technology use and it uncovers the level at which a teacher is willing to use various technologies (Teo, 2010; Teo et al., 2019). Researchers who employ TAM can easily address intentions and behaviors for different learning domains, technologies, and users (Granić & Marangunić, 2019), and this increases the credibility of the model for emerging technologies and future teachers. TAM serves as a useful and widespread framework for revealing teacher technology beliefs and intentions, allowing researchers to investigate teacher behaviors for different technological tools such as virtual labs (Kolil & Achuthan, 2023), artificial intelligence (Zhang et al., 2023), and mobile portfolio apps (Petko et al., 2023). The frequent use of TAM in these emerging fields in recent years has led to the conclusion that it is suitable for teacher education. Therefore, it is worth noting that using TAM in educational contexts would contribute to our understanding of how to describe, enhance, and promote teachers' productive beliefs regarding technology integration.

Considering the educational potential of technologies, teacher educators need to focus on preparing in-service and preservice teachers for efficient and successful technology integration into teaching and learning practices (Anderson et al., 2011; Baydas & Goktas, 2017; Li et al., 2016; Sang et al., 2010; Teo et al., 2012). Given that teachers mostly mature their beliefs during their teacher education training, it is essential to understand which beliefs influence preservice teachers' intention to use technologies to arrange programs to encourage them to teach with technology (Bahcivan et al., 2019; Bardakcı & Alkan, 2019; Li et al., 2016; Teo et al., 2012; Thomas & Palmer, 2014; Thurm & Barzel, 2022a). Preservice teachers should also be informed about issues in technology such as technology and game addiction. Şeker and et al. (2023) found that adolescents began to spend more time on the Internet, and their technology addiction levels increased after the COVID-19 pandemic. Besides, one interesting result of this research is that low-income levels led to higher levels of addiction. This might underpin the need to study TAM in educational contexts to better train future teachers to teach in this digital era.

Studying the possible relationships between teacher beliefs and intentions regarding technology use might help teacher educators see the impact of their instructional approaches on preservice teachers (Cheng et al., 2009). Researchers suggest that TAM should be integrated into a broader model with various variables to reveal which factors influence the intention to use directly or indirectly with a significant variance (Kiraz & Ozdemir, 2006; Teo et al., 2012). It is well-known that in/preservice teachers' beliefs about teaching and learning significantly contribute to their technology acceptance (Gurer & Akkaya, 2022; Gyamfi, 2016; Huang & Teo, 2021; Huang et al., 2021; Teo & Zhou, 2017). Furthermore, the close relationship between teaching and learning beliefs

and epistemological beliefs is also well-articulated by many researchers (Chan & Elliott, 2004; Deng et al., 2014; Sang et al., 2010). A vast body of research also emphasized pedagogical and epistemological beliefs in technology use (Bahcivan et al., 2019; Chai et al., 2009; Sang et al., 2010; Teo et al., 2008a; Thurm & Barzel, 2022b). However, to my best knowledge, how pedagogical and epistemological beliefs influence preservice teachers' technology acceptance has not been established. With this in mind, I tried to validate an extended TAM, including pedagogical and epistemological beliefs, to identify factors influencing preservice teachers' technology acceptance.

Theoretical framework

Davis (1989) adapted the TAM from the Theory of Reasoned Action (TRA) developed by Fishbein and Ajzen (1975) to predict individuals' social behaviors regarding technology use. TRA refers to the attitude toward the behavior that influences behavioral intention. TAM is a theoretically justified framework investigating the relationships between perceived usefulness (PU), perceived ease of use (PEU), and attitudes toward computer use (ATU), namely core variables, and behavioral intention (BI) and actual use, namely outcome variables (Scherer et al.,2019; Teo, 2009). PEU directly affects PU, and PEU and PU also directly influence ATU. ATU and PU directly affect BI (Joo et al., 2018). These hypotheses are illustrated in Figure 1. TAM proposes that it is likely for preservice teachers to develop positive attitudes toward technology if they perceive technology as valuable and easy to use (Teo, 2010). Anderson and et al. (2011) reported that intentions refer to teachers' internal motivation to use technology in their teaching. BI is closely related to technology use (Gyamfi, 2016; Teo, 2010) and predicts usage behavior (Anderson et al., 2011). Given the potential of BI to predict the actual use, many researchers examined the factors affecting BI.

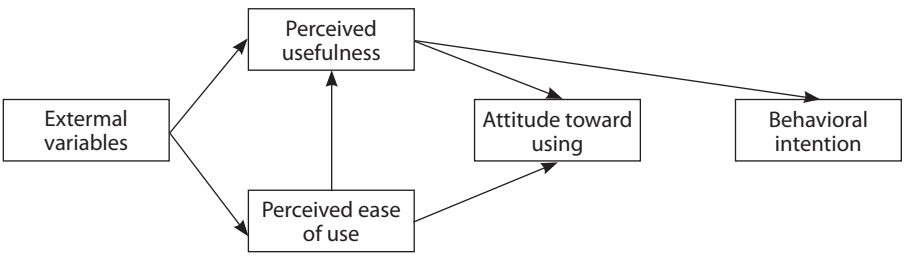

Figure 1. Technology acceptance model (adapted from Teo, 2010)

Although the original TAM version comprised PEU, PU, ATU, and BI, some researchers extended the model, including external variables influencing BI to account for more variance (Gyamfi, 2016; Joo et al., 2018; Teo & Zhou, 2017). Studying external variables might help determine the chain of influence from the external and independent variables to the BI in the TAM (Joo et al., 2018; Huang & Teo, 2021; Scherer et al., 2019; Teo, 2009; 2010; Yuen & Ma, 2002). In the literature regarding teachers' and preservice teachers'

technology acceptance, it is seen that the most used external variables are self-efficacy, facilitating conditions, subjective norms, and technological complexity (Aypay et al., 2012; Baydas & Göktas, 2017; Gurer, 2021; Teo, 2009; Teo et al., 2012; Yurdakul et al., 2014). Similarly, these external variables are also mentioned as the most investigated variables, considering to what degree they were related to TAM core variables, in a meta-analysis study by Scherer et al. (2019).

Huang and Teo (2021) proposed that the effect of second-order factors, such as pedagogical and epistemological beliefs, is little known. Teachers' use of technology in teaching is impacted by TAM, which, however, has a pedagogical aspect. Therefore, a considerable number of researchers included educational ideologies (Kiraz & Ozdemir, 2006), pedagogical beliefs (Gurer & Akkaya, 2022; Gyamfi, 2016; Huang & Teo, 2021; Huang et al., 2021; Kartal et al., 2022; Teo & Zhou, 2017), and TPACK (Joo et al., 2018; Teo et al., 2019). It is seen that some of the extended models with pedagogical beliefs only examined the effect of constructivist beliefs on technology acceptance (Teo & Zhou, 2017; Huang & Teo, 2021; Huang et al., 2021). Moreover, epistemological beliefs are also of interest since beliefs about technology are often rooted in and derived from epistemological beliefs (Dewey et al., 2009). Little is known about the relationships between the subdimensions of epistemological beliefs and beliefs regarding teaching with technology and technology competence (Thurm & Barzel, 2022b). More research is needed about the combined, direct, and indirect impact of teacher beliefs on technology use (Granić & Marangunić, 2019; Sang et al., 2010). Considering the need to reveal the combined impact of epistemological and pedagogical beliefs on technology acceptance, the following section presents literature review and research hypotheses.

Literature review

This study used the measurement constructs of epistemological beliefs, pedagogical beliefs, PEU, PU, ATU, and BI. The research hypotheses regarding these constructs align with theoretical and empirical explanations.

Epistemological Beliefs

Epistemological beliefs refer to beliefs about the nature of knowledge and knowing (Hofer & Pintrich, 1997). Schommer (1994) categorizes epistemological beliefs as naïve and sophisticated beliefs. Naïve epistemological beliefs address a person's belief that a vast amount of knowledge is certain and may hinder learning. On the other hand, sophisticated beliefs address a person's belief that a vast amount of knowledge is evolving and may promote learning (Cheng et al., 2009, p.320; Lehmann, 2022). Lehmann (2022) found that preservice teachers' naïve beliefs are negatively related to integrative learning and positively related to separative learning.

On the other hand, Conley et al. (2004) examined students' epistemological beliefs within the context of four dimensions, source, certainty, development, and justification. Source

and justification are related to beliefs about the nature of knowing, and development and justification are associated with the nature of knowledge (Bahcivan et al., 2019). The certainty of knowledge is determined by an individual's belief that knowledge is fixed or continuously evolving. On the other hand, the source of knowledge refers to whether individuals think that knowledge originates from external authorities or personal reasoning (Hofer, 2000). The development dimension includes beliefs that ideas in science today differ from what scientists used to think. The justification is that science experiments arise from curiosity and thoughtful consideration (Bahcivan et al., 2019).

Epistemological beliefs are closely related to beliefs about teaching and learning (Chan & Elliott, 2004; Deng et al., 2014; Wu et al., 2020). Preservice teachers' pedagogical and epistemological beliefs are considered a part of self-regulated learning (Lehmann, 2022). Deep learning is facilitated by epistemological beliefs (Ho & Liang, 2015; Winberg et al., 2019). Chan and Elliott (2004) examined 385 preservice teachers' epistemological and pedagogical beliefs. They found that traditional teaching beliefs perceive knowledge as specific and authority as the source of knowledge. Besides, Sinatra and Kardash (2004) reported that beliefs about knowledge as evolving concept and beliefs about teaching as the process of facilitating meaning construction are related to constructivist teaching beliefs. These beliefs make teachers engage students in meaningful learning activities (Chai et al., 2009). Furthermore, a recent study by Barnes et al. (2020) concluded that teachers' epistemological beliefs also impact how they assess students' work.

More research is needed about the impact of epistemological beliefs on initiatives, such as technology integration, in different cultures (Xiong et al., 2022). Some research explores PSTs' epistemological beliefs and technology use (Chai et al., 2009; Deng et al., 2014; Lee & Chan, 2015). For example, Chai et al. (2009) revealed that preservice teachers' attitudes toward ICT use are negatively correlated with their beliefs about authority as the source of knowledge and positively correlated with their traditional teaching beliefs. On the other hand, Deng et al. (2014) concluded that preservice teachers who consider knowledge as uncertain and do not consider authority as the source of knowledge are more likely to have constructivist beliefs and use technology as a knowledge construction tool. The literature incorporates limited evidence regarding the role of teachers' epistemological beliefs in teaching contexts (Xiong et al., 2022). However, it is also worth noting that epistemological beliefs are culturally sensitive. Therefore, incorporating epistemological beliefs into TAM would contribute to our knowledge of TAM. Hypotheses regarding epistemological beliefs are as follows:

Hypothesis 1a: Source will have a significant influence on traditional teaching beliefs.
Hypothesis 1b: Source will have a significant influence on PU.
Hypothesis 1c: Source will have a significant influence on PEU.
Hypothesis 2a: Certainty will have a significant influence on traditional teaching beliefs.
Hypothesis 2b: Certainty will have a significant influence on PU.

Hypothesis 2c: Certainty will have a significant influence on PEU.
Hypothesis 3a: Justification will have a significant influence on constructivist teaching beliefs.
Hypothesis 3b: Justification will have a significant influence on PU.
Hypothesis 3c: Justification will have a significant influence on PEU.
Hypothesis 4a: Development will have a significant influence on constructivist teaching beliefs.
Hypothesis 4b: Development will have a significant influence on PU.
Hypothesis 4c: Development will have a significant influence on PEU.

Pedagogical beliefs (Teaching and learning conceptions)

The terms "conceptions of teaching and learning" and "pedagogical beliefs" are interchangeable throughout this paper. Teaching and learning conceptions refer to teachers' "preferred ways of teaching" (Teo et al., 2008a) and are crucial constructs that need to be considered by teacher educators (Lehmann, 2022). They might be categorized as traditional or constructivist on a continuum with contrasting endpoints (Cheng et al., 2009). However, teachers might hold these beliefs simultaneously, switching between them (Crespo, 2016). Traditional teaching beliefs assume that teachers play a significant role and that knowledge transmission is the most efficient means of teaching. Teachers with traditional beliefs are inclined to design teacher-centered activities since they perceive lesson control and comprehensive instruction as essential for successful learning (Lehmann, 2022). In contrast, constructivist beliefs advocate that learners should be allowed to construct knowledge and perspectives by interpreting their prior experiences (Cheng et al., 2009; Liu et al., 2017).

Pedagogical beliefs are one of the most widely investigated factors that influence teachers' use of technology (Bahcivan et al., 2019; Li et al., 2019). Teachers' pedagogical beliefs affect the way and the degree of technology integration (Anderson et al., 2011; Chai et al., 2010; Huang et al., 2021; Kiraz & Ozdemir, 2006; Teo et al., 2008a; Thurm & Barzel, 2022b). Many researchers reported the relationship between constructivist beliefs and frequent and advanced-level technology use and the relationship between traditional beliefs and low technology use (Erens & Eicher, 2015; Gyamfi, 2016; Misfeldt et al., 2016; Thurm & Barzel, 2022b). Huang et al. (2019) found that teachers with constructivist beliefs used technology more than traditional ones. Student-centered beliefs consider that students should actively participate in teaching and learning activities aligned with their prior experiences and interests (Huang et al., 2021). These beliefs are significant factors that encourage teachers to use technology in their teaching practices (Ertmer, 2005; Han et al., 2017; Sang et al., 2010; Teo et al., 2008a). Teachers' constructivist beliefs promote their constructive use of technology (Teo et al., 2008a).

Constructivist teaching beliefs also positively influence technology acceptance (Gurer & Akkaya, 2022; Huang & Teo, 2021; Huang et al., 2021; Teo et al., 2018; Teo et al., 2019) and educational attitudes toward technology use (Chai et al., 2009; Ertmer,

2005). On the other hand, constructivist beliefs may not ensure effective and frequent technology use (Lim & Chai, 2008). Teo et al. (2008a) found that preservice teachers' constructivist teaching beliefs were related to constructive and traditional technology use. We still need to learn more about how traditional and constructivist beliefs relate to technology acceptance. The hypotheses regarding pedagogical beliefs are as follows:

Hypothesis 5a: Traditional teaching beliefs will have a significant influence on PU.
Hypothesis 5b: Traditional teaching beliefs will significantly influence PEU.
Hypothesis 5c: Traditional teaching beliefs will have a significant influence on BI.
Hypothesis 6a: Constructivist teaching beliefs will have a significant influence on PU.
Hypothesis 6b: Constructivist teaching beliefs will significantly influence PEU.
Hypothesis 6c: Constructivist teaching beliefs will have a significant influence on BI.

Technology acceptance model

PEU is a person's understanding of the extent to which the technology use will be relatively free of effort (Scherer et al., 2019; Teo, 2009). According to Venkatesh (2000), PEU is the primary driver in TAM (Gyamfi, 2016, p.109). Scherer et al. (2019) reported that the concept of "free of effort" implies "free of difficulty and great effort." The PU and PEU are the fundamental constructs, also the most critical factors in TAM, that affect ATU (Scherer et al., 2019; Teo, 2009). BI is related to the degree to which a person would like to use technology in the future. Teachers who perceive technology's ease of use and usefulness are more likely to use it in their teaching practices (Joo et al., 2018).

PU refers to a person's beliefs regarding the degree to which he/she believes technology will help perform a task efficiently and productively and enhance job performance (Scherer et al., 2019; Teo, 2009; Yurdakul et al., 2014). The benefits of technology, such as improving student learning and motivation and contributing to teachers' professional development, are critical components of PU (Baydas & Goktas, 2017). Teachers feel motivated to persist in technology integration when they perceive a clear benefit of technology on their performance (Anderson et al., 2011; Baydas & Goktas, 2017; Gyamfi, 2016; Teo, 2009; Thurm & Barzel, 2022b). The hypotheses regarding PEU and PU are as follows:

Hypothesis 7a: PEU will have a significant influence on PU.
Hypothesis 7b: PEU will have a significant influence on ATU.
Hypothesis 8a: PU will have a significant influence on ATU.
Hypothesis 8b: PU will have a significant influence on BI.

Successful technology integration into education is closely tied to teachers' attitudes toward technology use. Among the factors that affect teachers' technology use, attitudes play a crucial role and are an essential predictor of technology use (Li et al., 2016; Sang et al., 2010; Yurdakul et al., 2014). Attitudes toward technology use are a predisposition to respond favorably or unfavorably to technology use in teaching (Ajzen & Fishbein, 1977). Teo (2010) defines attitude toward behavior as the amount of pleasure a person has when performing the behavior (p. 128). Attitude toward technology use refers to

whether technology use is perceived as a positive or negative experience by in- and preservice teachers (Li et al., 2016). Positive attitudes toward technology use promote teachers' use of technology (Goos & Bennison, 2008; Yuen & Ma, 2002). It is essential to understand what impacts teachers' attitudes (Sang et al., 2010).

Hypothesis 9: ATU will have a significant influence on BI.

Methodology

Research design

This study utilizes a cross-sectional survey design and employs structural equation modeling (SEM) as an approach to reveal the relationships between the independent variables (pedagogical and epistemological beliefs and TAM core variables) and the dependent variable (behavioral intention) (Byrne, 2016; Ullman, 2019). An extended TAM was developed by adding preservice teachers' epistemological and pedagogical beliefs as external variables. SEM allowed the development of an adequate model representing the factors influencing preservice teachers' technology acceptance. The proposed research model is given in Figure 2.

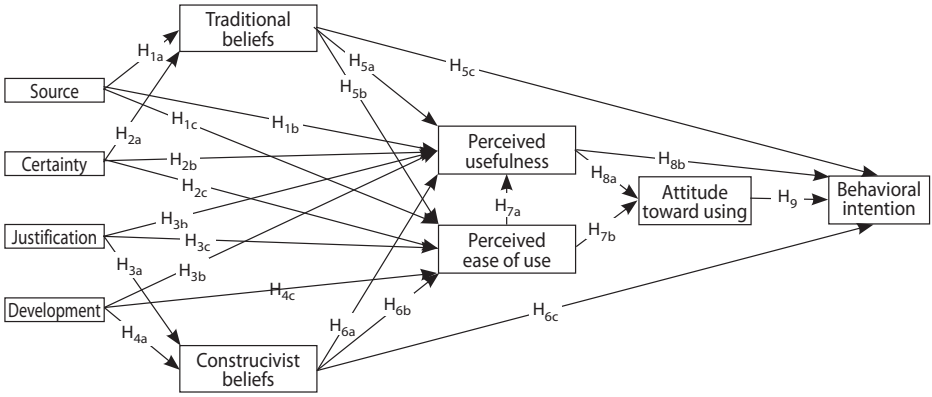

Figure 2. The proposed research model

Participants and context

The measurement instruments were administered to a sample of 657 preservice teachers at an Education Faculty that offers a four-year bachelor's degree in Turkey, employing a convenience sampling method. Preservice teachers participated in the study on a voluntary basis. Before administering data collection tools, preservice teachers were informed about the purpose of the research and their rights to withdraw from the study whenever they wished. The pen-and-paper version of the instruments was administered to all participants by the researcher. It took approximately 40 minutes for participants to complete the measurement tools. Two participants did not complete the whole instrument, and the data of these participants were excluded from the data set. Finally, the sample of participants consisted of 655 preservice teachers.

Table 1 demonstrates the demographic information of participants. The respondents were recruited from five major programs, and 75.3 % were female. 33 % of respondents were in sophomore year, 36 % were in junior year, and 31 % were in senior year. Three out of four participants had their computers and most (83.96 %) perceived their technological competence as either middle or high-level. Although it is not specified in the table, approximately 85 % of the participants reported they accessed the Internet via their smartphones. These demographics indicate that the research sample comprises young population, which might result in higher levels of technology proficiency and easy access to technology.

Table 1
Demographic information of participants

Variable	Number	%
Gender		
Female	493	75.3
Male	162	24.7
Major programs		
Science Education	178	27.2
Mathematics Education	90	13.8
Early Childhood Education	97	14.8
Elementary Education	198	30.2
Computer Education and Instructional Technology	92	14
Computer competency		
Basic level	47	7.2
Intermediate level	327	49.9
Advanced level	223	34
Proficient	58	8.9
Computer ownership		
Yes	491	75
No	164	25
Age	21.52 (SD=1.65)	

It might be good to give detailed information about the teacher preparation program in which the participants were enrolled. The university is in the middle of Türkiye. The teacher education courses can be grouped into the following categories: pedagogy, content, technology, and liberal education. The curriculum that participants pursued mostly included courses related to general pedagogy and content. The technology courses were information technology courses and material development courses.

Data collection tools

A survey instrument comprising four sections was used to collect data. The first section provided demographic information of participants. The second section was the "Teaching and Learning Conceptions Questionnaire (TLCQ)," which was developed by Chan and Elliott (2004), and the third was the "Scientific Epistemological Beliefs Scale (SEBs)," which was developed by Conley and colleagues (2004). Other researchers adapted these scales in Turkish (TLCQ by Eren in 2009 and SEBs by Bahcivan in 2014). TLCQ has two dimensions, and the SEBs has four.

Table 2
Number of items and sample items for each construct

Survey	Variables	Source	No. of items	Sample item
Conceptions about Teaching and Learning	*Constructive*	Chan & Elliott (2004)	12	Good teachers always encourage students to think for answers themselves.
	Traditional		18	Good teaching occurs when there is mostly teacher talk in the classroom.
Scientific Epistemological Beliefs	*Source*	Conley et al. (2004)	5	Only scientists know for sure what is true in science.
	Certainty		6	Scientists always agree about what is true in science.
	Development		6	New discoveries can change what scientists think is true.
	Justification		9	A good way to know if something is true is to do an experiment.
Technology Acceptance	*Perceived usefulness*	Sang et al. (2010) Teo (2009) Ursavaş et al. (2014)	7	Using computers will increase my productivity.
	Perceived ease of use		3	I find computers easy to use.
	Attitudes towards using		8	I like using computers.
	Behavioral intention		10	I plan to use computers in the future.

The last section contained items to measure the technology acceptance model's four constructs (PEU, PU, ATU, and BI). Some items in this section were derived from the study conducted by Ursavaş et al. (2014), which adapted items into Turkish. However, Sang et al. (2010) argued that measuring constructs such as BI by two items might not be enough to understand the constructs clearly. Ajzen (2006) proposed that it would be better to identify the behavior at an appropriate level of specificity because individuals focus on these specific definitions, and more valuable results would be yielded. It may be challenging for studies to result in similar findings related to the intention to use technology, as the target behavior might have overly broad definitions. Given this potential weakness, Lee and colleagues (2010) defined the target behavior as using technology to create and deliver lessons in their study examining teachers' decisions regarding educational technology use. Therefore, we added items from the existing research to the PU, ATU, and BI (Sang et al., 2010; Teo, 2009). The added items were prepared by using translation-back-translation procedures.

All items were measured on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The number of items and the sample items for each factor are given in Table 2.

Data analysis

The first step was to perform Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) to ensure the validity and reliability of the measurement items. The factor loadings for each variable were identified. The goodness of fit indices were the means of evaluating the model fit. Then, descriptive statistics (mean, standard deviation, minimum and maximum values) and correlation statistics were calculated. AMOS was used to calculate the parameter estimates, analyze the model fit, and investigate the direct, indirect, and total effects. Structural equation modeling (SEM) allows for revealing the relationships simultaneously among the constructs in this study (Byrne, 2016; Kline, 2011).

Results

This section comprises the descriptive statistics, reliability, and validity of the measurement items. The hypotheses were tested by assessing the model fit, the path model was evaluated, and the effects between constructs were identified.

Descriptive statistics

The descriptive statistics revealed that respondents' means were above the midpoint of 3. Standard deviations highlighted that respondents' scores lay on a narrow spread around the mean. It has been seen that preservice teachers had sophisticated epistemological beliefs and more positive responses to constructivist teaching than traditional teaching. Concerning technology acceptance, it is possible to report that preservice teachers had positive perceptions, attitudes, and intentions regarding technology in education (Table 3). The skewness (ranging from |.006| and |1.030|) and kurtosis (ranging from |.039| and |1.073|) were within the recommended value (|3.00| and |10.00|), respectively. The results showed that the data met the assumptions of normal distribution (Kline, 2011).

Table 3
Descriptive statistics, Skewness, and Kurtosis values for all constructs

Constructs	N	Min	Max	Mean	SD	Skewness	Kurtosis
Source	655	1.00	5.00	3.618	.698	.358	.133
Certainty	655	1.33	5.00	3.357	.717	.206	-.407
Development	655	1.17	5.00	3.835	.571	-.531	.724
Justification	655	1.00	5.00	3.908	.587	-.915	.947
Constructivist	655	1.00	5.00	4.059	.617	-1.030	.612
Traditional	655	1.22	4.72	3.120	.567	.056	.039
PU	655	1.29	5.00	3.904	.526	-.390	1.073
PEU	655	1.33	5.00	3.707	.731	-.334	.069
ATU	655	1.25	5.00	3.435	.482	-.006	.212
BI	655	1.00	5.00	3.860	.569	-.479	.734

Convergent validity

Convergent validity refers to the extent to which different items measure the same construct. Fornell and Larcker (1981) proposed three procedures to evaluate the convergent validity of the measurement items, that are (i) item reliability, (ii) composite reliability index (CRI), and (iii) average variance extracted (AVE). The factor loadings of items assess item reliability. Table 4 demonstrates the results of convergent validity. The correlations between the observed and latent variables (factor loading) should be (Kline, 2011) between at least .50 and above. It is seen that all factor loadings ranged from .514 to .805, indicating convergent validity at the item level. The composite reliability index is supposed to be 0.60 to 0.70 to be acceptable (Hair et al., 2017). The table demonstrates that the CRI ranged from .67 to .90. Besides, Cronbach's alpha values of each latent variable exceeded the threshold of .70, recommended by DeVellis (2017). Finally, the AVE values were found to be greater than the benchmark of .50, which is recommended to be adequate for convergent validity (Kline, 2011).

Table 4
Results for the measurement model

Latent Variable	No. of items	Range of the factor loadings	AVE	CRI	Cronbach's α
Source	5	.526-.687	0.55	0.73	,867
Certainty	6	.555-.632	0.56	0.77	,874
Development	6	.531-.697	0.55	0.77	,862
Justification	9	.514-.738	0.58	0.85	,797
Traditional	18	.523-.672	0.53	0.90	,896
Constructivist	12	.533-.735	0.61	0.89	,853
PU	7	.592-.712	0.78	0.83	,848
PEU	3	.636-.775	0.68	0.73	,786
ATU	8	.515-.805	0.51	0.67	,785
BI	10	.521-.680	0.57	0.85	,865

**Note.* $CR=(\Sigma\lambda)^2/((\Sigma\lambda)^2+(\Sigma(1-\lambda^2)))$
***Note.* $AVE= (\Sigma\lambda^2)/(\Sigma\lambda^2+\Sigma(1-\lambda^2))$

Discriminant validity

Discriminant validity exists if the correlations between a set of variables presumed to measure different constructs are not too high (Kline, 2011) and is assessed by comparing the square root of the average variance extracted values for a given construct with the correlations between that construct and other constructs. Table 5 demonstrates the inter-construct correlations and the square roots of the AVEs. The bold diagonal elements are the square roots of the AVEs. It is seen that the square roots of the average variances extracted were greater than the intercorrelations between constructs. Thus, the discriminant validity might be regarded as adequate for further analysis.

Table 5
Intercorrelation matrix

		1	2	3	4	5	6	7	8	9	10
1. Source	r	**0.741**									
2. Certainty	r	,646**	**0.748**								
3. Development	r	,272**	,196**	**0.741**							
4. Justification	r	,296**	,302**	,640**	**0.762**						
5. Constructivist	r	,160**	,178**	,473**	,607**	**0.781**					
6. Traditional	r	-,339**	-,446**	-,035	-,065	-,081*	**0.728**				
7. PU	r	,006	,005	,435**	,440**	,456**	,169**	**0.883**			
8. PEU	r	-,017	-,095*	,158**	,166**	,220**	,163**	,478**	**0.825**		
9. ATU	r	-,128**	-,124**	,229**	,190**	,202**	,282**	,491**	,403**	**0.768**	
10. BI	r	-,001	-,029	,307**	,360**	,404**	,178**	,614**	,471**	,545**	**0.755**

***Note.* Correlation is significant at the 0.01 level (2-tailed)
* *Note.* Correlation is significant at the 0.05 level (2-tailed)

Model fit

AMOS 21 was used to examine the fit between the research model and the obtained data, employing a maximum likelihood estimation procedure. It is common to use a variety of indices to measure the model fit. The model fit indices used in this study were the ratio of the minimum fit function to its degree of freedom (χ^2/df), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Standardized Root Mean Residual (SRMR), and Root Mean Square Error of Approximation (RMSEA). These indices are commonly used in similar research (Chen, 2010; Gurer & Akkaya, 2022; Huang & Teo, 2021; Joo et al., 2018; Teo, 2009). Table 6 presents the recommended level of acceptable fit (Collier, 2020) and fit indices of the research model. According to Table 6, all values satisfied the recommended threshold values.

Table 6
The recommended level of acceptable fit and fit indices for the research model

Model fit indices	Values	Recommended level of acceptable fit
χ^2/df	3.586	<5
CFI	.982	>.90
TLI	.951	>.90
SRMR	.040	<.08
RMSEA	.063	<.08

Hypothesis testing and path modeling

Table 7 shows the hypotheses testing, and Figure 3 demonstrates the path coefficients of the research model. Sixteen out of twenty-three hypotheses were supported by the obtained data. Preservice teachers' beliefs related to the source of knowledge had significant and negative effects on traditional beliefs (β=-.10, p<.05) and PU (β=-.10, p<.05). The beliefs assuming knowledge was certain did not significantly influence traditional teaching beliefs, PU, and PEU. The justification and development constructs had significant influences on constructivist teaching (β=.57, p<.001; β=.15, p<.001, respectively) and PU (β=.11, p<.05; β=.20, p<.001, respectively).

Table 7
Hypothesis testing results

Hypotheses	Path	Path coefficient	Results
H1a	SourceTraditional	-.10*	Supported
H1b	SourcePU	-.10*	Supported
H1c	SourcePEU	.06	Not supported
H2a	CertaintyTraditional	-.46	Not supported
H2b	Certainty PU	.05	Not supported
H2c	Certainty PEU	-.09	Not supported
H3a	JustificationConstructivist	.57**	Supported
H3b	Justification PU	.11*	Supported
H3c	Justification PEU	.01	Not supported
H4a	DevelopmentConstructivist	.15**	Supported
H4b	Development PU	.20**	Supported
H4c	Development PEU	.04	Not supported
H5a	TraditionalPU	.15*	Supported
H5b	Traditional PEU	.20*	Supported
H5c	Traditional BI	.07	Not supported
H6a	ConstructivistPU	.28**	Supported
H6b	Constructivist PEU	.28**	Supported
H6c	Constructivist BI	.21**	Supported
H7a	PEUPU	.34**	Supported
H7b	PEUATU	.22**	Supported
H8a	PUATU	.40**	Supported
H8b	PUBI	.35**	Supported
H9	ATUBI	.31**	Supported

When it comes to pedagogical beliefs, it is seen that both traditional and constructivist beliefs significantly influenced PU and PEU. Also, constructivist beliefs significantly influenced BI (β=.21, p<.001). The obtained data supported all TAM hypotheses. It was found that PEU significantly influenced PU (β=.34, p<.001), and these two constructs had significant effects on ATU (β=.22, p<.001; β=.40, p<.001). Lastly, PU and ATU significantly influence BI (β=.35, p<.001; β=.31, p<.001).Six endogenous variables were tested in the research model. Their predictors significantly determined traditional and constructivist teaching beliefs by the percentages of variances of 28 % and 45 %, respectively. 47 % of the variance in PU was explained by its predictors. PEU and PU significantly determined ATU and resulting in a 28 % variance. BI had the largest variance accounted for by its exogenous constructs (R^2=.49).

Table 8 presents the standardized total effects and direct and indirect effects between the variables in the research model. According to Cohen (1988), an effect size with a value less than .1 is considered small, a value less than .3 is medium, and values with .5 and above are considered large. The strongest determinant of BI is PU, with a total effect size of .471. This is followed by constructivist teaching beliefs and ATU, with total effect sizes of .405 and .309. These effects have medium positive effect sizes.

Constructivist teaching beliefs have the strongest effect on BI among the variables external to TAM. The nine variables explain 49 % of the variance in BI.

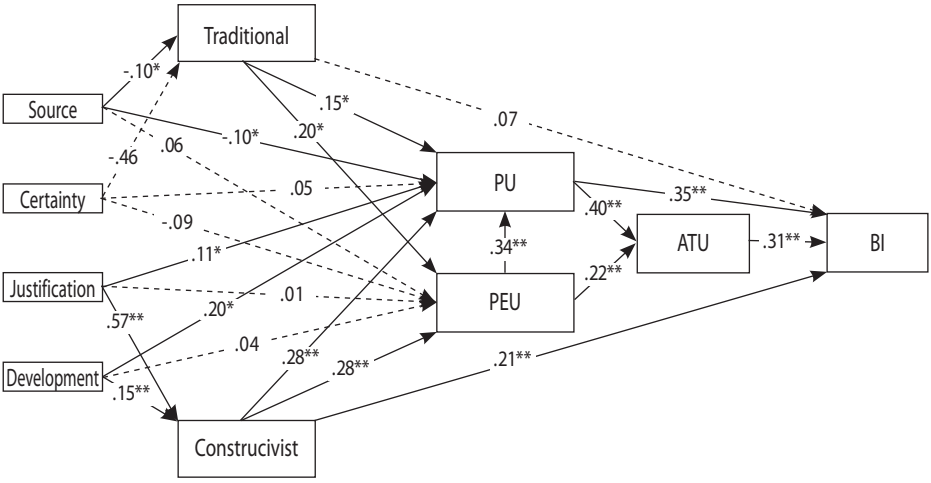

Figure 3. Path coefficients of the research model

Note: Dotted lines refer to unsupported hypotheses, and the solid lines refer to supported hypotheses.

Epistemological and pedagogical beliefs, PU, and PEU account for approximately 28 % of ATU variance. PU is the most prominent determinant for ATU, with a total effect of .391, which is also entirely a direct effect. PEU followed PU, with a total effect of .350 for ATU.

The most dominant determinant for PU is constructivist teaching beliefs, with a total effect of .374. PEU is the second prominent determinant, with a total effect of .335, entirely a direct effect. The determinants explain 47 % of the variance in PU.

All total effects on PEU have small effect sizes. The strongest effect on PEU is constructivist teaching beliefs among the external variables to TAM, with a total effect of .277. Together, the external variables account for 13 % of the variance in PEU.

Discussion and conclusions

This study aims to validate an extended TAM, identifying the factors directly or indirectly influencing preservice teachers' technology acceptance. The model was assessed through convergent and discriminant validity and model fit indices. It is seen that the results supported the validity of the extended model, which consisted of epistemological beliefs, conceptions of teaching, and TAM constructs. Descriptive statistics showed that preservice teachers hold sophisticated epistemological beliefs, they were more inclined to constructivist teaching than traditional teaching, and generally accepted technology in education, which is consistent with previous research (Bahcivan et al., 2019; Chai et al., 2009).

Table 8
Direct, indirect, and total effects of the model

Outcome	Determinant	Standard estimates		
		Direct effect	Indirect effect	Total effect
Constructivist teaching (R^2=.45)	Justification	.569	-	.569
	Development	.146	-	.146
Traditional teaching (R^2=.28)	Source	-.102	-	-.102
	Certainty	-.456	-	-.456
PEU (R^2=.13)	Source	.057	-.021	.037
	Certainty	-.093	-.092	-.185
	Justification	.011	.158	.169
	Development	.040	.041	.080
	Constructivist	.277	-	.277
	Traditional	.201	-	.201
PU (R^2=.47)	Source	-.102	-.003	-.105
	Certainty	.050	-.130	-.080
	Justification	.113	.217	.330
	Development	.200	.068	.268
	Constructivist	.282	.093	.374
	Traditional	.149	.067	.217
	PEU	.335	-	.335
ATU (R^2=.28)	Source	-	-.033	-.033
	Certainty	-	-.072	-.072
	Justification	-	.166	.166
	Development	-	.122	.122
	Constructivist	-	.207	.207
	Traditional	-	.129	.129
	PEU	.219	.131	.350
	PU	.391	-	.391
BI (R^2=.49)	Source	-	-.054	-.054
	Certainty	-	-.083	-.083
	Justification	-	.286	.286
	Development	-	.162	.162
	Constructivist	.210	.195	.405
	Traditional	.071	.116	.186
	PEU	-	.226	.226
	PU	.350	.121	.471
	ATU	.309	-	.309

The research model included two teacher-related constructs external to TAM: epistemological beliefs and conceptions of teaching. Twenty-three hypotheses were generated based on the literature review. According to path analysis results, sixteen of them were supported. Constructivist teaching beliefs, PU, and ATU had statistically

significant influences on BI, while traditional beliefs did not. In line with vast TAM research, PU and PEU were significant determinants of ATU (Park, 2009; Teo, 2010; Teo et al., 2012).

Regarding pedagogical beliefs, traditional and constructivist teaching beliefs were statistically significant determinants of PU and PEU. The results showed that preservice teachers' epistemological beliefs did not statistically influence their PEU. However, justification and development factors positively influenced respondents' perception of the usefulness of technology, and the source factor negatively impacted it. It is worth noting that the beliefs about the certainty of knowledge did not impact pedagogical beliefs and technology acceptance. Conversely, Deng and colleagues (2014) revealed significant positive relationships between the certainty of knowledge and pedagogical beliefs and technology use, both traditional and constructivist. These disparities may be because epistemic beliefs are sensitive to cultural contexts and may lead to different conclusions in different contexts.

The variables in the model explained 49 % of the variance in the dependent variable, BI, a percentage higher than that of previous research regarding preservice teachers' technology acceptance (Teo, 2009; Teo et al., 2008b; Teo et al., 2012; Teo & Zhou, 2017). A lot of research found that PU was the strongest determinant in predicting technology acceptance (Anderson et al., 2011; Aypay et al., 2012; Baydas & Goktas, 2017; Joo et al., 2018; Huang & Teo, 2021; Teo et al., 2019). Joo and colleagues (2018) asserted that preservice teachers' critical thinking of technology acceptance mostly depends on their beliefs about the benefits of technology to teaching and learning. PU was the strongest determinant of BI, followed by constructivist teaching beliefs and ATU, respectively. Preservice teachers' pedagogical beliefs, perceptions of usefulness of technology, and ATU directly affected BI, while epistemological beliefs and perceptions of ease of technology use had indirect effects, similar to other research (Huang et al., 2021; Teo et al., 2012).

Given the direct effects on BI, it is possible to say that respondents are more likely to use technology in their future teaching when they believe that using technology would improve their performance and feel positive feelings regarding technology use in education. Besides, having robust constructivist beliefs might promote preservice teachers' technology acceptance. This confirms previous findings in the literature (Sang et al., 2010). The strong effect of constructivist beliefs on BI is a remarkable finding. This finding is consistent with the previous findings highlighting the relationship between constructivist teaching beliefs and technology-related teaching behaviors (Teo et al., 2008b; Sang et al., 2010).

The indirect effects of epistemological beliefs on BI imply that believing that knowledge has an evolving nature, and that not only the authority has knowledge might not lead to technology acceptance without enriching the epistemological beliefs with pedagogical beliefs, perceptions of usefulness and ease of use of technology, and positive attitudes towards technology use. PEU also has an indirect effect on BI, and

PU and ATU mediated its effect. Even if respondents perceive technology as relatively free of effort, they might not accept integrating technology into teaching if they do not also perceive the efficiency of technology on their performance and if they do not have positive attitudes (Teo et al., 2019).

ATU was influenced directly by PEU and PU and indirectly by epistemological beliefs and pedagogical beliefs. Preservice teachers' epistemological and pedagogical beliefs indirectly affect their ATU with the mediating effect of PEU and PU. Preservice teachers with sophisticated epistemological beliefs and constructivist beliefs should also be encouraged to perceive that technology would improve their productivity and efficiency, and technology is relatively free of effort to use technology in their teaching. Chai and colleagues (2009) determined that preservice teachers' epistemological and pedagogical beliefs correlated with their ATU. Remarkably, constructivist teaching beliefs were the most prominent determinant in predicting PU. In other words, preservice teachers mostly believed technology would improve their performance when they perceived teaching as knowledge construction. This result confirms previous findings (Huang & Teo, 2021; Huang et al., 2021).

To sum up, the research model explained nearly half percent of the variance in BI. Constructivist teaching beliefs, PU, and ATU were significant determinants of BI. As an add-on to TAM, epistemological beliefs affected PU more than PEU. On the other hand, constructivist teaching beliefs were significant determinants of the PEU, PU, and BI. When it comes to the contributions of this research to teacher education, we can address several issues. Firstly, aligning with the socio-cultural demographics of participants such as being a younger sample, ease of access to technology, and perceived high technological competence, preservice teachers were found to be more likely to accept technology in teaching practices. Secondly, it is seen that epistemic beliefs might influence technology acceptance only when they are combined with pedagogical beliefs. Furthermore, beliefs, that suppose knowledge is certain, do not have any effect or have a very small effect on either pedagogical beliefs or technology acceptance core variables. This may imply that believing knowledge is fixed may become unfashionable with the increasing speed of acquiring knowledge, and as such this kind of epistemic belief did not affect most of the variables directly. Results might describe the characteristics of future teachers who accept and integrate technologies. Teachers who value the development and evolvement of knowledge will also appreciate their students' initiatives to make sense of knowledge and make several valuable attempts to integrate technology into their teaching practices to guide students' knowledge-construction journeys.

Limitations

Although SEM and path analysis provide remarkable benefits to achieve a more accurate model to predict factors influencing technology acceptance, it is worth noting that this study clearly has some limitations. Firstly, the data was collected through

a self-reported measure which may lead to overestimating the results. This may be because preservice teachers might tend to give desirable responses. Secondly, the respondents were preservice teachers who might have limited experience in teaching and using technology in teaching. Thirdly, the respondents participated in the study using convenience sampling rather than random sampling. The sampling procedure makes it challenging to generalize the findings. Lastly, the research model explains 49 % of the variance in BI, leaving 51 % unexplained. The excluded variables, such as teacher efficacy, TPACK, STEM efficacy and attitudes, and technology self-efficacy, might significantly impact BI. This study could not highlight to what extent these variables explain the variance in BI.

Implications

This study would help improve strategies to increase the technology acceptance of preservice teachers. Given the positive effect of constructivist beliefs on BI and TAM constructs, teacher preparation programs should also consider improving preservice teachers' conceptions of learning in a constructivist way. Cheng et al. (2009) proposed that promoting preservice teachers' constructivist learning might encourage them to adopt constructivist teaching approaches in their future teaching. This study might provide an insight into preservice teachers' future technology use in their teaching but might not reflect their actual use. Therefore, future studies should employ observations and interviews to reveal how these factors influence the actual use of technology. The comparison studies regarding in-service and preservice teachers' technology acceptance might contribute to identifying the differences and similarities of factors influencing technology acceptance.

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Utjecaj pedagoških i epistemoloških uvjerenja na način na koji budući nastavnici u Turskoj prihvaćaju tehnologiju: model strukturne jednadžbe

Sažetak

Epistemološka i pedagoška uvjerenja utječu na ponašanje nastavnika kada se radi o korištenju tehnologije u nastavi. Nekoliko studija bavilo se istraživanjem utjecaja pedagoških uvjerenja na prihvaćanje tehnologije. Međutim, još uvijek nema dovoljno saznanja o zajedničkom utjecaju epistemoloških i pedagoških uvjerenja na način na koji nastavnici prihvaćaju tehnologiju. Ovo se istraživanje bavi strukturnim odnosima između epistemoloških i pedagoških uvjerenja budućih nastavnika i načina na koji oni prihvaćaju tehnologiju. Podatci su dobiveni na uzorku koji se sastojao od 655 budućih nastavnika, a obrađeni su metodom analize putanje. Model istraživanja objašnjava 49 % varijance zavisne varijable, namjere ponašanja, a taj je postotak veći nego u prethodno provedenim istraživanjima o načinu na koji budući nastavnici prihvaćaju tehnologiju. Rezultati su pokazali da konstruktivistička uvjerenja nastavnika, percepcije o korisnosti tehnologije te stavovi o korištenju tehnologije značajno utječu na namjeru ponašanja. Osim toga, konstruktivistička i tradicionalna uvjerenja nastavnika također su i značajne odrednice percipirane korisnosti i percipirane lakoće korištenja. Dokazi prikazani u ovome istraživanju idu u prilog ideji da uključivanje raznih vanjskih varijabli u model prihvaćanja tehnologije može rezultirati značajnijom varijancom u namjeri ponašanja.

Ključne riječi: *budući nastavnici; epistemološka uvjerenja; model prihvaćanja tehnologije; model strukturne jednadžbe; pedagoška uvjerenja.*

Uvod

Integriranje IKT-a u nastavu tijekom 12 godina školovanja i obrazovanja na učiteljskom fakultetu cilj je koji mnoge zemlje žele postići (Antonietti i sur., 2023; Joo i sur., 2018; Sang i sur., 2010; Scherer i sur., 2019; Teo i sur., 2019). Štoviše, promjene koje su se u obrazovanju dogodile za vrijeme pandemije COVID-19 prisilile su dionike obrazovne zajednice da u nastavnu praksu uključe nove tehnologije (Ratten, 2023). Nastavnici su

morali prihvatiti nove digitalne izvore tijekom i nakon pandemije, dok su u razdoblju prije nje o tim tehnologijama učili ili ih koristili samoinicijativno (Al Mazrooei i sur., 2022). Nastavnici su ključni čimbenici za uspješnu integraciju tehnologije u nastavu (Aypay i sur., 2012; Chen, 2010; Gyamfi, 2016; Li i sur., 2019; Siyam, 2019; Teo, 2010; Teo i sur., 2019; Thurm i Barzel, 2022a). Usprkos mnogim prednostima tehnologije u učenju i poučavanju, mnoga istraživanja pokazuju da ju nastavnici ne koriste često i učinkovito (Fraillon i sur., 2020; Li i sur., 2019; Sang i sur., 2010; Thurm i Barzel, 2022b). Antonietti i suradnici (2023) došli su do saznanja da se način na koji nastavnici koriste tehnologiju uglavnom svodi na aktivnosti u kojima učenici imaju pasivnu ulogu te obično podrazumijeva prezentacije na računalu. Stoga je način na koji nastavnici integriraju tehnologiju u svoju nastavnu praksu još uvijek zanimljiva tema za istraživanje. Uzimajući u obzir čimbenike koji određuju upotrebu tehnologije i utječu na njezinu integraciju, može se reći da je integracija tehnologije u nastavu vrlo složen proces koji donosi obrazovne i profesionalne promjene (Antonietti i sur., 2023; Scherer i sur., 2019; Thurm i Barzel, 2022b).

Prepreke za integraciju tehnologije podijeljene su u dvije skupine: jednostavne prepreke (pristup tehnologiji, podrška itd.) i složene prepreke (uvjerenja, znanje, vještine itd.) (Ertmer, 2005). U posljednjih desetak godina škole su postale opremljenije digitalnim tehnologijama, što je dovelo do promjene fokusa istraživanja, koji je s jednostavnih prepreka premješten na složene prepreke (Bahcivan i sur., 2019; Schmitz i sur., 2022). Zato su istraživači prvo počeli ispitivati kako određena uvjerenja nastavnika utječu na integraciju tehnologije u nastavu. Odrediti koliko se integracija tehnologije u nastavni proces prihvaća, težak je proces koji otkriva otežavajuće i olakotne čimbenike i pruža uvid u namjere nastavnika i stvarnu upotrebu obrazovnih tehnologija (Scherer i sur., 2019). Čimbenici koji utječu na prihvaćanje tehnologije utječu i na način na koji nastavnici interpretiraju nova iskustva i informacije o korištenju tehnologije (Teo, 2009; Thomas i Palmer, 2014; Thurm i Barzel, 2022a). Davies je izradio model prihvaćanja tehnologije 1989. godine kako bi se prepoznali čimbenici koji utječu na namjeru korištenja IKT-a u organizacijama. Model prihvaćanja tehnologije najpoznatiji je model za predviđanje načina na koji pojedinci prihvaćaju tehnologiju i za prepoznavanje čimbenika i uvjeta koji doprinose integraciji tehnologije (Scherer i sur., 2019; Teo, 2009; 2010) jer se može lako prenijeti na različite uzorke i kontekste, a lako se može primijeniti i pri objašnjavanju namjere korištenja tehnologije (Scherer i sur., 2019). Taj je model ujedno i najčešće korišten teorijski okvir za određivanje načina na koji nastavnici ili budući nastavnici prihvaćaju tehnologiju (Baydas i Goktas, 2017; Scherer i sur., 2019; Yurdakul i sur., 2014). Novije metaistraživanje potvrdilo je da model prihvaćanja tehnologije uspješno predviđa ponašanje nastavnika i budućih nastavnika, bez obzira na njihovu razinu obrazovanja i državu u kojoj žive (Scherer i sur., 2019).

Model prihvaćanja tehnologije polazi od ideje da uvjerenja nastavnika utječu na njihove namjere ponašanja i upotrebu tehnologije te otkriva u kojoj je mjeri nastavnik voljan koristiti različite tehnologije (Teo, 2010; Teo i sur., 2019). Istraživači

koji upotrebljavaju model prihvaćanja tehnologije mogu lako izdvojiti namjere i ponašanja bitna za određene domene, tehnologije i korisnike (Granić i Marangunić, 2019), što povećava kredibilitet modela za nove tehnologije i buduće nastavnike. Model prihvaćanja tehnologije koristan je i uobičajen okvir za prepoznavanje uvjerenja nastavnika o tehnologiji i njihovih namjera, a istraživačima omogućava ispitivanje ponašanja nastavnika vezano uz različite alate, poput virtualnih laboratorija (Kolil i Achuthan, 2023), umjetne inteligencije (Zhang i sur., 2023) i mobilnih aplikacija za izradu portfolija (Petko i sur., 2023). Česta upotreba modela prihvaćanja tehnologije u novim područjima u posljednje je vrijeme dovela do zaključka da je model prikladan i za područje izobrazbe nastavnika. Stoga je bitno napomenuti da korištenje modela prihvaćanja tehnologije u obrazovnom kontekstu pomaže bolje razumjeti kako opisati, povećati i promicati produktivna uvjerenja nastavnika o integraciji tehnologije u nastavni proces.

S obzirom na obrazovni potencijal koji tehnologija ima, nastavnici koji obrazuju buduće nastavnike trebaju se usredotočiti na to da sadašnje i buduće nastavnike pripreme za učinkovito i uspješno integriranje tehnologije u proces učenja i poučavanja (Anderson i sur., 2011; Baydas i Goktas, 2017; Li i sur., 2016; Sang i sur., 2010; Teo i sur., 2012). Budući da nastavnici svoja uvjerenja oblikuju uglavnom tijekom studiranja, iznimno je važno utvrditi koja to uvjerenja utječu na namjere budućih nastavnika da koriste tehnologiju, kako bi se mogli osmisliti programi koji bi ih potaknuli da poučavaju učenike pomoću tehnologije (Bahcivan i sur., 2019; Bardakcı i Alkan, 2019; Li i sur., 2016; Teo i sur., 2012; Thomas i Palmer, 2014; Thurm i Barzel, 2022a). Buduće bi nastavnike također trebalo informirati o izazovima koje tehnologija donosi, kao što je ovisnost o igricama i tehnologiji općenito. Şeker i sur. (2023) utvrdili su da adolescenti počinju provoditi više vremena na internetu te da se razina ovisnosti o tehnologiji povećala nakon pandemije COVID-19. Osim toga, zanimljiv rezultat ovoga istraživanja pokazuje da je ovisnost o tehnologiji veća u obiteljima s nižim prihodima. To bi moglo ići u prilog tvrdnji da je potrebno proučavati model korištenja tehnologije u obrazovnom kontekstu kako bi se buduće nastavnike osposobilo za poučavanje u ovoj digitalnoj eri.

Proučavanje mogućih veza između uvjerenja nastavnika i njihovih namjera korištenja tehnologije moglo bi pomoći nastavnicima koji obrazuju budući nastavnički kadar shvatiti utjecaj vlastitih nastavnih metoda na buduće nastavnike (Cheng i sur., 2009). Istraživači predlažu uključivanje modela prihvaćanja tehnologije u širi model s raznim varijablama kako bi se odredili čimbenici koji utječu na namjeru da se tehnologija koristi izravno ili neizravno sa značajnom varijancom (Kiraz i Ozdemir, 2006; Teo i sur., 2012). Uvelike je poznato da uvjerenja nastavnika i budućih nastavnika o učenju i poučavanju značajno doprinose načinu na koji oni prihvaćaju tehnologiju (Gurer i Akkaya, 2022; Gyamfi, 2016; Huang i Teo, 2021; Huang i sur., 2021; Teo i Zhou, 2017). Nadalje, usku povezanost između uvjerenja o poučavanju i učenju i epistemoloških uvjerenja jasno su istaknuli mnogi istraživači (Chan i Elliott, 2004; Deng i sur., 2014; Sang i sur., 2010). Mnogobrojna su istraživanja naglasila pedagoška i epistemološka

uvjerenja u korištenju tehnologije (Bahcivan i sur., 2019; Chai i sur., 2009; Sang i sur., 2010; Teo i sur., 2008a; Thurm i Barzel, 2022b). Međutim, koliko je meni poznato, nije utvrđeno u kojoj mjeri pedagoška i epistemološka uvjerenja utječu na način na koji budući nastavnici prihvaćaju tehnologiju. S tim na umu, testirao sam prošireni model prihvaćanja tehnologije koji uključuje pedagoška i epistemološka uvjerenja, kako bi se odredili čimbenici koji utječu na način na koji budući nastavnici prihvaćaju tehnologiju.

Teorijski okvir

Davis (1989) je izradio model prihvaćanja tehnologije tako što je prilagodio teoriju razumnoga djelovanja (TRA) koju su 1975. godine osmislili Fishbein i Ajzen, s ciljem predviđanja ponašanja pojedinaca u vezi s korištenjem tehnologije. Teorija razumnoga djelovanja odnosi se na stav o ponašanju koje utječe na namjeru ponašanja. Model prihvaćanja tehnologije je opravdan teorijski okvir za ispitivanje veza između percipirane korisnosti (engl. PU), percipirane lakoće korištenja (engl. PEU) i stavova o korištenju računala (engl. ATU), što su temeljne varijable, te namjere ponašanja (engl. BI) i stvarnoga korištenja, što su izlazne varijable (Scherer i sur.,2019; Teo, 2009). Percipirana lakoća korištenja ima izravan utjecaj na percipiranu korisnost, a percipirana lakoća korištenja i percipirana korisnost također izravno utječu na stavove o korištenju računala. Stavovi o korištenju računala i percipirana korisnost izravno utječu na namjere ponašanja (Joo i sur., 2018). Ove su hipoteze ilustrirane na Slici 1. Prema modelu prihvaćanja tehnologije, budući nastavnici razvijaju pozitivne stavove o tehnologiji ako smatraju da je ona dragocjena i da ju je lako koristiti (Teo, 2010). Anderson i sur. (2011) došli su do saznanja da se namjere odnose na unutarnju motivaciju nastavnika da koriste tehnologiju u svojem nastavnom procesu. Namjera ponašanja usko je povezana s korištenjem tehnologije (Gyamfi, 2016; Teo, 2010) i predviđa ponašanje pri korištenju tehnologije (Anderson i sur., 2011). S obzirom na to da namjera ponašanja ima potencijal za predviđanje stvarnoga korištenja, mnogi su se istraživači bavili ispitivanjem čimbenika koji utječu na namjeru ponašanja.

Slika 1

Iako je originalna verzija modela prihvaćanja tehnologije sadržavala percipiranu lakoću korištenja, percipiranu korisnost, stavove o korištenju računala i namjeru ponašanja, neki su istraživači proširili model i uključili vanjske varijable koje utječu na namjeru ponašanja, s ciljem postizanja veće varijance (Gyamfi, 2016; Joo i sur., 2018; Teo i Zhou, 2017). Proučavanje vanjskih varijabli može pomoći odrediti niz utjecaja od vanjskih i nezavisnih varijabli do namjere ponašanja u modelu prihvaćanja tehnologije (Joo i sur., 2018; Huang i Teo, 2021; Scherer i sur., 2019; Teo, 2009; 2010; Yuen i Ma, 2002). U literaturi koja se bavi načinom na koji nastavnici i budući nastavnici prihvaćaju tehnologiju može se vidjeti da su najčešće korištene vanjske varijable samoučinkovitost, olakotni uvjeti, subjektivne norme i tehnološka kompleksnost (Aypay i sur., 2012; Baydas i Göktas, 2017; Gurer, 2021; Teo, 2009; Teo i sur., 2012; Yurdakul i sur., 2014).

Te se vanjske varijable u metaanalizi koju su proveli Sherer i sur. (2019) spominju i kao najčešće ispitivane varijable, s obzirom na njihovu povezanost s glavnim varijablama modela prihvaćanja tehnologije.

Huang i Teo (2021) smatraju da je malo toga poznato o utjecaju čimbenika drugoga reda, poput pedagoških i epistemoloških uvjerenja. Na način na koji nastavnici u nastavnom procesu koriste tehnologiju utječe model korištenja tehnologije, koji ima pedagoški aspekt. Stoga je veći broj istraživača u svoja istraživanja uključio i obrazovne ideologije (Kiraz i Ozdemir, 2006), pedagoška uvjerenja (Gurer i Akkaya, 2022; Gyamfi, 2016; Huang i Teo, 2021; Huang i sur., 2021; Kartal i sur., 2022; Teo i Zhou, 2017) i tehnološko pedagoško sadržajno znanje (TPACK) (Joo i sur., 2018; Teo i sur., 2019). Može se vidjeti da su neki od proširenih modela koji uključuju pedagoška uvjerenja ispitali samo utjecaj konstruktivističkih uvjerenja na prihvaćanje tehnologije (Teo i Zhou, 2017; Huang i Teo, 2021; Huang i sur., 2021). Štoviše, epistemološka uvjerenja također su jako zanimljiva jer su uvjerenja o tehnologiji često na njima utemeljene i izgrađuju pomoću njih (Dewey i sur., 2009). Malo se zna o vezama između poddimenzija epistemoloških uvjerenja te uvjerenja o poučavanju pomoću tehnologije i tehnološke kompetencije (Thurm i Barzel, 2022b). Potrebno je provesti još istraživanja o kombiniranom, izravnom i neizravnom utjecaju uvjerenja nastavnika o upotrebi tehnologije (Granić i Marangunić, 2019; Sang i sur., 2010). S obzirom na potrebu da se utvrdi kombinirani utjecaj epistemoloških i pedagoških uvjerenja na prihvaćanje tehnologije, u sljedećem dijelu rada daje se prikaz literature i predstavljaju hipoteze istraživanja.

Pregled literature

U ovome su istraživanju kao mjerni konstrukti korištena epistemološka uvjerenja, pedagoška uvjerenja, percipirana lakoća korištenja, percipirana korisnost, stavovi o korištenju računala i namjera ponašanja. Hipoteze postavljene na temelju tih konstrukata u skladu su s teorijskim i empirijskim objašnjenjima.

Epistemološka uvjerenja

Epistemološka uvjerenja su uvjerenja o prirodi znanja i stjecanju znanja (Hofer i Pintrich, 1997). Schommer (1994) dijeli epistemološka uvjerenja na naivna i sofisticirana uvjerenja. Naivna se odnose na uvjerenja pojedinca da je veliko znanje izvjesno i da ono može biti zapreka učenju. Suprotno tome, sofisticirana su uvjerenja nečija uvjerenja da se veliko znanje neprestano razvija i da može pomoći daljnjem učenju (Cheng i sur., 2009, p.320; Lehmann, 2022). Lehmann (2022) je utvrdio da su naivna uvjerenja budućih nastavnika negativno povezana s integrativnim učenjem, a u pozitivnoj su vezi s odvojenim učenjem.

S druge pak strane, Conley i sur. (2004) ispitali su epistemološka uvjerenja studenata u kontekstu četiriju dimenzija – izvori, izvjesnost, razvoj i opravdanost. Izvori i opravdanost povezani su s uvjerenjima o prirodi stjecanja znanja, dok su razvoj i

opravdanost povezani s prirodom znanja (Bahcivan i sur., 2019). Ono što određuje izvjesnost znanja jest uvjerenje pojedinca da je znanje konstantno ili da se neprestano razvija. Međutim, izvor znanja odnosi se na to smatra li pojedinac da znanje potječe od vanjskih čimbenika ili od vlastitoga procesa razmišljanja (Hofer, 2000). Razvoj uključuje uvjerenja da se današnje znanstvene ideje razlikuju od onoga što su znanstvenici ranije mislili. Opravdanost implicira da su znanstveni eksperimenti proizašli iz znatiželje i pažljivoga promišljanja (Bahcivan i sur., 2019).

Epistemološka uvjerenja usko su povezana s uvjerenjima o učenju i poučavanju (Chan i Elliott, 2004; Deng i sur., 2014; Wu i sur., 2020). Pedagoška i epistemološka uvjerenja budućih nastavnika smatraju se dijelom samoreguliranoga učenja (Lehmann, 2022). Epistemološka uvjerenja olakšavaju duboko učenje (Ho i Liang, 2015; Winberg i sur., 2019). Chan i Elliott (2004) ispitali su epistemološka i pedagoška uvjerenja 285 budućih nastavnika. Došli su do saznanja da se kod tradicionalnih uvjerenja nastavnika smatra da je znanje specifično, a da je glavni izvor znanja autoritet (nastavnik). Osim toga, Sinatra i Kardash (2004) smatraju da su uvjerenja o znanju kao konceptu koji se stalno razvija i uvjerenja o poučavanju kao procesu koji olakšava otkrivanje značenja povezani s konstruktivističkim uvjerenjima nastavnika. Zbog takvih uvjerenja nastavnici uključuju učenike u smislene aktivnosti učenja (Chai i sur., 2009). Nadalje, u istraživanju koje su nedavno proveli Barnes i sur. (2020) pokazalo se da epistemološka uvjerenja nastavnika također utječu i na način na koji nastavnici ocjenjuju učeničke radove.

Potrebno je provesti više istraživanja o utjecaju epistemoloških uvjerenja na različite nove inicijative, poput integracije tehnologije, i to u različitim kulturama (Xiong i sur., 2022). U nekim su istraživanjima ispitana epistemološka uvjerenja i korištenje tehnologije kod budućih nastavnika prirodoslovnih predmeta (Chai i sur., 2009; Deng i sur., 2014; Lee i Chan, 2015). Na primjer, Chai i sur. (2009) došli su do zaključka da su stavovi budućih nastavnika o IKT-u u negativnoj korelaciji s njihovim uvjerenjima o nastavniku kao izvoru znanja, a u pozitivnoj korelaciji s njihovim tradicionalnim uvjerenjima o poučavanju. S druge pak strane, Deng i sur. (2014) zaključili su da budući nastavnici koji smatraju da znanje nije izvjesno i da nastavnik nije izvor znanja imaju uglavnom konstruktivistička uvjerenja i koriste tehnologiju kao alat za izgradnju znanja. Literatura pruža ograničeni broj dokaza o ulozi epistemoloških uvjerenja nastavnika u obrazovnom kontekstu (Xiong i sur., 2022). Međutim, valja istaknuti da su epistemološka uvjerenja kulturološki osjetljiva. Stoga bi uključivanje epistemoloških uvjerenja u model prihvaćanja tehnologije doprinijelo našem znanju o tom modelu. Ovo su hipoteze koje se odnose ne epistemološka uvjerenja:

Hipoteza 1a: Izvor će imati značajan utjecaj na tradicionalna uvjerenja o nastavnom procesu.

Hipoteza 1b: Izvor će imati značajan utjecaj na percipiranu korisnost.

Hipoteza 1c: Izvor će imati značajan utjecaj na percipiranu lakoću korištenja.

Hipoteza 2a: Izvjesnost će imati značajan utjecaj na tradicionalna uvjerenja o nastavnom procesu.

Hipoteza 2b: Izvjesnost će imati značajan utjecaj na percipiranu korisnost.
Hipoteza 2c: Izvjesnost će imati značajan utjecaj na percipiranu lakoću korištenja.
Hipoteza 3a: Opravdanost će imati značajan utjecaj na konstruktivistička uvjerenja o nastavnom procesu.
Hipoteza 3b: Opravdanost će imati značajan utjecaj na percipiranu korisnost.
Hipoteza 3c: Opravdanost će imati značajan utjecaj na percipiranu lakoću korištenja.
Hipoteza 4a: Razvoj će imati značajan utjecaj na konstruktivistička uvjerenja o nastavnom procesu.
Hipoteza 4b: Razvoj će imati značajan utjecaj na percipiranu korisnost.
Hipoteza 4c: Razvoj će imati značajan utjecaj na percipiranu lakoću korištenja.

Pedagoška uvjerenja (Predodžbe o učenju i poučavanju)

Pojmovi „predodžbe o učenju i poučavanju" i „pedagoška uvjerenja" naizmjenično se koriste u ovome radu. Predodžbe o učenju i poučavanju odnose se na nastavnikove „preferirane načine poučavanja" (Teo i sur., 2008a) i ključni su konstrukti koje trebaju razmotriti nastavnici koji obrazuju buduće nastavnike (Lehmann, 2022). Te se predodžbe mogu kategorizirati kao dva suprotna pola - tradicionalne ili konstruktivističke (Cheng i sur., 2009). Međutim, nastavnici istovremeno mogu imati i jedna i druga uvjerenja te se prebacivati s jednih na druge (Crespo, 2016). Tradicionalna uvjerenja kreću od toga da nastavnici imaju značajnu ulogu te da je prijenos znanja glavni cilj nastavnoga procesa. Nastavnici koji imaju tradicionalna uvjerenja češće osmišljavaju aktivnosti u kojima je nastavnik u središtu jer smatraju da su kontrola nad nastavnim procesom i detaljne upute osnova uspješnoga učenja (Lehmann, 2022). Za razliku od toga, konstruktivistička uvjerenja kreću od toga da bi učenicima trebalo dopustiti da sami izgrađuju znanje i gledišta kroz interpretaciju svojih prethodnih iskustava (Cheng i sur., 2009; Liu i sur., 2017). Pedagoška uvjerenja su jedan od najčešće ispitivanih čimbenika u istraživanjima, jer utječu na način na koji se nastavnici koriste tehnologijom (Bahcivan i sur., 2019; Li i sur., 2019). Pedagoška uvjerenja nastavnika utječu na način i količinu integracije tehnologije (Anderson i sur., 2011; Chai i sur., 2010; Huang i sur., 2021; Kiraz i Ozdemir, 2006; Teo i sur., 2008a; Thurm i Barzel, 2022b). Mnogi su istraživači uočili povezanost između konstruktivističkih uvjerenja i česte upotrebe napredne tehnologije, kao i povezanost između tradicionalnih uvjerenja i slabe upotrebe tehnologije (Erens i Eicher, 2015; Gyamfi, 2016; Misfeldt i sur., 2016; Thurm i Barzel, 2022b). Huang i sur. (2019) zaključili su da nastavnici koji imaju konstruktivistička uvjerenja češće se koriste tehnologijom nego nastavnici s tradicionalnim uvjerenjima. Uvjerenja koja u centar stavljaju učenike polaze od toga da bi učenici trebali aktivno sudjelovati u aktivnostima učenja i poučavanja, u skladu sa svojim prethodnim iskustvima i interesima (Huang i sur., 2021). Ta su uvjerenja značajni čimbenici koji potiču nastavnike da u svojoj nastavnoj praksi koriste tehnologiju (Ertmer, 2005; Han i sur., 2017; Sang i sur., 2010; Teo i sur., 2008a). Konstruktivistička uvjerenja nastavnika promiču konstruktivnu upotrebu tehnologije (Teo i sur., 2008a).

Konstruktivistička uvjerenja o nastavnom procesu pozitivno utječu na prihvaćanje tehnologije (Gurer i Akkaya, 2022; Huang i Teo, 2021; Huang i sur., 2021; Teo i sur., 2018; Teo i sur., 2019) i stavove o upotrebi tehnologije u obrazovnom kontekstu (Chai i sur., 2009; Ertmer, 2005). Međutim, konstruktivistička uvjerenja ne garantiraju da će se tehnologija učinkovito i često koristiti (Lim i Chai, 2008). Teo i sur. (2008a) uočili su da su konstruktivistička uvjerenja o nastavnom procesu kod budućih nastavnika povezana s konstruktivnom i tradicionalnom upotrebom tehnologije. Još uvijek moramo saznati puno toga o tome kako tradicionalna i konstruktivistička uvjerenja utječu na prihvaćanje tehnologije. Ovo su hipoteze koje se odnose na pedagoška uvjerenja:

Hipoteza 5a: Tradicionalna uvjerenja o nastavnom procesu imat će značajan utjecaj na percipiranu korisnost.

Hipoteza 5b: Tradicionalna uvjerenja o nastavnom procesu imat će značajan utjecaj na percipiranu lakoću korištenja.

Hipoteza 5c: Tradicionalna uvjerenja o nastavnom procesu imat će značajan utjecaj na namjeru ponašanja.

Hipoteza 6a: Konstruktivistička uvjerenja o nastavnom procesu imat će značajan utjecaj na percipiranu korisnost.

Hipoteza 6b: Konstruktivistička uvjerenja o nastavnom procesu imat će značajan utjecaj na percipiranu lakoću korištenja.

Hipoteza 6c: Konstruktivistička uvjerenja o nastavnom procesu imat će značajan utjecaj na namjeru ponašanja.

Model prihvaćanja tehnologije

Percipirana lakoća korištenja odnosi se na to u kolikoj će se mjeri tehnologija koristiti bez posebnoga truda (Scherer i sur., 2019; Teo, 2009). Venkatehs (2000) smatra da je percipirana lakoća korištenja glavna pokretačka snaga modela prihvaćanja tehnologije (Gyamfi, 2016, str. 109). Scherer i sur. (2019) istaknuli su da pojam „bez posebnoga truda" implicira „bez teškoća i puno muke". Percipirana korisnost i percipirana lakoća korištenja temeljni su konstrukti, a ujedno i najvažniji čimbenici modela prihvaćanja tehnologije koji utječu na stavove o korištenju računala (Scherer i sur., 2019; Teo, 2009). Namjera ponašanja povezana je s mjerom u kojoj bi osoba voljela koristiti tehnologiju u budućnosti. Nastavnici koji smatraju da je tehnologiju lako koristiti i da je to korisno više će je i koristiti u svojoj nastavnoj praksi (Joo i sur., 2018).

Percipirana korisnost odnosi se na uvjerenja pojedinca o tome koliko će mu tehnologija pomoći odraditi određeni zadatak učinkovito i produktivno te mu povećati radni učinak (Scherer i sur., 2019; Teo, 2009; Yurdakul i sur., 2014). Prednosti tehnologije, kao što je poboljšanje procesa učenja i motivacije kod učenika i poboljšanje profesionalnoga razvoja nastavnika, ključne su sastavnice percipirane korisnosti (Baydas i Goktas, 2017). Nastavnici su motivirani ustrajati u integraciji tehnologije kada percipiraju pozitivan utjecaj tehnologije na vlastiti radni učinak (Anderson i sur., 2011; Baydas i Goktas, 2017; Gyamfi, 2016; Teo, 2009; Thurm i Barzel, 2022b). Ovo su hipoteze koje se tiču percipirane lakoće korištenja i percipirane korisnosti:

Hipoteza 7a: Percipirana lakoća korištenja imat će značajan utjecaj na percipiranu korisnost.

Hipoteza 7b: Percipirana lakoća korištenja imat će značajan utjecaj na stavove o korištenju računala.

Hipoteza 8a: Percipirana korisnost imat će značajan utjecaj na stavove o korištenju računala.

Hipoteza 8b: Percipirana korisnost imat će značajan utjecaj na namjeru ponašanja.

Uspješna integracija tehnologije u obrazovanju usko je povezana sa stavovima nastavnika o korištenju tehnologije. Među čimbenicima koji utječu na način na koji se nastavnici koriste tehnologijom, stavovi imaju važnu ulogu i glavni su prediktor korištenja tehnologije (Li i sur., 2016; Sang i sur., 2010; Yurdakul i sur., 2014). Stavovi o korištenju tehnologije ključni su za to hoće li pojedinac željeti ili ne željeti koristiti se tehnologijom u nastavi (Ajzen i Fishbein, 1977). Teo (2010) definira stav prema ponašanju kao intenzitet zadovoljstva koju pojedinac osjeća kada provede određeno ponašanje (str. 128). Stav prema korištenju tehnologije odnosi se na to smatraju li nastavnici i budući nastavnici da je korištenje tehnologije pozitivno ili negativno iskustvo (Li i sur., 2016). Pozitivni stavovi o korištenju tehnologije promiču stvarnu upotrebu tehnologije u nastavi (Goos i Bennison, 2008; Yuen i Ma, 2002). Od iznimne je važnosti shvatiti što utječe na formiranje stavova nastavnika (Sang i sur., 2010).

Hipoteza 9: Stavovi o korištenju računala imat će značajan utjecaj na namjeru ponašanja.

Metodologija

Nacrt istraživanja

Istraživanje je provedeno kao presječno istraživanje, a uključuje model strukturne jednadžbe kao pristup za otkrivanje povezanosti između nezavisnih varijabli (pedagoška i epistemološka uvjerenja te glavne varijable modela prihvaćanja tehnologije) i zavisne varijable (namjera ponašanja) (Byrne, 2016; Ullman, 2019). Prošireni model prihvaćanja tehnologije izrađen je tako što su dodana epistemološka i pedagoška uvjerenja budućih nastavnika kao vanjske varijable. Model strukturne jednadžbe omogućio je izradu odgovarajućega modela čimbenika koji utječu na to kako će budući nastavnici prihvatiti tehnologiju. Predloženi model istraživanja prikazan je na Slici 2.

Slika 2

Sudionici i kontekst

Mjerenja su provedena na uzorku od 657 budućih nastavnika, studenata na učiteljskom fakultetu u Turskoj koji provodi četverogodišnji prijediplomski studij. Primijenjena je metoda prigodnoga uzorka. Ispitanici su u istraživanju sudjelovali dobrovoljno. Prije samoga prikupljanja podataka sudionici su informirani o svrsi istraživanja i o pravu na povlačenje iz istraživanja u bilo kojem trenutku. Primijenjena je metoda papira i olovke,

a bilo je potrebno otprilike 40 minuta za popunjavanje upitnika. Dvoje sudionika nije popunilo cijeli upitnik pa su njihovi podatci uklonjeni iz cjelokupnoga seta podataka. Na kraju se uzorak ispitanika sastojao od 655 budućih nastavnika.

Tablica 1 prikazuje njihove demografske podatke. Odabrani su ispitanici iz pet glavnih studijskih programa, a 75,3 % ispitanika bilo je ženskoga spola. 33 % ispitanika bilo je na drugoj godini studija, 36 % na trećoj, a 31 % na četvrtoj godini studija. Troje od četvero ispitanika posjeduje vlastito računalo, a većina (83,96 %) smatra da je njihova tehnološka kompetencija na srednjoj ili visokoj razini. Iako to nije izričito navedeno u tablici, otprilike 85 % ispitanika izjavilo je da internetu pristupaju preko mobitela. Ovi demografski podatci upućuju na to da se uzorak sastojao od mlade populacije, što može za rezultat imati viši stupanj razvijenosti tehnoloških kompetencija i lagan pristup tehnologiji.

Tablica 1

Bilo bi korisno dati detaljne informacije o studiju nastavničkoga smjera koji su sudionici pohađali. Sveučilište je smješteno u središtu Turske. Njegovi se kolegiji mogu svrstati u sljedeće kategorije: pedagogija, sadržaj, tehnologija i liberalno obrazovanje. Kurikul prema kojemu studenti rade uključuje uglavnom kolegije povezane s općom pedagogijom i nastavnim sadržajem. Kolegiji u kojima se koristi tehnologija bili su kolegiji iz područja IKT-a i izrade nastavnih materijala.

Instrumenti za prikupljanje podataka

Za prikupljanje podataka korišten je upitnik koji se sastojao od četiri dijela. U prvome su se dijelu prikupljali demografski podatci o ispitanicima. Drugi je dio bio Upitnik o predodžbama o učenju i poučavanju, koji su izradili Chan i Elliott (2004), dok je treći dio bio Skala znanstvenih epistemoloških uvjerenja, a izradili su je Conley i sur. (2004). Drugi su istraživači preveli skale na turski jezik i prilagodili ih (Upitnik o predodžbama o učenju i poučavanju prilagodio je Eren 2009., a Skalu znanstvenih epistemoloških uvjerenja prilagodio je Bahcivan 2014. godine). Upitnik o predodžbama o učenju i poučavanju ima dvije dimenzije, a Skala znanstvenih epistemoloških uvjerenja ima četiri dimenzije.

Zadnji dio upitnika sastojao se od tvrdnji pomoću kojih su se mjerila četiri konstrukta modela prihvaćanja tehnologije (percipirana lakoća korištenja, percipirana korisnost, stavovi o korištenju računala i namjera ponašanja). Neke od tvrdnji koje su korištene u ovome dijelu formulirane su iz studije koju su proveli Ursavaş i sur. (2014), a prevedene su na turski jezik. Međutim, Sang i sur. (2010) smatraju da mjerenje konstrukata poput namjere ponašanja pomoću dviju tvrdnji ne može biti dovoljno da bi se te konstrukte uistinu moglo jasno razumjeti. Ajzen (2006) je predložio da bi bilo bolje prepoznati ponašanje na odgovarajućoj razini specifičnosti jer se ljudi fokusiraju na određene definicije te bi se moglo doći do puno relevantnijih rezultata. U istraživanjima nije lako doći do sličnih rezultata vezano uz namjeru korištenja tehnologije jer se ciljno

ponašanje može definirati vrlo široko. S obzirom na taj potencijalni nedostatak, Lee i sur. (2010) proveli su istraživanje u kojemu su ispitali odluke nastavnika da se koriste tehnologijom u obrazovnom kontekstu. Definirali su ciljno ponašanje kao korištenje tehnologije s ciljem izrade nastavnih materijala i provedbe nastave. Mi smo stoga uveli tvrdnje iz postojećih istraživanja koje se odnose na percipiranu korisnost, stavove o korištenju računala i namjeru ponašanja (Sang i sur., 2010; Teo, 2009). Dodane su tvrdnje pripremljene postupkom povratnoga prijevoda.

Sve su tvrdnje mjerene na skali od 5 stupnjeva, od 1 (uopće se ne slažem) do 5 (u potpunosti se slažem). Broj i primjeri tvrdnji za svaki faktor prikazani su u Tablici 2.

Tablica 2

Analiza podataka

Prvi je korak bio provedba eksploratorne faktorske analize i konfirmatorne faktorske analize, kako bi se provjerila valjanost i pouzdanost mjerenja. Određena su faktorska opterećenja za svaku varijablu. Indeksi prikladnosti modela bili su ujedno i način procjene prikladnosti modela. Nakon toga su izračunati deskriptivni (srednja vrijednost, standardna devijacija, minimalne i maksimalne vrijednosti) i korelacijski statistički podatci. Provedena je analiza momentnih struktura (engl. AMOS) kako bi se izračunale procjene parametara, analizirala prikladnost modela te ispitali izravni, neizravni i ukupni učinci. U ovome istraživanju model strukturne jednadžbe omogućava istovremeno otkrivanje veza između konstrukata (Byrne, 2016; Kline, 2011).

Rezultati

U ovome dijelu rada prikazuju se deskriptivni statistički podatci te pouzdanost i valjanost mjerenih tvrdnji. Hipoteze su testirane pomoću procjene prikladnosti modela, procijenjen je model putanje te su utvrđeni utjecaji između konstrukata.

Deskriptivna statistika

Deskriptivni statistički podatci pokazali su da su srednje vrijednosti podataka koje su dali ispitanici bile iznad 3. Standardne su devijacije otkrile da su rezultati raspršeni blizu srednje vrijednosti. Uočeno je da budući nastavnici imaju sofisticirana epistemološka uvjerenja i pozitivnije stavove prema konstruktivističkom pogledu na nastavni proces nego prema tradicionalnom. Što se tiče prihvaćanja tehnologije, može se reći da budući nastavnici imaju pozitivne percepcije, stavove i namjere u vezi s korištenjem tehnologije u obrazovanju (Tablica 3). Nakošenost (u rasponu od |.006| do |1,030|) i spljoštenost krivulje (u rasponu od |.039| do |1,073|) bile su unutar preporučenih vrijednosti (|3.00| i |10,00|), svaka pojedinačno. Rezultati su pokazali da podatci odgovaraju kriterijima normalne distribucije (Kline, 2011).

Tablica 3

Konvergentna valjanost

Konvergentna valjanost podrazumijeva mjerenje istoga konstrukta različitim tvrdnjama. Fornell i Larcker (1981) predložili su tri postupka za procjenu konvergentne valjanosti tvrdnji pomoću kojih se vrši mjerenje. To su: (1) pouzdanost tvrdnje, (2) indeks kompozitne pouzdanosti i (3) ekstrahirana srednja varijanca. Faktorska opterećenja tvrdnji određuju pouzdanost tvrdnji. U Tablici 4 prikazani su rezultati konvergentne valjanosti. Korelacije između opaženih i latentnih varijabli (faktorsko opterećenje) trebale bi imati vrijednost od barem 0,50 ili veću (Kline, 2011). Može se vidjeti da su sva faktorska opterećenja bila u rasponu između 0,514 i 0,805, što upućuje na konvergentnu valjanost na razini tvrdnje. Da bi indeks kompozitne pouzdanosti bio prihvatljiv, trebao bi se kretati u rasponu između 0,60 i 0,70 (Hair i sur., 2017). Tablica pokazuje da je indeks kompozitne pouzdanosti u rasponu između 0,67 i 0,90. Osim toga Cronbachova alfa je za svaku latentnu varijablu bila veća od granične vrijednosti od 0,70 u skladu s preporukama koje je dao DeVellis (2017). Na kraju je utvrđeno da su vrijednosti ekstrahirane srednje varijance bile više od granične vrijednosti od 0,50 što je je preporuka za konvergentnu valjanost (Kline, 2011).

Tablica 4

Diskriminantna valjanost

Diskriminantna valjanost postoji ako korelacije između skupina varijabli koje mjere različite konstrukte nisu prevelike (Kline, 2011), a procjenjuje se usporedbom kvadratnoga korijena ekstrahirane srednje varijance za određeni konstrukt i korelacija između toga konstrukta i ostalih konstrukata. U Tablici 5 prikazane su korelacije između konstrukata i kvadratni korijeni ekstrahiranih srednjih varijanci. Podebljani dijagonalni elementi su kvadratni korijeni ekstrahiranih srednjih varijanci. Može se vidjeti da su njihove vrijednosti veće od međukorelacija između konstrukata. Stoga se može reći da je diskriminantna valjanost pogodna za daljnju analizu.

Tablica 5

Prikladnost modela

Računalni softver AMOS 21 korišten je za procjenu prikladnosti između modela istraživanja i dobivenih podataka, a primijenjena je metoda procjene maksimalne vjerodostojnosti. Obično se koriste raznovrsni indeksi za mjerenje prikladnosti modela. Indeksi prikladnosti modela korišteni u ovome istraživanju bili su omjer minimalne funkcije prikladnosti i njezinoga stupnja slobode (χ^2/df), komparativni indeks prikladnosti, Tucker-Lewisov indeks, standardni korijen srednjega kvadratnog preostatka (engl. SRMR) i srednja kvadratna pogreška aproksimacije (engl. RMSEA). Ovi se indeksi često koriste u sličnim istraživanjima (Chen, 2010; Gurer i Akkaya, 2022; Huang i Teo, 2021; Joo i sur., 2018; Teo, 2009). U Tablici 6 prikazana je preporučena razina prihvatljive prikladnosti (Collier, 2020) i indeksi prikladnosti modela istraživanja. Prema Tablici 6 sve su vrijednosti u skladu s preporučenim graničnim vrijednostima.

Tablica 6

Testiranje hipoteza i analiza putanje

Tablica 7 prikazuje testiranje hipoteza, a Slika 3 prikazuje koeficijente putanje modela istraživanja. Pomoću dobivenih podataka potvrđeno je šesnaest od dvadeset tri hipoteze. Uvjerenja budućih nastavnika o izvoru znanja imala su značajan i negativan utjecaj na tradicionalna uvjerenja ($\beta = -.10$, $p < .05$) i percipiranu korisnost ($\beta = -.10$, $p < .05$). Uvjerenja koja polaze od toga da znanje nije izvjesno nisu imala značajan utjecaj na tradicionalna uvjerenja o nastavnom procesu, percipiranu korisnost i percipiranu lakoću korištenja. Konstrukti opravdanost i razvoj imali su značajan utjecaj na konstruktivistički pogled na nastavni proces ($\beta = .57$, $p < .001$; $\beta = .15$, $p < .001$, za svaki konstrukt pojedinačno) i percipiranu korisnost ($\beta = .11$, $p < .05$; $\beta = .20$, $p < .001$, za svaki konstrukt pojedinačno).

Tablica 7

Kada se radi o pedagoškim uvjerenjima, može se vidjeti da su i tradicionalna i konstruktivistička uvjerenja značajno utjecala na percipiranu korisnost i percipiranu lakoću korištenja. Konstruktivistička su uvjerenja također značajno utjecala na namjeru ponašanja ($\beta = .21$, $p < .001$). Dobiveni podatci potvrđuju sve hipoteze vezane uz model prihvaćanja tehnologije. Uočeno je da je percipirana lakoća korištenja značajno utjecala na percipiranu korisnost ($\beta = .34$, $p < .001$), a ta su dva konstrukta imala značajan utjecaj na stavove o korištenju računala ($\beta = .22$, $p < .001$; $\beta = .40$, $p < .001$). Na kraju, percipirana korisnost i stavovi o korištenju računala imali su značajan utjecaj na namjeru ponašanja ($\beta = .35$, $p < .001$; $\beta = .31$, $p < .001$).

Slika 3

U ovome je istraživanju testirano šest endogenih varijabli. Prediktori su značajno odredili tradicionalna i konstruktivistička uvjerenja o nastavnom procesu pomoću postotaka varijanci od 28 % i 45 %, pojedinačno. 47 % varijance percipirane korisnosti objasnili su njezini prediktori. Percipirana lakoća korištenja i percipirana korisnost značajno su odredili stavove o korištenju računala i rezultirali s 28 % varijance. Namjera ponašanja imala je najveću varijancu, što se može objasniti njezinim egzogenim konstruktima ($R^2 = .49$).

Tablica 8 prikazuje standardizirane ukupne učinke i izravne i neizravne učinke između varijabli unutar modela istraživanja. Prema Cohenu (1988), veličina učinka s vrijednošću manjom od 0,1 smatra se malom, vrijednost ispod 0,3 smatra se umjerenom, a vrijednosti od 0,5 i više smatraju se velikima. Najjača determinanta namjere ponašanja je percipirana korisnost, ukupne veličine učinka od 0,471. Iza toga slijede konstruktivistička uvjerenja o nastavnom procesu i stavovi o korištenju računala, ukupne veličine učinka od 0,405 i 0,309. Ovi učinci imaju srednju pozitivnu veličinu učinka. Konstruktivistička uvjerenja o nastavnom procesu imaju najjači učinak

na namjeru ponašanja od svih varijabli izvan modela prihvaćanja tehnologije. Devet varijabli objašnjava 49 % varijance namjere ponašanja.

Tablica 8

Epistemološka i pedagoška uvjerenja, percipirana korisnost i percipirana lakoća korištenja objašnjavaju otprilike 28 % varijance stavova o korištenju računala. Najistaknutija determinanta za stavove o korištenju računala jest percipirana korisnost, ukupne veličine učinka od 0,391, što je u potpunosti izravan utjecaj. Nakon toga slijedi percipirana lakoća korištenja, ukupnoga učinka od 0,350 za stavove o korištenju računala.

Najistaknutija determinanta za percipiranu korisnost su konstruktivistička uvjerenja o nastavnom procesu, ukupnoga učinka od 0,374. Percipirana lakoća korištenja je druga najistaknutija determinanta, ukupnoga učinka od 0,335, što je u potpunosti izravan učinak. Determinante objašnjavaju 47 % varijance percipirane korisnosti.

Svi ukupni učinci imaju malu veličinu učinka na percipiranu lakoću korištenja. Najjači učinak na nju od svih vanjskih varijabli u modelu prihvaćanja tehnologije imaju konstruktivistička uvjerenja o nastavnom procesu, ukupnoga učinka od 0,277. Vanjske varijable zajedno objašnjavaju 13 % varijance percipirane lakoće korištenja.

Rasprava i zaključci

Cilj je ovoga istraživanja bio potvrditi prošireni model prihvaćanja tehnologije te utvrditi čimbenike koji izravno ili neizravno utječu na način na koji budući nastavnici prihvaćaju tehnologiju. Model je procijenjen kroz konvergentnu i diskriminantnu valjanost te indekse prikladnosti. Može se vidjeti da rezultati idu u prilog valjanosti proširenoga modela koji se sastoji od epistemoloških uvjerenja, predodžbi o poučavanju i konstrukata modela prihvaćanja tehnologije. Deskriptivni statistički podatci pokazali su da budući nastavnici imaju sofisticirana epistemološka uvjerenja, da više naginju konstruktivističkom nastavnom procesu nego tradicionalnom te da općenito prihvaćaju tehnologiju u obrazovnom procesu, što je u skladu s ranije provedenim istraživanjima (Bahcivan i sur., 2019; Chai i sur., 2009).

Model istraživanja uključio je dva konstrukta koji su povezani s nastavnicima, a koji su vanjski elementi modela prihvaćanja tehnologije: epistemološka uvjerenja i predodžbe o poučavanju. Na temelju pregleda literature sastavljene su dvadeset tri hipoteze. Prema rezultatima analize putanje, šesnaest od njih je potvrđeno. Konstruktivistička uvjerenja o nastavnom procesu, percipirana korisnost i stavovi o korištenju računala imali su statistički značajan utjecaj na namjeru ponašanja, dok tradicionalna uvjerenja nisu imala takav utjecaj. U skladu s mnogobrojnim istraživanjima modela prihvaćanja tehnologije, percipirana korisnost i percipirana lakoća korištenja bili su značajne determinante stavova o korištenju računala (Park, 2009; Teo, 2010; Teo i sur., 2012).

Što se tiče pedagoških uvjerenja, tradicionalna i konstruktivistička uvjerenja o nastavnom procesu bila su statistički značajne determinante percipirane korisnosti i percipirane lakoće korištenja. Rezultati su pokazali da epistemološka uvjerenja

budućih nastavnika nemaju statistički utjecaj na percipiranu lakoću korištenja. Međutim, opravdanost i razvoj kao čimbenici pozitivno utječu na percepcije korisnosti tehnologije kod ispitanika, a izvor kao čimbenik ima negativan utjecaj na njih. Važno je napomenuti da uvjerenja o izvjesnosti znanja nisu imala utjecaj na pedagoška uvjerenja i prihvaćanje tehnologije. Za razliku od toga, Deng i sur. (2014) uočili su značajne pozitivne veze između izvjesnosti znanja, pedagoških uvjerenja i korištenja tehnologije, i kod tradicionalnih i kod konstruktivističkih uvjerenja. Ove razlike mogle su nastati zbog toga što su epistemološka uvjerenja pod utjecajem kulturalnoga konteksta te mogu dovesti do različitih zaključaka u različitim kontekstima.

Varijable u modelu objašnjavaju 49 % varijance zavisne varijable, namjere ponašanja, a postotak je veći od onoga koji je dobiven u ranijim istraživanjima o načinu na koji budući nastavnici prihvaćaju tehnologiju (Teo, 2009; Teo i sur., 2008b; Teo i sur., 2012; Teo i Zhou, 2017). U mnogim je istraživanjima utvrđeno da je percipirana korisnost najjača determinanta u predviđanju prihvaćanja tehnologije (Anderson i sur., 2011; Aypay i sur., 2012; Baydas i Goktas, 2017; Joo i sur., 2018; Huang i Teo, 2021; Teo i sur., 2019). Joo i sur. (2018) tvrde da kritičko promišljanje budućih nastavnika o prihvaćanju tehnologije uglavnom ovisi o njihovim uvjerenjima o prednostima tehnologije u učenju i poučavanju. Percipirana korisnost najjača je determinanta namjere ponašanja, a slijede konstruktivistička uvjerenja i stavovi o korištenju računala. Pedagoška uvjerenja budućih nastavnika, percepcije o korisnosti tehnologije te stavovi o korištenju računala izravno su utjecali na namjeru ponašanja, dok su epistemološka uvjerenja i percepcije o lakoći korištenja tehnologije imale neizravan utjecaj, što je u skladu s drugim istraživanjima (Huang i sur., 2021; Teo i sur., 2012).

S obzirom na izravan utjecaj na namjeru ponašanja, može se reći da će ispitanici u svojoj nastavi u budućnosti koristiti tehnologiju jer smatraju da će korištenje tehnologije unaprijediti njihov radni učinak i jer imaju pozitivne stavove o tehnologiji u obrazovanju. Osim toga, čvrsta konstruktivistička uvjerenja mogu potaknuti buduće nastavnike na prihvaćanje tehnologije. Time se potvrđuju rezultati istraživanja opisani u literaturi (Sang i sur., 2010). Snažan utjecaj konstruktivističkih uvjerenja na namjeru ponašanja izvanredno je otkriće, u skladu s rezultatima drugih istraživanja. Takav rezultat stavlja naglasak na vezu između konstruktivističkih uvjerenja o nastavnom procesu i ponašanja nastavnika pri korištenju tehnologije (Teo i sur., 2008b; Sang i sur., 2010).

Neizravan utjecaj epistemoloških uvjerenja na namjeru ponašanja upućuje na to da ako pojedinac smatra da se priroda znanja stalno razvija i da znanje ne dolazi samo od nastavnika, možda neće dovesti do prihvaćanja tehnologije ako se epistemološka uvjerenja ne povežu s pedagoškim uvjerenjima, percipiranom korisnošću i lakoćom korištenja tehnologije te pozitivnim stavovima o korištenju tehnologije. Percipirana lakoća korištenja također ima neizravan utjecaj na namjeru ponašanja, a percipirana korisnost i stavovi o korištenju računala prenose njezin učinak. Čak i ako ispitanici smatraju da se tehnologija može koristiti bez velikoga truda, možda ju ipak neće integrirati u svoj nastavni proces ako ne vide njezin utjecaj na vlastiti radni učinak i ako nemaju pozitivne stavove o njoj (Teo i sur., 2019).

Na stavove o korištenju računala izravno su utjecali percipirana lakoća korištenja i percipirana korisnost, a neizravno epistemološka i pedagoška uvjerenja. Oba tipa uvjerenja kod budućih nastavnika neizravno utječu na njihove stavove o korištenju računala, s posrednim utjecajem percipirane lakoće korištenja i percipirane korisnosti. Buduće nastavnike sa sofisticiranim epistemološkim i konstruktivističkim uvjerenjima trebalo bi poticati da prihvate činjenicu da će im tehnologija pomoći poboljšati radni učinak i učinkovitost te da ju je relativno jednostavno koristiti u nastavi. Chai i sur. (2009) smatraju da su epistemološka i pedagoška uvjerenja budućih nastavnika u korelaciji s njihovim stavovima o korištenju računala. Iznenađuje činjenica da su konstruktivistička uvjerenja o nastavnom procesu najistaknutija determinanta u predviđanju percipirane korisnosti. Drugim riječima, budući nastavnici uglavnom smatraju da bi im tehnologija mogla pomoći poboljšati radni učinak ako na nastavni proces gledaju kao na proces izgradnje znanja. Ovaj je rezultat u skladu s rezultatima drugih istraživanja (Huang i Teo, 2021; Huang i sur., 2021).

Ukratko, u istraživanju je objašnjena gotovo polovica varijance namjere ponašanja. Konstruktivistička uvjerenja o nastavnom procesu, percipirana korisnost i stavovi o korištenju računala značajne su determinante namjere ponašanja. Kao dodatak modelu prihvaćanja tehnologije, epistemološka su uvjerenja više utjecala na percipiranu korisnost nego na percipiranu lakoću korištenja. S druge strane, konstruktivistička uvjerenja o nastavnom procesu značajne su determinante percipirane lakoće korištenja, percipirane korisnosti i namjere ponašanja. Kada se radi o značajnom doprinosu ovoga istraživanja izobrazbi budućih nastavnika, možemo spomenuti nekoliko aspekata. Kao prvo, sociološki i kulturološki demografski podatci o ispitanicima pokazuju da se radi o uzorku mladih ispitanika. Kada se tome dodaju jednostavan pristup tehnologiji i percipirana visoka tehnološka kompetencija, očito je da su budući nastavnici skloni prihvatiti tehnologiju u svojoj nastavnoj praksi. Kao drugo, uočeno je da epistemološka uvjerenja mogu utjecati na prihvaćanje tehnologije samo kada se kombiniraju s pedagoškim uvjerenjima. Nadalje, uvjerenja koja polaze od toga da je znanje izvjesno, nemaju utjecaja ili imaju vrlo mali utjecaj ili na pedagoška uvjerenja ili na glavne varijable prihvaćanja tehnologije. To implicira da uvjerenje koje polazi od toga da je znanje nepromjenjivo može postati zastarjelo zbog sve veće brzine kojom se nova znanja usvajaju, zbog čega ova vrsta epistemološkoga uvjerenja nije imala izravan utjecaj na većinu varijabli. Rezultati mogu pomoći opisati karakteristike budućih nastavnika koji prihvaćaju i integriraju tehnologiju u svoj rad. Nastavnici koji podržavaju razvoj znanja također će znati cijeniti nastojanja svojih učenika da znanje učine smislenim i jako se truditi integrirati tehnologiju u vlastitu nastavnu praksu kako bi vodili učenike na putu izgradnje znanja.

Ograničenja

Iako su model strukturne jednadžbe i analiza putanje jako korisni za izradu preciznijega modela za predviđanje čimbenika koji utječu na prihvaćanje tehnologije,

važno je napomenuti da ovo istraživanje ima i nekoliko ograničenja. Prvo, podatci su prikupljeni putem samoiskaza, što može dovesti do precijenjenih rezultata. Razlog tome može biti to što su budući nastavnici davali odgovore za koje su mislili da su poželjni. Kao drugo, ispitanici su studenti nastavničkoga smjera na fakultetu te možda imaju ograničeno iskustvo poučavanja i korištenja tehnologije u nastavi. Kao treće, ispitanici su odabrani za sudjelovanje u istraživanju metodom prigodnoga uzorka, a ne nasumičnoga uzorka, što otežava generalizaciju rezultata. Na kraju, u istraživanju je objašnjeno 49 % varijance namjere ponašanja, a 51 % ostalo je neobjašnjeno. Varijable koje su uklonjene, poput samoučinkovitosti nastavnika, tehnološkoga pedagoškog sadržajnog znanja, učinkovitosti STEM-a i stavova o STEM-u te tehnološke učinkovitosti mogle su imati značajan utjecaj na namjeru ponašanja. U ovome se istraživanju nije moglo utvrditi u kojoj mjeri te varijable objašnjavaju varijancu namjere ponašanja.

Implikacije

Ovo bi istraživanje moglo pomoći razviti strategije za bolje prihvaćanje tehnologije kod budućih nastavnika. S obzirom na pozitivan utjecaj konstruktivističkih uvjerenja na namjeru ponašanja i model prihvaćanja tehnologije kao konstrukte, studijski programi koje pohađaju budući nastavnici trebali bi uključiti i načine na koje se može utjecati na predodžbe budućih nastavnika o učenju na konstruktivistički način. Cheng i sur. (2009) smatraju da bi promicanje konstruktivističkoga načina učenja buduće nastavnike moglo potaknuti da usvoje konstruktivistički način poučavanja u svojoj nastavnoj praksi u budućnosti. Ovo bi istraživanje moglo pružiti uvid u model prema kojemu će budući nastavnici u nastavnoj praksi koristiti tehnologiju, ali ne mora nužno odražavati njezino stvarno korištenje. Stoga bi buduća istraživanja trebala uključiti opažanja i intervjue kako bi se došlo do saznanja kako ti čimbenici utječu na stvarno korištenje tehnologije. Usporedba istraživanja o načinima na koje nastavnici i budući nastavnici prihvaćaju tehnologiju mogla bi doprinijeti prepoznavanju razlika i sličnosti u čimbenika koji utječu na prihvaćanje tehnologije.

Napomena

Autor izjavljuje da ne postoji sukob interesa.