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Key factors influencing teachers' motivation to transfer technology-enabled educational innovation

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Abstract

In response to the digital transformation in education, teachers are expected to develop new competencies. Although teachers gained valuable experience in digital technology use during the COVID-19 pandemic, research and practice show that primary school teachers need to be supported and trained for the new normal of innovative, advanced use and adoption of digital technologies in educational practice. This study aims to identify the key factors that influence teachers' motivation to transfer technology-enabled educational innovation in primary education. The Learning Transfer System Inventory (LTSI) factors and the adoption factors of technology-enabled educational innovation have been conceptually mapped. The LTSI model has been empirically validated with data collected from 12.7% of Lithuanian primary school teachers. The structural equation modeling technique was utilized to analyze causal relationships of factors influencing teachers' motivation to transfer technology-enabled educational innovation. The qualitative research method was used to provide a deeper understanding of key factors that influence motivation to transfer. The conducted analysis shows that motivation to transfer is significantly influenced by all five domains of factors: perceived value, personal characteristics, social practices, organizational and technology-enabled innovation factors. Motivation to transfer innovation varies according to teachers' perceived digital technology integration skills, which underpin the importance of applying different roles and strategies based on the teachers' skills. This study provides implications for designing effective professional development for in-service teachers and creating a suitable environment in schools for the adoption of innovation in post-COVID-19 education.

Keywords Technology-enabled educational innovation · Teacher training · Learning transfer · Motivation to transfer · LTSI

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1 Introduction

Over the past decade, availability and access to digital technology in schools have significantly increased (Minea-Pic, 2020; Francom, 2020; European Commission, 2019). During the COVID-19 pandemic, teachers entered an instructional environment where digital technology became a necessary medium for remote teaching and learning (Trust & Whalen, 2021). Furthermore, due to the accelerated digital transformation of nearly all aspects of daily life, digital competencies have become a mandatory part of education and training for all, including primary school children (IEEE Standards Association, 2020). Although teachers gained valuable experience in the use of digital technology in remote teaching (Myyry et al., 2022), research and practice show that teachers' digital educational competencies vary considerably (Lavidas et al., 2022; Howard et al., 2021b; Scherer et al., 2021; Sánchez-Cruzado et al., 2021; Minea-Pic, 2020). This is especially relevant when it comes to innovative and advanced use of digital technologies in educational practices, particularly, in primary education (Diz-Otero et al., 2023; Guillén-Gámez et al., 2022; Trust & Whalen, 2021; Jevsikova et al., 2021). The ability to use digital technologies in educational practices on an advanced level of technological creativity and coding are necessary characteristics for twenty-first-century learners (IEEE Standards Association, 2020). Teachers' ability to undertake the conceptual change in education from using to understanding digital technologies, requires a change in personal attitudes, intensive and reimagined competence development, institutional policies, and support.

In this context, technology-enabled teaching and learning, when technology is not just a tool to substitute traditional tools (such as paper, blackboard, slides, worksheets, textbooks, etc.), but is used to transform existing practices, is an innovation. The disruptive times of the COVID-19 pandemic represent a period of "forced innovation" in relation to the educational applications of digital technologies (González et al., 2023; Howard et al., 2022). Teachers' capacity to take up innovations in their teaching practice has become a "new normal" in our constantly changing digital age and the advanced level of educators' digital competence development (Punie & Redecker, 2017). However, this process is influenced both by individual and institutional factors (e.g., Howard, 2019; Ertmer & Ottenbreit-Leftwich, 2010). The development of teachers' competencies for advanced use of digital technologies is hardly possible without appropriate teacher training programs (Lavidas et al., 2022) and online teaching environments (Katsaris & Vidakis, 2021). Technology-enabled teaching courses may be insufficient to prepare in-service teachers to ensure the integration of technologies for this purpose. Innovation adoption relies on teachers' motivation – first, motivation to participate in innovation-related professional development programs, and second, motivation to transfer this learning into the class. Teachers may face external barriers, influencing the ability of teachers to innovate, including inadequate infrastructure or equipment, lack of recognition or reward, lack of institutional support from management and institutional vision, lack of time due to workload, as well as students' attitudes toward learning technology (Dale et al., 2021; Al-Senaidi et al.,

2009). Therefore, the problem of how to transfer technology-enabled educational innovation into teaching practices should be further studied. The determinants of innovation adoption can be understood by applying an integrative, multi-level approach (Callan & Johnston, 2020), focusing not only on the characteristics of the innovation but also on the role of adopters (with special emphasis on different levels of skills and motivation) and organizational factors. The current study aims to identify the key factors that influence teachers' motivation to transfer technology-enabled educational innovation in primary education.

The research data was collected by conducting a survey and interviews with the in-service primary school teachers, enrolled in an online teacher professional development program for technological creativity. This training program is continuous (up to 4 years long) and introduces in-service primary school teachers to the innovative classroom activities of digital technology integration. The Learning Transfer System Inventory (LTSI) model has been applied to the data collected from 12.7% of Lithuanian primary school teachers. The influence of LTSI factors on motivation to transfer has been studied with two groups of innovation adopter categories based on teachers' perceived digital technology integration skills. Mixed research methods (qualitative research methods are used to explain the results of the quantitative research) were used to provide a deeper understanding of the key factors that influence motivation to transfer. The present study contributes to the literature by an evaluation of multi-level factors that influence teachers' motivation to transfer technology-enabled educational innovation as well as a conceptual mapping between the learning transfer factors and the innovation adoption factors.

In the next section, we conceptualize technology-enabled innovation in education, provide mechanisms of teacher training transfer, map learning transfer and technology-enabled educational innovation factors as well as present the importance of teachers' perceived digital skills in innovation transfer. Then, we introduce the research design in section 3. In section 4, we present a structural equation modeling technique used for quantitative research and sequential explanatory design as a qualitative research method as well as the validation of the LTSI instrument. In Section 5, we present the results of both quantitative and qualitative research. Finally, we discuss the results, extend them by the implications for practice, and conclude the current study.

2 Theoretical framework

2.1 Conceptualizing technology-enabled innovation in education

According to the diffusion of innovations theory, an *innovation* is defined as "an idea, practice or object that is perceived as new by an individual or other unit of adoption" (Rogers, 2003, p. 12). An aspect of the *application* of such an idea, practice, or object is also stressed (Kirkland & Sutch, 2009). An innovation, driven by or having a significant focus on the use of digital technologies, is a *technological innovation* (Howard et al., 2021a). In turn, *educational innovation* is characterized by the

dynamic change intended to add value to the educational process and resulting in measurable outcomes (Organisation for Economic Co-operation and Development, 2016; Organisation for Economic Co-operation and Development, 2010). In education, technological innovation is not just related to new technology and its usage, but to new approaches to teaching and learning as well as many other interrelated processes which transform teaching and learning practices.

In this study, we use the term *technology-enabled educational innovation* to stress the disruptive use of digital technologies in classroom practices, replacing the traditional ones, as defined by Kampylis et al. (2012). We concentrate on educational innovation involving understanding the technology, creating with technology, and creating technology both by teachers and students, as opposed to technological innovation involving solely the usage of digital technology to replace traditional educational practices or to perform educational administrative goals (e.g., electronic systems for student registration). To realize the innovative potential of digital technologies in education, their use should be accompanied by educational and institutional changes (Kampylis et al., 2012). In the innovation diffusion process, learning and transfer of learning are considered to be essential (Gautam & Basnet, 2020).

2.2 Teacher training transfer for technology-enabled educational innovation

2.2.1 Learning transfer system

Human resource development research has aggregated the main factors in professional training (Baldwin & Ford, 1988) and provided the model of learning transfer on their conceptual basis (Holton et al., 2000). The model includes the training-specific factors linked to the training program (e.g., supervisor and peer support, training design, and course content), as well as general factors such as self-efficacy, expectations, and resistance to change. The model provides an empirically driven, validated self-report instrument (Learning Transfer System Inventory, LTSI) to assess individual perceptions of learning transfer in professional training. The LTSI instrument identifies the factors affecting the training transfer, assumes that training outcome is a function of ability, motivation, and environmental influences, and also includes secondary influencing factors (attitudes and personality) that affect motivation. The LTSI constructs and their definitions are presented in Table 1.

2.2.2 Teachers' motivation to transfer training and innovation adoption

Motivation to transfer, one of the core LTSI constructs, is "the trainees' desire to use the knowledge and skills mastered in the training program on the job" (Noe, 1986, p. 743) and is considered to be a key factor for the transfer of training (Holton et al., 2000; Burke & Hutchins, 2007; Gegenfurtner et al., 2009; Massenberg et al., 2017). Motivation to transfer plays the mediating role between other LTSI factors and actual learning transfer (Gegenfurtner et al., 2009; Hutchins et al., 2013; Nafukho et al., 2017; Celestin & Yunfei, 2018; Yaghi & Bates, 2020). The most influential factor in predicting actual training transfer of school innovation by the in-service

Table 1 Mapping LTSI constructs with acceptance and adoption factors of technology-enabled educational innovation

LTSI domain	LTSI construct	LTSI construct definition	LTSI construct type	Technology-enabled educational innovation acceptance and adoption factors
General	Performance self-efficacy	The general confidence of individuals in their ability to overcome barriers that hinder the transfer of learning.	Learner characteristics	Personal factors
	Performance expectation	The expectation that learning transfer efforts will help improve job performance.	Learner characteristics	Personal factors
	Outcome expectation	The expectation that better work performance will lead to valuable and meaningful recognition in the organization.	Work environment	Organizational factors
	Performance coaching	Formal and informal social processes, required to equip employees with the necessary knowledge and skills to improve their work performance.	Work environment	Social practices
	Resistance to change	The extent to which the current organizational culture is perceived by employees as preventing or refusing to transfer learning (e.g., the resistance of the colleagues to change the current situation).	Work environment	Social practices

Table 1 (continued)

LTSI domain	LTSI construct	LTSI construct definition	LTSI construct type	Technology-enabled educational innovation acceptance and adoption factors
Specific	Learner readiness	State of individuals that allows them to actively participate in a given learning activity.	Learner characteristics	Perceived value factors
	Motivation to transfer	The desire of trainees to use the skills and knowledge, acquired in a training program, at their workplace.	Learner characteristics	Perceived value factors
	Positive personal outcome	The extent to which employees believe that the transfer of learning leads to positive outcomes for employees on the organizational side.	Work environment	Organizational factors
	Negative personal outcome	The degree to which employees perceive that failure to transfer learning will result in negative consequences for employees in the organization.	Work environment	Organizational factors
	Personal capacity to transfer	The degree to which an employee's workload, time and energy promotes or hinders the transfer of learning.	Learner characteristics	Personal factors
	Supervisor support	The extent to which mentors of the training program give opportunities to transfer learning.	Training design and delivery	Technology-enabled innovation factors
	Supervisor opposition	The level of resistance, negative feedback and lack of support for learning transfer from supervisors or the organization's administrative staff.	Work environment	Organizational factors
	Content validity	The degree to which trainees recognize that the training, knowledge and skills taught in the training program meet the job requirements and performance expectations.	Training design and delivery	Technology-enabled innovation factors
	Transfer design	The extent to which the training program is designed to link the learning to the requirements of the job through the use of training methods, examples and relevant instructions.	Training design and delivery	Technology-enabled innovation factors
	Peer support	The level of support from peers for learning transfer.	Work environment	Social practices
	Opportunity to use learning	The extent to which trainees have the opportunities, roles and resources to deliver learning on the job.	Work environment	Organizational factors

teachers was their motivation to transfer (Dreer et al., 2017). Teacher motivation was found to be related to frequency as well as the quality of technology integration in daily teaching processes (Backfisch et al., 2021).

According to the theory of planned behavior (Ajzen, 1991), an individual's actual behavior can be predicted by the intention to use the knowledge and skills gained in the training program. Innovation adoption tightly relies on the adopters' motivation. On the one hand, this is teachers' motivation to introduce new approaches in the classroom that they learned independently or during the training program; on the other hand, this is motivation related to teachers' desire to actively participate in professional development programs related to innovation. Teachers' motivation might be decisive for the new introduction of technologies in teaching and learning, as this process is related to changes in teachers' daily classroom practices: teachers must rethink and redesign their instructional methods so that enrichment with technology is meaningful (Backfisch et al., 2021).

Teachers' involvement in professional development programs related to innovation adoption is usually not mandatory in many countries, therefore, teachers' motivation to pursue professional learning and become lifelong learners is essential (Gorozidis & Papaioannou, 2014). As innovators and early adopters are those willing to take risks and often are the first ones to develop new ideas (Rogers, 2003), this group of teachers may be characterized as driven by extra intrinsic motivation (Zheng et al., 2019). Intrinsic motivation of the teachers was in turn found to be a predictor of creativity, a crucial component in educational innovation adoption and training transfer (Fidan & Oztürk, 2015).

Even the availability of technological infrastructure in schools only partly explains teachers' technology use (Backfisch et al., 2021). This is not a surprising finding as the phases of innovation (technology-enabled educational innovation, in particular) show that motivation makes an important influence (Backfisch et al., 2021), especially, when we consider deep-level use and understanding of digital technologies, involving coding and creativity.

2.2.3 Mapping training transfer and technology-enabled innovation adoption factors

The LTSI model includes constructs related to individual learner characteristics, work environment, training design and delivery, as it is discussed in numerous studies (e.g., Baldwin & Ford, 1988; Bates et al., 2012; Chang & Chiang, 2013; Nickerson et al., 2019). Training transfer is influenced by general and specific factors (Holton et al., 2000). Additionally, the technology-enabled educational innovation acceptance and diffusion process involves similar categories of factors (Granić, 2022; Das, 2020). Leoste et al. (2021) have identified technology-enabled learning innovation acceptance and adoption factors based on several related theories and models: diffusion of innovations theory (Rogers, 2003), unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003), technology acceptance model (TAM) (Davis, 1989), technology-organization-environment (TOE) framework (DePietro et al., 1990), knowledge appropriation model (KAM) (Ley et al.,

2020), concerns-based adoption model (CBAM) (Hall & Hord, 1987), and technological pedagogical content knowledge (TPACK) (Koehler & Mishra, 2009).

In this study, we propose a conceptual linking between the LTSI factors and the acceptance and adoption factors of technology-enabled educational innovation (Table 1). The linking of training transfer factors and innovation adoption factors shows a similar origin. This mapping allows a different possible interpretation of LTSI factors based on the acceptance and adoption factors of technology-enabled educational innovation. The main difference in the interpretation of LTSI factors is the separation of the work environment category into social practices and organizational factors. This aspect is crucial when assessing the factors that influence teacher motivation to transfer technology-enabled educational innovation.

LTSI construct types have been derived based on theoretical and empirical studies (Burke & Hutchins, 2007; Gegenfurtner et al., 2009; Chang & Chiang, 2013). Besides technological innovation factors included in the table, there are contextual factors, describing the wider environment where innovation adoption is taking place (Leoste et al., 2021). When mapping LTSI constructs to technology-enabled educational innovation acceptance and adoption factors, technological factors transfer correspond to the factors of a training program and design, i.e., the program designed to adopt technology-enhanced innovation. In the case of our research, these are technology-enabled innovation factors.

2.3 Teachers' perceived digital skills in innovation transfer

Teachers' digital skills are not homogeneous; therefore, teachers may follow different paths in their training and innovation transfer (González et al., 2023). Teachers' readiness to integrate digital technologies in education is based on the belief that educational technologies are useful for teaching and learning and the confidence that they have sufficient skills to use these technologies for teaching practices (Petko et al., 2018). The COVID-19 pandemic has accelerated teachers' pedagogical and technological growth as they responded to the closings of their schools and adapted to the new digital environment (Moorhouse & Wong, 2022). In the post-COVID-19 world, we must continue rethinking the teachers' characteristics and digital skills to ensure the most benefit from the pandemic experience and the capacity to transfer innovation not only in times of crisis but also in times of stability. Teachers' confidence in their digital technology skills ensures that they can act as innovators and can successfully transfer innovation.

Technology-enabled educational innovation transfer can be reflected by the general innovation diffusion curve suggested by Rogers (2003). According to that curve, innovation adopter categories are defined as "the classifications of members of a social system on the basis of innovativeness" (Rogers, 2003, p. 22). These categories include innovators, early adopters, early majority, late majority, and laggards. As with any other innovators, teachers-innovators are those willing to experience new ideas. They are the first to cope with the uncertainty about innovation, with unprofitable and unsuccessful trials. Early adopters usually hold leadership roles and may influence innovation adoption. The early

majority of teachers have good interaction with other members of the social system, but they do not have the leadership role that the early adopters have, and their decisions toward innovation take more time than of innovators and early adopters. The late majority and laggards make up about half of all the users and are the last adopter groups in an innovation diffusion process.

Teachers' self-assessment, a subjective estimation of how they are skilled to integrate digital technology into educational practice, is reflected by their perceived digital technology integration skills. This concept is related to digital/computational self-efficacy and confidence (Hatos et al., 2022). Lunde (1996), as cited in Dale et al. (2021), notices that innovative teachers demonstrate more persistence in the face of adversity. They differ in self-efficacy, risk-taking, pedagogical beliefs, and practicing student-centered approaches. Early adopters may be characterized as risk-takers engaging in multidisciplinary interactions while the majority are usually more conservative and operating within their own disciplines (Wilson & Stacey, 2004). Aguayo et al. (2022) in their study on digital activism in the COVID-19 era have found that computational self-efficacy is related to the diffusion of innovations and technological habits. Therefore, teachers' confidence in their educational technology skills, i.e., how teachers perceive their own technological skills, is an important criterion to distinguish teachers who might take up technology-enabled educational innovations.

3 Research design

3.1 Research questions

In order to address the main aim of the current study – to identify the key factors that influence teachers' motivation to transfer technology-enabled educational innovation in primary education – the following research questions are raised:

RQ1. What are the LTSI factors that influence teachers' motivation to transfer technology-enabled educational innovation?
RQ2. How do these factors vary between groups of teachers with different levels of perceived digital technology integration skills?

Based on the literature review, a transfer intention is influenced by general and specific factors. Holton et al. (2000) systematized these factors by developing an LTSI model that includes 5 general factors and 11 training-specific factors that are related to the training transfer. As discussed above, motivation to transfer as transfer intention is a key factor for training transfer. Figure 1 graphically illustrates the research model to be tested to answer RQ1.

The heterogeneity of the key factors that influence teachers' motivation to transfer innovation according to teacher skills is analyzed in order to answer RQ2. Teachers are assigned to different groups according to their perceived digital technology integration skills for pedagogical purposes.

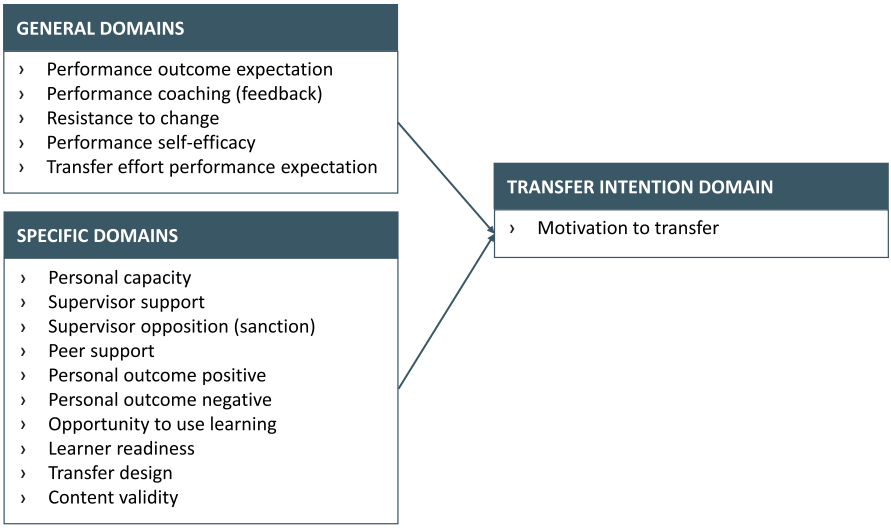

Fig. 1 Research model

3.2 Technological creativity as a technology-enabled educational innovation

The case of technology-enabled educational innovation in the current study is an online teacher professional development program for technological creativity. This program is open-ended enough to foster student-centered, creative play experiences. It may be used as a continuous training program (up to 4 years long), as well as a curriculum for diverse learning settings and in varied pedagogical contexts. To examine the relevance of the concept of innovation, we analyzed this program in terms of the nature of innovation, dimensions of the implementation phase, access level, impact area, and target as suggested by Kampylis et al. (2012).

The program is *radical* in nature and brings in many radical learning and teaching practices. While experimenting with digital tools, teachers and then their students, are merging tools in order to find new ways to solve problems, develop critical thinking, and express creativity in everyday classroom activities. While integrating different subjects, curricula knowledge and a holistic view of the world are being gradually developed. Technological creativity is reached with student-centered teaching and learning methods. Under this training program, in-service primary school teachers learn how to create using programming, 3D modeling, virtual reality, artificial intelligence, and other concepts of technologies. Teachers learn how to integrate those concepts in different subjects, e.g., learn math by merging it with machine learning or learn geography whilst using 3D modeling. The program is based on three stages: 1) understand: teachers learn technological concepts, and understand the basics of them; 2) practice: the concepts are put into simple guided practice exercises; 3) create: teachers merge learned concepts to build and create solutions through everyday classroom subjects.

However, the current *access level* of the program is limited to innovators and early adopters. The content of technological creativity innovation is tightly related to but not limited to the core parts of the integrative subject of Computing, or Informatics. Informatics as a subject in primary school is gaining a lot of attention worldwide, and curricula are being actively developed (Dagienė et al., 2022). In Lithuania, the Informatics curriculum for primary school is in its development stage, and at the moment of this paper writing, Informatics is not a mandatory primary school subject. Computer programming, data processing, and deeper digital tool integration are rather an initiative of innovative teachers.

In terms of geographical coverage, this program can be attributed to the *national* initiative that covers a large number of schools across the country. This innovation affects practices at schools (teaching and learning *processes*) and introduces new means (*services*). Regarding actors, innovation involves *specific target groups* (teachers and students in primary schools).

4 Methods

Quantitative and qualitative research methods were used to provide a deeper understanding of key factors that influence teacher motivation to transfer technology-enabled educational innovation.

4.1 Quantitative research method

4.1.1 Sample and procedure

This study aimed to identify the key factors influencing teachers' motivation to transfer technology-enabled educational innovation in a sample of 771 primary education teachers who participate in the teacher training process. The study involved 12.7% of Lithuanian primary education teachers. We launched an online questionnaire survey at the end of the training program in May 2021 (the program continued throughout the 2020–2021 school year). Although the proportion of female primary education teachers was substantially high (98.9%), this distribution was representative of the body of primary education teachers in Lithuania at the time of the data collection (2021). Almost three-quarters of participants (71.7%) had more than 20 years of teaching experience. All participants completed an online survey that contained questions concerning learning transfer, the perceived technology integration skills for pedagogical purposes, teachers' use of technology-enabled educational innovation, and background information (e.g., gender, age, experience). All respondents agreed to participate voluntarily after being informed about the purpose of the research.

4.1.2 Measures of the LTSI instrument

In the present study, we measured factors influencing teachers' motivation to transfer technology-enabled educational innovation by using the validated LTSI

questionnaire based on Holton et al. (2000). The LTSI questionnaire has a total of 48 items, of which 15 items relate to 5 constructs considered as general for independent constructs of the training program, whereas 33 items are related to 11 constructs that pertain to specific domains associated with the training program. The items were adapted to fit the focus of the research and assess teachers' motivation to transfer technology-enabled educational innovation (the overview of adapted examples of all LTSI constructs is provided in Appendix Table 7). Participants responded on a Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Reliability analysis followed by confirmatory factor analysis was chosen to test whether the data fit the theoretically expected structure. The validation of the LTSI instrument (Lithuanian version) was done using SPSS software. The principal component analysis with varimax rotation was used to explore the natural dimensions between general and specific domains (respectively, 15 and 33 items). Principal components analysis of the 15 general domain items revealed a Kaiser–Meyer–Olkin (KMO) of 0.807 and Bartlett's test $\chi^2 = 6557$ ($df = 105$) with $p = 0.000$ confirmed a linear dependence. A second Principal components analysis was conducted on the 33 specific domain items. The KMO index was satisfactory (0.886), as was Bartlett's test $\chi^2 = 15048$ ($df = 528$) with $p = 0.000$. Five factors accounted for 79.36% of the variance in the sample of general domain items and eleven factors accounted for 78.27% of the variance in the sample of specific domain items.

Once the dimensions were identified, the confirmatory factor analysis was performed to validate the instrument. The reliability of these 16 factors was assessed by carrying out confirmatory factor analysis for each of the factors. Cronbach's alpha coefficient and composite reliability (CR) in every case exceeded the threshold value of 0.7 for internal consistency (Table 2). In addition, the average variance extracted (AVE) for each factor was greater than 0.5.

The square roots of each AVE (shown diagonally with bold values in Table 3) were greater than the off-diagonal values (inter-factor correlations), and that confirms sufficient discriminant validity.

4.1.3 Measure of teachers' perceived technology integration skills

Additionally, to examine the heterogeneity in key factors that significantly affect teachers' motivation to transfer between different groups of program participants, we divided the respondents into two groups based on teachers' perceived digital technology skills. We measured the variable of perceived technology integration skills for pedagogical purposes using the statement "I believe that I have the skills to use digital technologies for teaching purposes" using a scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Among the participants, almost a third of teachers (32.2%) strongly agree that they have the skills to use digital technologies for teaching purposes. The full distribution of the variable is 0%, 1.3%, 18.9%, 47.6%, 32.2%, respectively, from 1 to 5. As shown by cross-tabulation, there are no statistically significant differences between participants who choose the values from 1 to 4 on the scale given. To exclude teachers who have characteristics of innovators, we divided the respondents into two groups – respondents choosing 5 were labeled as *confident*

Table 2 Reliabilities of the factors

Domain	Factor		Item loading	Cronbach's alpha	AVE	CR
General	Performance self-efficacy	SE	0.76–0.80	0.86	0.61	0.82
	Performance expectation	PE	0.71–0.84	0.87	0.63	0.83
	Outcome expectation	OE	0.70–0.83	0.86	0.62	0.83
	Performance coaching	PC	0.78–0.89	0.91	0.72	0.88
	Resistance to change	RC	0.60–0.81	0.81	0.54	0.78
Specific	Learner readiness	LR	0.70–0.81	0.85	0.61	0.82
	Motivation to transfer	MT	0.79–0.82	0.87	0.64	0.84
	Supervisor support	SS	0.76–0.83	0.87	0.63	0.84
	Supervisor opposition	SO	0.70–0.83	0.82	0.55	0.79
	Peer support	PS	0.70–0.86	0.86	0.62	0.83
	Positive personal outcome	PP	0.58–0.81	0.81	0.54	0.77
	Negative personal outcome	NP	0.78–0.84	0.88	0.64	0.84
	Opportunity to use learning	OU	0.92	0.92	0.85	0.92
	Personal capacity to transfer	PT	0.76	0.68	0.58	0.73
	Content validity	CV	0.84–0.92	0.93	0.77	0.91
	Transfer design	TD	0.74–0.79	0.84	0.59	0.81

technology users, and respondents choosing [1 to 4] – as *reserved technology users*. We use the definition of confident technology users (32.2%, N = 248) and reserved technology users (67.8%, N = 523), respectively.

The conducted qualitative study has confirmed that only confident technology users (who perceive their own technological skills in education as advanced) differ from others who participate in research and have the characteristics of innovators. According to Roger's innovation diffusion curve, we can assume that teachers who have characteristics of late majority and laggards did not participate in the teacher professional development program for technological creativity (participating in the program was voluntary).

4.1.4 Data analysis

The explanatory analysis of the different dimensions was examined to explain teachers' motivation to transfer. The dependent variable was Motivation to transfer regressed by 13 constructs. Structural equation modeling (SEM) using the MPlus software was used to investigate the relations between the LTSI components. An SEM analysis was conducted to assess the research model, using the robust maximum likelihood estimation. To test the heterogeneity in the key factors that significantly affect teachers' motivation to transfer between confident and reserved technology users a multi-group SEM analysis was included. Invariance was tested by scaled chi-squared difference tests (Satorra & Bentler, 2001) comparing configural and metric models, and metric and scalar models.

Table 3 Correlation matrix of factors

	PS	PE	OE	PC	RC	LR	MT	SS	SO	PS	PP	NP	OU	PT	CV	TD
PS	0.78															
PE	0.63	0.79														
OE	0.21	0.30	0.78													
PC	0.01	0.09	0.44	0.85												
RC	0.02	−0.03	−0.17	−0.16	0.74											
LR						0.78										
MT						0.48	0.80									
SS						0.25	0.52	0.80								
SO						−0.07	−0.16	−0.12	0.74							
PS						0.19	0.36	0.30	−0.25	0.79						
PP						0.15	0.25	0.18	−0.15	0.39	0.73					
NP						−0.11	−0.12	−0.13	0.23	−0.05	0.05	0.80				
OU						0.21	0.35	0.18	−0.23	0.33	0.29	−0.11	0.92			
PT						−0.17	−0.36	−0.22	0.25	−0.24	−0.12	0.23	−0.32	0.76		
CV						0.28	0.62	0.41	−0.19	0.30	0.13	−0.16	0.41	−0.38	0.87	
TD						0.34	0.66	0.57	−0.22	0.35	0.13	−0.19	0.36	−0.38	0.71	0.77

Diagonal elements are the square roots of the average variance extracted (AVE)

4.2 Qualitative research method

4.2.1 Sample and procedure

To explain the results of quantitative research and to provide a better understanding of factors that influence learning transfer among program participants, a qualitative research method was used. The study employed a sequential explanatory design, in which the collection of qualitative data follows the collection and analysis of quantitative data (Creswell & Plano Clark, 2011). Two groups of research participants were selected: (1) teachers who perceived their skills to use technologies for teaching purposes as high – identified as *confident technology users* ($N = 10$) and (2) teachers who self-identified as having low skills to use technologies for teaching purposes – identified as *reserved technology users* ($N = 20$). The selection of the research participants was based on their answers to quantitative surveys, following the participant selection model (Creswell & Plano Clark, 2011).

The data collection method used in the qualitative study was individual semi-structured interviews conducted via video-conferencing tools. The duration of interviews differed between the two groups – 60-80 minutes with confident technology users, and 20–40 minutes with reserved technology users. It is also important to note that the response rate was significantly lower among the reserved technology users (20 interviews out of 176 invitations) than in the first group (10 out of 27 invitations).

The interview questionnaires focused on LTSI constructs, which were mapped with acceptance and adoption factors of technology-enabled educational innovation. Questionnaires covered the following topics: 1) perceived value (motivation to learn and transfer), 2) personal characteristics (self-regulation [emotions in learning] and self-efficacy), social practices (student feedback, peer and supervisor support), organizational factors (opportunities to use learning and environmental resources), and technology-enabled innovation factors (challenges and benefits of online training, course design, and mentor support). The study was conducted in two phases: the first group of teachers was interviewed in January–February 2021 and the second group of teachers – in May–June, 2021.

4.2.2 Data analysis

The interview data were analyzed using a thematic coding approach that focuses on identifying patterns within the data (DeCuir-Gunby et al., 2011). The research team iteratively reviewed each transcript and assigned initial codes. The codes were discussed and defined by the research team. Perceived value, personal characteristics, social practices, organizational factors, and technology-enabled innovation factors were defined based on the LTSI constructs (which were mapped with acceptance and adoption factors of technology-enabled educational innovation) and designated as the five main categories of the codebook for both teacher groups. The subcategories within each category were established in the analysis process.

5 Results

5.1 Quantitative research

The effects of perceived value factor, personal characteristics, social practices, organizational and technology-enabled innovation factors to teachers' motivation to transfer technology-enabled educational innovation were examined by reviewing the unstandardized regression coefficient (β), standard error (S.E.), critical ratio (C.R.), and significance level p value (p). We used the unstandardized coefficients to do a later comparison between groups (standardized effects might be different due to different standard deviations).

The overall model fit is acceptable to good: χ^2/df=2.255 it is less than 5 and is an acceptable fit (Hair et al., 2010); RMSEA = 0.04, it is less than 0.08 and is a good fit (Byrne, 2010); CFI = 0.953, and TLI = 0.943 are both above 0.8 and are both considered as acceptable fit (Hair et al., 2010); SRMR = 0.037 is less than 0.08 and reports a good fit. Structural model results revealed that constructs underpinned LTSI explained 76.8% of the variance in motivation to transfer. This is relatively high, higher than the level of 70% suggested by Venkatesh et al. (2003).

The findings of this research reveal that 8 out of 15 factors are significant as the critical ratio (C.R.) exceeded 1.96 and the p value is less than 0.05 within the current sample data (Table 4).

All categories of technology-enabled educational innovation acceptance and adoption factors significantly influence *motivation to transfer*. The major determinant of *motivation to transfer* is *performance expectation* (personal characteristic) with an effect of 0.719 ($p < 0.01$). The second determinant is *transfer design* (technology-enhanced innovation factor) with an effect of 0.429 ($p < 0.01$). The other two technology-enhanced innovation factors (*content validity* and *supervisor support*) are also statistically significant with an effect of 0.277 ($p < 0.01$) and 0.216 ($p < 0.01$), respectively. The third determinant is *learner readiness* (perceived value factor) with an effect of 0.385 ($p < 0.01$). Social practices such as *resistance to change* and *peer support* have significant positive effects on *motivation to transfer* (β = 0.207 and β = 0.196, $p < 0.01$, respectively). Organizational factor (*negative outcomes*) is also a crucial antecedent of *motivation to transfer* with an effect of 0.153 ($p < 0.1$).

To examine the heterogeneity in key factors influencing teachers' motivation to transfer technology-enabled educational innovation between confident and reserved technology users, we performed a group analysis based on the teachers' perceived digital technology skills. The measurement invariance for comparing groups was tested and the results indicated that the model is invariant at the metric level ($p > 0.05$). This result suggested that the factor loadings in the model are treated as invariant between confident and reserved technology users (the items used to estimate the factor loadings have the same meaning for both groups). Next, the unconstrained structural model, which allowed the structural paths to vary between groups, was compared with the constrained structural model, which constrained the factor loadings and intercepts to be equal between confident and

Table 4 Path coefficients for the research model

Technological innovation acceptance and adoption factors	LTSI construct	Motivation to transfer (all respondents, $N=771$)				
		β	*S.E.*	*C.R.*	*p*	
Perceived value factor	Learner readiness	0.39	0.067	5.75	0.000	***
Personal characteristics	Performance self-efficacy	0.073	0.09	0.81	0.419	
	Performance expectation	0.719	0.109	6.60	0.000	***
	Personal capacity	−0.154	0.082	−1.88	0.061	
Social practices	Performance coaching	−0.030	0.06	−0.50	0.615	
	Resistance to change	0.207	0.072	2.88	0.004	**
	Peer support	0.196	0.079	2.48	0.013	**
Organizational factors	Outcome expectation	−0.059	0.097	−0.61	0.546	
	Supervisor opposition	−0.048	0.062	−0.77	0.443	
	Positive outcome	0.153	0.090	1.70	0.088	
	Negative outcome	0.139	0.058	2.40	0.017	*
	Opportunity to use	0.003	0.065	0.05	0.964	
Technology-enabled innovation factors	Supervisor support	0.216	0.082	2.63	0.008	**
	Content validity	0.277	0.105	2.64	0.009	**
	Transfer design	0.429	0.151	2.84	0.005	**

*** $p<0.001$, ** $p<0.01$, * $p<0.05$, an empty cell indicates that the effect is insignificant

reserved technology users. The χ^2 difference test shows that there exist significant differences between the unconstrained and constrained models ($\Delta\chi^2$=46.14; Δdf=31; p=0.039). The estimated path coefficients (unstandardised) are presented in Table 5.

Innovation *transfer design* (β=0.867, $p<0.01$), *performance outcome expectation* (β=0.687, $p<0.01$), and *learner readiness* (β=0.293, $p<0.01$), are statistically significant when influencing confident technology users' *motivation to transfer* technology-enabled educational innovation into classroom practices. The technology-enabled innovation factor associated with a transfer design, personal performance expectation, and perceived value of a training program has the potential to influence the motivation to transfer for primary school teachers who are comfortable with using technologies for teaching purposes (Rogers (2003) calls them "innovators"). As stated before, these teachers are driven by extra intrinsic motivation, and the present study indicates that organizational factors and social practices have no impact on confident technology users' motivation to transfer.

Performance expectation (β=0.714, $p<0.05$), *learner readiness* (β=0.407, $p<0.01$), and *negative outcome* (β=0.188, $p<0.05$) have a statistically significant impact on reserved technology users' *motivation to transfer* technology-enabled educational innovation. Two factors – personal performance expectation and perceived value of a training program – were found to have an impact on motivation to adopt a technology-enabled educational innovation for both groups of teachers. None of the factors associated with technology-enabled educational innovation has an impact on reserved technology users' motivation to transfer. A *negative outcome* that

Table 5 Path coefficients by undertaking group analysis

Technological innovation acceptance and adoption factors	LTSI construct	Motivation to transfer (Confident technology users, N = 248)					Motivation to transfer (Reserved technology users, N = 523)				
		β	S.E.	C.R.	p		β	S.E.	C.R.	p	
Perceived value factor	Learner readiness	0.293	0.117	2.50	0.013	**	0.407	0.119	3.42	0.001	***
Personal characteristics	Performance self-efficacy	0.130	0.191	0.68	0.496		0.001	0.189	0.01	0.995	
	Performance expectation	0.687	0.212	3.24	0.001	***	0.714	0.365	1.96	0.051	*
	Personal capacity	−0.074	0.128	−0.58	0.561		−0.208	0.165	−1.26	0.208	
Social practices	Performance coaching	−0.036	0.074	−0.49	0.622		−0.005	0.116	−0.04	0.964	
	Resistance to change	0.169	0.124	1.36	0.174		0.226	0.129	1.75	0.080	
	Peer support	0.021	0.126	0.17	0.870		0.28	0.166	1.69	0.092	
Organizational factors	Outcome expectation	−0.163	0.150	−1.09	0.276		0.017	0.198	0.09	0.930	
	Supervisor opposition	−0.161	0.177	−0.91	0.364		−0.008	0.117	−0.07	0.945	
	Positive outcome	0.231	0.146	1.58	0.115		0.144	0.212	0.68	0.498	
	Negative outcome	0.006	0.091	0.07	0.950		0.188	0.089	2.11	0.036	*
	Opportunity to use	0.101	0.122	0.83	0.408		−0.06	0.109	−0.55	0.584	
Technology-enabled innovation factors	Supervisor support	0.151	0.165	0.92	0.361		0.276	0.337	0.82	0.413	
	Content validity	−0.261	0.244	−1.07	0.285		0.432	0.423	1.02	0.308	
	Transfer design	0.867	0.315	2.75	0.006	**	0.298	0.872	0.34	0.733	

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, an empty cell indicates that the effect is insignificant

influences *motivation to transfer* in this context can be identified as external pressure (e.g. if it were not transferred in class, the training completion certificate would not have been issued). As we see from the results, peer support is more important for the reserved technology users' motivation to transfer as they are less driven by an intrinsic motivation to adopt a technology-enabled educational innovation.

5.2 Qualitative research

Consistent with the LTSI model, the technology-enabled educational innovation acceptance and adoption factors are related to five categories: 1) perceived value factor, 2) personal characteristics, 3) social practices, 4) organizational factors, and 5) technology-enabled innovation factors. The results of our exploration of the factors that influence teachers' motivation to transfer innovation and how these factors vary between program participants according to teachers' skills are presented firstly with the codebook (Table 6), then with a summarizing analysis of each category.

Data analysis showed that topics discussed and issues raised by the teachers differed between confident and reserved technology users. In relation to the perceived value factor, confident technology users showed homogeneous personal characteristics and shared similar enthusiasm in joining the training program – the group demonstrated high receptivity to innovation and strong intrinsic motivation to learn new subjects. On the other hand, reserved technology users were more likely to have been encouraged to join the training program by their peers or school administration. When informed about the opportunity, their first reaction was often rejection. When asked why they decided to join the training program, the majority of reserved technology users mentioned a desire to keep up with innovations, to be up-to-date and to improve their competencies. Still, some reserved technology users shared the enthusiasm of the confident technology users but lacked technological skills to have the same confidence for teaching the new subject.

Important differences were observed in the personal characteristics of the two groups. All confident technology users pointed out that participating in the online teacher professional development program is interesting for them, so they always find time and willingly solve the difficulties that arise. On the other hand, reserved technology users were more likely to mention various stress factors (i.e., lack of time, difficulty applying the learned material in class, lack of confidence, anxiety about teaching, etc.) that played into their learning process and contributed to delayed or patchy training transfer in the classroom. The two groups differed in their reactions to stress factors – while both groups experienced similar constraints in the training transfer (i.e., lack of technical equipment, lack of on-site technical support, difficult class management in a new environment, etc.), confident technology users were more open to risk-taking and were not afraid of mistakes. Reserved technology users, on the other hand, noted that they required more time in training to be able to build their confidence and transfer innovation in the classroom.

Interview data on social practices in schools showed that only a few teachers in both groups worked in schools where the introduction of technological innovation was part of a wider school strategy. Confident technology users were

Table 6 Codebook with factors' category, frequency, and example for both groups of teachers

Technological innovation acceptance and adoption factors	Code for qualitative research	Confident technology users		Reserved technology users	
		Frequency in interviews	The most illustrative citation	Frequency in interviews	The most illustrative citation
Perceived value factor	Motivation to start the training program	10/10	"As long as I know myself, I am interested in [new] things [*laughs*]. I am interested in it; I was interested in trying it out. If I just hear that something is happening somewhere, then I'm the first [to attend]" (4_20210127)	12/20	"I learned [about the training] from a colleague. A colleague attended this training, and she invited me. At first, I was still afraid; I did not immediately join after the invitation. But later I was persuaded [to join]" (4_20210526)
Personal characteristics	Performance self-efficacy (emotions in training and transfer)	10/10	"You know, I cannot stay still. I have to…, well, even if it does not work out, I have to study. Because if I start to stand still, it is over for me. […] I think - I will try [it out], if I do not understand – I will study more. I think, nothing bad will happen to me" (5_2021206)	15/20	"That anxiety, you know, it's still there. It is some kind of fear, because somehow... we are used to being confident in [a subject] before teaching it to others. If you want to teach, you must know it very well yourself. Although I told the children frankly, that I do not feel confident and that I am still studying. Nevertheless, the anxiety is there. I don't know how to reduce it" (4_20210526)
	Performance expectation (reflections on personal learning)	7/10	"[Is learning difficult or easy?] I would maybe say that it is interesting. Sometimes it is easy, sure, but sometimes it is difficult. And somehow, I could not say that it is one way or the other. I would rather say that it is interesting" (9_20210215)	13/20	"At first it seemed that everything was incomprehensible – it was very difficult for me to put those [blocks in Scratch] together. Yet later, somehow, everything fell into place in my mind. And then I already understood how those programs work" (8_20210528).
	Personal capacity (ability to use in class)	10/10	All teachers applied the innovation in class – they have had a few years of teaching experience already. "I participated in [a similar program] before, I learned a lot and I really liked it. At that time, I taught second grade and we applied what I learned [in the training]. It was only natural to continue" (9_20210215).	17/20	17 out of 20 teachers tested innovation in class. "I attended the training, but I had headaches after the classes and I thought – what should I do next? I started participating in the training in September, and I had the confidence to use the material in class for the first time only in April" (7_20210528).

Table 6 (continued)

Technological innovation acceptance and adoption factors	Code for qualitative research	Confident technology users		Reserved technology users	
		Frequency in interviews	The most illustrative citation	Frequency in interviews	The most illustrative citation
Social practices	Positive school culture, peer support and resistance to change	4/10	4 out of 10 teachers mentioned a supportive work environment, often created by their own initiative. "It is not important for me to have a supportive colleague. But if you find an interested person, it is quite nice" (3_20210125).	6/20	Only 6 teachers mentioned a supportive work environment. "The headmaster is happy that programming classes are available for primary grade students at our school. She supports the initiative – the school bought an interactive board. Of course, some equipment is lacking, but they cannot do anything about it. I feel supported by the administration, especially my supervisor, the headmaster. I cannot say that I feel support from other teachers – they are not really interested" (9_20210531).
Organizational factors	Negative outcome	NA	All teachers have applied the training in class – negative outcomes not discussed in interviews.	2/20	Majority teachers felt a personal duty to apply knowledge in class as well as encouragement from training leaders, but no negative consequences from school administration. "I thought to myself – if I just learn and do not apply this knowledge, it will lead nowhere. So, I just asked for an additional non-formal education class. And I threw myself out of my comfort zone" (9_20210531).
	Opportunity to use	10/10	All teachers were confident that they would continue teaching children technological creativity in the future. "We will definitely work with it and will look for opportunities to use it in class. I hope for new ideas from this team [of trainers]" (7_20210215).	13/20	13/20 teachers wanted to continue the training, but when discussing transfer of knowledge, the majority of them referred to organizational constraints and considered a non-formal education setting. "It depends on workload of all classes. If anything, I always have my non-formal education class and I could teach Scratch there. Children would enjoy it. But we would need to ensure access to the computer lab classroom first" (15_20210601).

Table 6 (continued)

Technological innovation acceptance and adoption factors	Code for qualitative research	Confident technology users		Reserved technology users	
		Frequency in interviews	The most illustrative citation	Frequency in interviews	The most illustrative citation
Technology-enabled innovation factors	Supervisor support	8/10	"Trainers are very patient, very patient indeed. Always in a good mood, charismatic. They are able to calm everyone – teachers are often afraid to make mistakes, but they always help to calm everyone down. […] Very patient indeed, sometimes I even think that too patient" (3_20210125).	4/20	"I received support only from the trainers. I asked for help during the training sessions and after-session office hours. I raised questions maybe 5–6 times in front of the whole class [...]. Of course, it is not so easy to ask in front of 300 teachers. However, what to do – you go and ask. You cannot be afraid, you must move forward" (7_20210528).
	Content validity and transfer design	10/10	"I like the training course, because it is very well structured and you can directly apply it in class. There is no need to think how to use it in class – you just take it as it is and use it" (4_20210127).	7/20	Teachers were interested in the program but planned to apply it to a certain extent, mainly in non-formal education. "When [IT classes] will be mandatory, maybe it will be different. […] But for now, I want to work with motivated students, in a non-formal education setting" (8_20210528).

often the first in their schools to start learning technological creativity and did so even if they did not receive support from their peers or the administration. On the other hand, the majority of reserved technology users indicated that they received some support from the school administration, but it was usually limited to covering course fees and access to technical equipment. Confident technology users were often frustrated by the inertia of their peers, lack of interest in innovation, and unwillingness to change working practices, but they also showed empathy and understanding of potential difficulties. Reserved technology users were less likely to talk about their peers' skepticism towards technological creativity and were more reticent about the training program themselves. The support of both peers and the school administration was important for reserved technology users, especially when deciding whether to start or continue the professional development program for technological creativity.

Organizational factors were much more widely discussed by reserved technology users, which gave important insights into innovation adoption by the school as an organization rather than by just some teachers. Contrary to confident technology users, all of whom have transferred innovation to classrooms, reserved technology users listed a number of barriers that prevented them from teaching their students technological creativity. The most prevalent barrier is difficult access to technological equipment (partly due to restrictions caused by the COVID-19 pandemic), followed by the lack of on-site technical assistance, a need for a second teacher/assistant in class, and a possibility to divide the classroom into smaller groups (all of which point to the need of safe testing space for the introduction of the innovation). The majority of reserved technology users identified that they would need clear guidelines on the introduction of technological creativity as a subject (separate class is preferred over integration in other subjects). Contrary to confident technology users, they prefer pre-planned structured learning paths both for themselves and for their students rather than the open-ended design of learning environments.

Analysis of technology-enabled innovation factors showed that both groups evaluated the training design positively, noting the convenience of online education, the possibility to use recorded material for additional guidance, the possibility to choose learning pace, and the supervisor's support. Yet, reserved technology users argued that good training design by itself was not sufficient for training transfer to the classroom. Whereas confident technology users praised the training program, highlighting its direct applicability in the classroom, reserved technology users noted that a more structured teaching plan and well-prepared work environment would be important for the transfer of technological creativity in the classrooms. Reserved technology users shared a sense of duty to follow instructions of the training and to transfer technological creativity to their classrooms, yet the majority of them noted that the transfer of innovation has been limited in scope (few classes or a smaller number of students in a non-formal education setting) and has not yet reached a level of full integration in the school curriculum.

6 Discussion and conclusion

The COVID-19 pandemic has demonstrated an important role of the innovative use of digital technologies in education. The so-called "new normal" job conditions emerged following the initial stage of the pandemic, the scope of work and communication changes have directly affected almost all school employees causing COVID-19-associated technological distress and burnout in teachers and school administration (Karakose et al., 2022). During this period, teachers have gained difficult but valuable experiences in various aspects of the practical use of educational digital technologies in their classes. Teachers' digital competence became a necessity, and many teachers have overcome some barriers related to educational technology use and online teacher training. This experience brought important directions to post-pandemic education, where we already look beyond digital technology use in education just as a substitute for traditional, non-digital tools. In a world of uncertainty and constant changes: 1) we experience the need for teachers to be ready to take up the technology-enabled educational innovations, 2) we reconsider the curriculum in the teacher training that relates to digital technology use in education – stressing a deep understanding of digital technologies, programming and creative expression with technology.

The conceptual change in the use of digital technologies in teaching practice requires teachers' and schools' readiness for the new normal of constant adoption of innovation. This study investigates the technology-enabled educational innovation acceptance and adoption factors that influenced teacher motivation to transfer training. It contributes to the literature by an evaluation of heterogeneity in key predictors of teachers' motivation to transfer learned skills into teaching practices. From a methodological point of view, a multi-method research design with a qualitative dimension allowed us to examine factors that influence teachers' motivation to transfer technology-enabled educational innovation in breadth and depth. In terms of methodological contributions, this study extends the application of the LTSI model in the context of technological innovation acceptance and adoption in education.

6.1 Findings and insights

By analyzing an expanded model, we found that the *motivation to transfer* is significantly influenced by all five domains: personal characteristics (*performance expectation*), technology-enabled innovation factors (*transfer design*, *content validity,* and *supervisor support*), perceived value factor (*learner readiness*), social practices (*resistance to change* and *peer support*) and organizational factor (*positive outcome*). As in previous studies, our findings show that the perceived learner factor (learner readiness) is a significant predictor of transfer (e.g., Celestin & Yunfei, 2018) – learning readiness denotes teachers' motivational factors and expectation that the training program will enhance their job performance. Yaghi and Bates (2020) confirmed that there is a positive relationship between

training transfer and the support system within the organization (organizational factors) with motivation to transfer playing the mediating role in this process. This study also found that the training transfer increases when peer and supervisor support increases. Organizational factors and a positive organizational climate are critical to learning transfer not only in face-to-face training programs but also in online training enrollment (Joo Ju et al., 2011). As found by Hutchins et al. (2013), transfer design and performance expectations are significant predictors.

As stated by González et al. (2023), teachers' digital skills are not homogeneous, and teacher trainers should consider these differences when designing professional development programs by the inclusion of different learning paths depending on the initial stage. We have extended this statement by proving that the key factors that influence teachers' motivation to transfer learning varied considerably according to teachers' skills and effective innovation adoption requires applying different roles and strategies based on the teachers' skills. To investigate the heterogeneity depending on teachers' skills, two groups were analyzed according to teachers' perceived digital technology integration skills – confident and reserved technology users.

Confident technology users Quantitative research showed that primary school teachers who are confident technology users are motivated to transfer learned skills into teaching by technology-enabled innovation factors associated with a transfer design, personal performance expectation, and perceived value of a training program. Organizational factors and social practices had no impact on these teachers' motivation to transfer. These findings support the statements of innovation diffusion theories that teachers-innovators and early adopters use the organizational climate as an enabler, i.e., these categories of teachers have the persistence to overcome management reservations or they are more successful in persuading management of the benefits of technology-enabled educational innovation (Leoste et al., 2021).

Qualitative research showed that confident technology users had characteristics of innovators: they wanted to try new things, they were not afraid to experiment and could learn from mistakes. It was important for them to bring innovations to the educational process, and to initiate wider changes in their schools. Confident technology users were driven by the personal intention to improve job performance. In addition to intrinsic motivation to improve their own performance, teachers noted that it was important for them to introduce innovations in the educational process, and to find ways to make the curriculum more interesting and relevant to their students. Interviewed teachers noted that salary increase was not the main reason for them to engage in educational innovation. Teachers who participated in the qualitative research were often the first in their schools to start learning technological creativity and did so even when they did not receive support from the administration and their peers.

Reserved technology users Quantitative research showed that organizational factors are important for reserved technology users' motivation to transfer as they are less driven by an intrinsic motivation to adopt innovation. Qualitative research showed that reserved

technology users have different characteristics than confident technology users – they were rarely the initiators of change in their communities and they participated in the teacher training process more out of necessity, duty, or desire to keep up with their peers rather than driven by curiosity. They often hesitated, doubted their ability to teach technological creativity, and expressed a wish to improve one's knowledge before teaching children. Some teachers expressed a sense of shame for what they perceived as insufficient digital competence, and they were afraid of making mistakes teaching children.

Reserved technology users often relied on external motivation factors to engage with the training process and to initiate a transfer of knowledge in their classrooms. Interviewed teachers noted that encouragement and support from school administration and peers were important when deciding to join the teacher training program. Some teachers transferred knowledge to class only after the insistence of training supervisors (if it were not transferred in class, a training completion certificate would not have been issued). Teachers who transferred innovation in their classrooms highlighted that students' interest was an important factor that motivated them to continue the teacher training process.

Furthermore, reserved technology users highlighted that they preferred a structured framework for guidance on how to transfer learning in class (i.e., how to start with simple tasks and move to complex ones, and how to prepare materials for different lessons). This differed from confident technology users who preferred an individualized approach and often designed their own teaching curriculum based on their classroom needs and interests. Reserved technology users also asked for a clear structure in their own teaching – although the opportunity to choose different programs and individualize their learning path was generally viewed positively, preference was expressed for a pre-planned or curated structure.

Previous studies state that the changes we expect in education in the post-COVID-19 world are reimagining the competencies of the teachers, and there is a need for a paradigm shift in education, in order to enhance teachers' capabilities to provide high-quality learning in all situations for all students (Imara et al., 2021; Korkmaz & Toraman, 2020). Based on our findings, the importance of teacher and school readiness can be highlighted in order to ensure effective innovation transfer which guarantees that innovation becomes a daily practice not only among confident technology users but also among all teachers in primary education.

It is very important to understand different needs, motivations, and skills within a group of teachers. As noticed by Leoste et al. (2021), teachers' personal factors are especially important at the stage when teachers become aware of technology-enabled educational innovation. Teachers' readiness and motivation to transfer innovation in class vary widely. Only a small proportion of teachers have an intrinsic motivation to accept and adopt innovations, while the majority of teachers prefer to work with tried and tested material. As found by Imara et al. (2021), the pandemic has demonstrated the need for teachers with a high level of resilience and the capacity to adapt to emergencies and the ability to recover, teachers must possess specialized competencies that allow them to successfully perform their role. To encourage the adoption of innovation in the post-COVID-19 world, it is important to engage with both groups. Confident digital technology users who are quick to adopt an innovation might serve an important role to stimulate the intrinsic motivation of reserved technology users to engage in innovation. The possibility of peer-to-peer learning

and willingness to keep up with innovations were observed to be important factors for reserved technology users to open up for the adoption of innovation. As stated by Callan and Johnston (2020), senior leaders' support was a critical factor in promoting the continued use of new technologies in educational settings.

It is necessary to consider, that the COVID-19 pandemic has been a catalyst of innovation and professional growth among teachers. The results of the study by Moorhouse and Wong (2022) imply that there are distinct processes for innovation in times of stability and times of crisis. The findings of this study also showed that after a period of online teaching, teachers had a greater level of competency and willingness to use digital instructional approaches; this period had a positive impact on their pedagogical and technological development. To ensure effective innovation transfer in primary education, it is also important to consider the readiness of schools as organizations to accept innovation. While the focus is often placed on teacher training, the involvement of school administration is as crucial for the successful adoption of innovation throughout the school.

Based on our findings, it can be assumed that innovation becomes a daily practice for the majority of teachers (not just for confident technology users) only when a school administration is involved and supports the wider change. Researchers emphasize the influence of the school's organizational climate, its flexibility, and support for change, as well as other organizational aspects (Dale et al., 2021). Moreira-Fontán et al. (2019) and Vongkulluksn et al. (2018) also highlighted the importance of institutional support for technological innovation. The task of the school administration is to provide a receptive working environment for exchanging knowledge and peer-to-peer learning as well as to define the vision of the school (a strategic plan), which would motivate teachers to purposefully improve their knowledge. The school administration also defines how innovation (technological creativity) is placed in the curriculum – i.e., whether it is integrated into other subjects, taught as a new subject, or offered during a non-formal education of students.

6.2 Implications for practice

Taken together, these findings and insights contribute to implications for educational institutions and policymakers as determinants of teachers' motivation to transfer technology-enabled educational innovations to teaching and learning practices to help develop effective professional development of in-service teachers and create a suitable environment in schools for the adoption of innovation.

The results of this study highlight the importance of understanding the different needs, motivations, and skills of teachers. Based on this, different strategies and roles can be assigned. Furthermore, the results indicate that the role of school administration is crucial for the successful adoption of innovation. Such results indicate the fact that the adoption of innovation is a time-consuming process at individual and organizational levels. At the individual level, teachers need time: (1) to overcome the fear of innovation (technology), (2) to acquire basic knowledge; (3) to reach such a level of self-confidence that would allow the acquired knowledge to be transferred

to class. At the organizational level, it is necessary to ensure enough time: (1) for all teachers to become interested and involved in the proposed innovation; (2) to ensure the applicability of innovation in teaching practice; (3) to motivate teachers to participate in the training process and transfer their knowledge in class; (4) to provide a trialability space where teachers can test to transfer the innovation.

From the findings of this study, in-person support and technical support might help to encourage reserved technology users to transfer training in class. The in-person support is important to reduce the stress of transferring innovation and to assist during the first lessons with a new subject. A person (teacher assistant) can track mistakes and introduce corrections to the students' work. An alternative could be to split the class into smaller groups (12–14 children) so that a teacher can attend to each of the children's needs. Technical support is important to provide easy access to digital devices for both students and teachers. This includes not only access to quality and suitable base of digital devices but also the need to have an in-house specialist who provides technical support such as setting up computers, installing the needed programs, and being on-call for any technical problems.

6.3 Limitations and further research

This research is associated with certain data collection limitations. The sample size is sufficient for the quantitative techniques employed (12.7% of Lithuanian primary education teachers participated) and qualitative data volumes provide a rich picture of learner characteristics, training design, and work environment. The main limitation of this study relates to the specific analysis of Lithuanian primary education teachers. Future studies should be conducted considering different stages of innovation diffusion, other levels of education, as well as various cultural environments. While this research offers insights into teachers' motivation to transfer learned skills into teaching, further research is needed on training transfer (transfer outcome).

6.4 Conclusion

In conclusion, we proposed a conceptual link between learning transfer factors and innovation adoption factors, which shows a similar origin of two theoretical frameworks and provides a more detailed interpretation of LTSI factors. Furthermore, we discovered that perceived value factors, personal characteristics, social practices, organizational and technology-enabled innovation factors influence teachers' motivation to transfer technology-enabled educational innovation. The results emphasize the importance of applying different roles and strategies based on the teachers' skills. The results also highlight the necessary involvement of school administration in the innovation adoption process. Our findings may be the basis for designing effective professional development of in-service teachers and creating a suitable environment in schools for the adoption of innovation in post-COVID-19 education.

Appendix

Table 7 Overview of example items of LTSI constructs

LTSI domain	LTSI construct	Example item
General	Performance self-efficacy	I am sure I can overcome the obstacles in the classroom activities that hinder my use of new skills or knowledge
	Performance expectation	The more training I apply in the classroom activities, the better I do my job
	Outcome expectation	When I do things to improve my performance in class, good things happen to me
	Performance coaching	Colleagues often tell me things to help improve my classroom activities
	Resistance to change	Colleagues are not willing to put in the effort to change the way things are done

Table 7 (continued)

LTSI domain	LTSI construct	Example item
Specific	Learner readiness	Before this training, I had a good understanding of how technology-enabled educational innovation would improve my classroom performance
	Motivation to transfer	When I finish this training, I can't wait to try what I learned in class
	Positive personal outcome	I am likely to receive some recognition if I use technology-enabled educational innovation in class
	Negative personal outcome	If I do not use technology-enabled educational innovation in class I will be reprimanded
	Personal capacity to transfer	There is too much happening at work right now for me to try to use technology-enabled educational innovation in class
	Supervisor support	Mentor of the training program will meet with me to discuss ways to apply technology-enabled educational innovation in classroom activities
	Supervisor opposition	School administration will oppose the use of technology-enabled educational innovation in the classroom activities
	Content validity	The instructional aids used in this training are very similar to the real things I use in class
	Transfer design	The trainer(s) used many examples that showed me how I could use technology-enabled educational innovation in classroom activities
	Peer support	My colleagues will encourage me to use technology-enabled educational innovation in classroom activities
	Opportunity to use learning	The resources needed to use technology-enabled educational innovation in classroom activities will be available to me

Data availability The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Code availability Not applicable.

Declarations

Conflict of interest None

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