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Rethinking determinants of primary school teachers' technology acceptance during the COVID-19 pandemic

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ABSTRACT

The COVID-19 pandemic forced teachers to suddenly change their teaching mode from face-to-face to emergency remote teaching creating the biggest disruption in the history of education. Despite facing significant challenges such as a lack of proper information technology training, teaching unprepared students, and infrastructural barriers, there is a gap in research on primary school teachers' readiness to integrate technology. This study aims to address this gap by utilizing the technology acceptance model to explore the relationships between primary school teachers' computer self-efficacy beliefs, attitudes, and intentions to incorporate computer-based technology during times of disruption. Participants were $N = 144$ Greek, primary school teachers, who taught in virtual settings during the pandemic. Findings from structural equation modeling showed that self-efficacy beliefs, perceived ease of use, and perceived usefulness are strong predictors of teachers' attitudes towards computer use. The study adds to the scarce literature on the crucial role of teachers' self-efficacy beliefs as drivers of their intention to use technology during emergency remote teaching. Additionally, it highlights the need to consider the unique circumstances in which technology is used and provides insights that can inform the design of effective interventions and policies.

Introduction

The Covid-19 pandemic led schools to immediate shutdowns, causing radical changes in learning environments in primary, secondary, and higher education [75]. For education to continue working, teachers were expected to suddenly adjust the way they taught, evaluated, guided, and worked with their students [65]. The sudden shift of instructional delivery from face-to-face to online education, known as emergency remote teaching (ERT) [9], became the only alternative delivery mode [31]. ERT imposed high challenges for all teachers, who carried the responsibility to ensure continuity for their students' learning [81] under the unprecedented pressure to successfully use computer-based educational technology [34].

In this context, especially primary school teachers faced unique challenges due to their students' lower levels of digital literacy [40] and young age, which required parental facilitation and teacher engagement [50]. Remote teaching is particularly challenging in the education of younger children, where real communication is essential and computer screen time is limited resulting in lower levels of digital competence among primary school teachers compared to higher education teachers [39,58]. In many European countries, digital literacy and informatics are still developing as compulsory subjects in primary education [18].

Although primary school teachers' role in educating young students is critical, and their online teaching skills and adaptability have a significant impact on the success of online education, research on their technology acceptance during the COVID-19 pandemic and the impact of the mandate on their intentions to continue using technology in their teaching practices is limited. This study aims to address this research gap by exploring primary school teachers' technology acceptance during the COVID-19 pandemic, building on the extended technology acceptance model [19] and utilizing computer self-efficacy (CSE) as the external variable [82].

In addition to addressing the gap in research on technology acceptance among primary school teachers during the pandemic, there is a need to investigate the technology acceptance model (TAM) model in various educational contexts and circumstances, as recent meta-analysis has shown contradictory results with varying levels of variance in use intention explained by the model [64]. Furthermore, we believe that the experience gained during the pandemic period is important and can be applied to face-to-face educational settings as well. Accessible,

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sustainable, and quality education for all is a priority declared by the General Assembly of the United Nations [76], and one of the most important aspects in emergent situations is how teachers accept and use information technology to provide quality teaching. Therefore, it is necessary to investigate the determinants that drive primary school teachers' acceptance of technology usage.

Thus, the aim of the present study is twofold: first, we investigate whether the TAM is applicable in the context of primary education under the unprecedented circumstances of the pandemic; then, we explore the relationship between the TAM variables and technology acceptance in education to better understand the determinants related to teachers' intention to use technology in their practice. The significance of the study is to identify the factors influencing specifically primary school teachers' technology acceptance during the pandemic to address interventions and design training courses that will motivate and increase the use of technology by primary school teachers.

Before presenting our research in detail, it is important to clarify that this study is not limited to investigating any specific type of computer technology but rather examines the overall use of information technology by primary school teachers during the Covid-19 emergency remote teaching, including but not limited to the specific online platforms suggested by schools and ministries of education (e.g., Moodle, Zoom, Microsoft Teams).

Literature review

Technology acceptance model

Technology Acceptance (TA) refers to a condition or state in which the user is open to trying new technological tools [74]. TAM mainly measures how users accept and use technology [19]. Although TAM was developed several years ago, its utility to investigate a variety of contexts demonstrates how relevant it is today [53]. In education, TAM has been used to examine a variety of educational contexts which include primary [21] and higher education [1,10], early childhood education, educational wikis [46], pre-service teachers [17], E-governance training [41], and MOOCs [72].

In TAM, two specific predicting variables namely, perceived usefulness (PU) and perceived ease of use (PEU) are seen as important motivational factors determining users' acceptance and use of technologies [19]. PU has to do with the extent to which an individual believes that the use of technology to perform a certain task will support their performance [73], whereas PEU refers to the degree to which a person believes that using technology will be easy and effortless [63]. In a nutshell, PU and PEU describe users' cognitive responses to the use of technology which in turn influence users' attitudes (AtU) toward the use of technology. Attitudes ultimately drive users' behavioral intention to use (ItU) technology [11]. Fig. 1 shows the TAM.

The aforementioned key variables directly or indirectly explain the outcomes of technology use [48]. They are often accompanied by factors that focus on the educators' instructional attributes [14], the technology and system characteristics [3], or social factors [4] as external variables explaining differences in the outcomes. Today due to the Covid-19 outbreak, the concept of teachers' TA takes new dimensions because teachers were confronted with the sudden reality of quickly accepting and adopting online teaching techniques, they were not familiar with before [59]. Despite the increasing interest in teachers' technology readiness and acceptance during the pandemic, similar research in the primary school educational field is limited [34]. Thus, the current circumstances impose the need to further explore the extent to which the variables in TAM predict primary school teachers' technology acceptance during the COVID-19 pandemic.

Computer self-efficacy

Self-efficacy refers to an individual's belief in their ability to accomplish certain objectives and expected outcomes [7]. Specifically, computer self-efficacy (CSE) is defined as an individual's belief in their ability to effectively use educational technologies [30]. Previous research has found that an individual's perception of ease of use is significantly associated with their computer self-efficacy beliefs (Scherer et al., 201). Furthermore, teachers' computer self-efficacy beliefs have been linked to their intention to use technology in their teaching practices [73]. Teachers who perceive themselves as competent computer users are more likely to incorporate technology into their lesson plans and teaching practices [56], while those with a weaker sense of self-efficacy may feel challenged and frustrated, leading to negative perceptions of technology use [73].

In addition to intention to use technology, computer self-efficacy has been linked to various parameters of the TAM [69]. However, the relationship between the TAM variables and computer self-efficacy has shown varying and sometimes conflicting results [33]. For instance, Hong et al. [34] found that computer self-efficacy is a significant factor in perceived ease of use but not perceived usefulness, while Alfadda and Mahdi [2] found a substantial positive relationship between computer self-efficacy and both perceived ease of use and perceived usefulness. These discrepancies may be attributed to differences in populations [79] or technology applications [11].

Despite these situational variations in the relationship between computer self-efficacy and the TAM variables, understanding how primary school teachers come to accept and effectively use technology is crucial, especially in the context of ERT. With school closures during the pandemic, primary school teachers have been required to exclusively use technology as their medium of instruction, and computer self-efficacy is considered a critical factor in their success [51].

The example of greek primary school teachers during the ERT

Greek primary school teachers rank low in the use of technology in their classrooms compared to their counterparts in Europe [22]. In

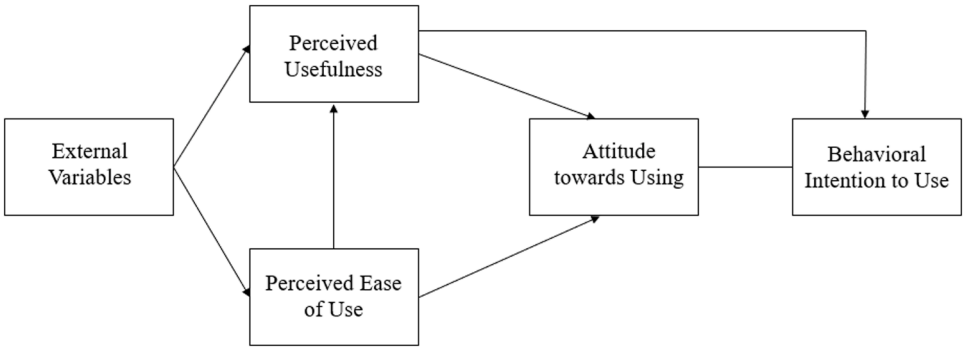

Fig. 1. The Technology Acceptance Model [19]

Greece, the number of schools with strong technology policies and support for digital education is lower compared to the European average [22]. Despite the large-scale computer training programs during the 2020-2021 school year, Greek teachers had limited resources and mostly used their own technological equipment [47,57]. Infrastructure impediments, including limited access to hardware and broadband-speed internet, were already documented even before the pandemic [22].

The example of Greece is not rare. Similar barriers to technology acceptance have been observed in other European countries such as Germany, Ireland, Italy, and Spain, as well as overseas, in Australia and the United States [67]. The digital divide and the need for emergency planning appear to be global challenges that affected education despite substantial investment in promoting the incorporation of ICT on a national and international level [60]. Given the widespread nature of the barriers to technology acceptance observed in Greece and other countries, and the urgent need to address digital inequities and emergency planning in education, it is crucial to shed light on the country-specific population of Greek primary school teachers' technology acceptance during the ERT. This study can provide valuable insights for policymakers and educational practitioners to develop evidence-based interventions [25] that can help improve the incorporation of ICT in primary education in Greece and beyond.

Aim of the study

This study aims to investigate primary school teachers' technology acceptance and the determinant factors towards technology use utilizing the extended TAM model in the context of the COVID-19 pandemic. The study will address three research gaps: first, the lack of research on primary school teachers' technology readiness; second, the need to explore the situational nature of the TAM in the pandemic context; and third, the need for additional evidence to identify the types of preparation required for emergency online teaching in the future. Research on country-specific populations, such as the present study, has been found to exhibit similar cross-national characteristics and outcomes that can be generalized [67].

Based on previous research we formulated the following hypotheses:

- H_1: Teachers' perceived ease of use of computers will have a significant influence on their perceived usefulness.
- H_2: Teachers' perceived ease of use of computers will have a significant influence on their attitudes towards computer use.
- H_3: Teachers' perceived usefulness of computers will have a significant influence on their attitudes towards computer use.
- H_4: Teachers' perceived usefulness of computers will have a significant influence on their behavioral intention to use technology.
- H_5: Teachers' attitudes towards computer use will have a significant influence on their behavioral intention to use technology.
- H_6: Teachers' computer self-efficacy beliefs will have a significant influence on their perceived usefulness of computers.
- H_7: Teachers' computer self-efficacy beliefs will have a significant influence on their perceived ease of use.

Method

Procedure

The data collection took place in May and June 2021. The participants were recruited via e-mails to a list of primary school principals and personal invitations sent by mobile phone messages. For the data collection, in addition to the final version of the questionnaire, a short information letter was sent followed by the consent form. The average duration of time needed to complete the survey was around 20 minutes. The SoSci (www.soscisurvey.de) survey tool was used for the delivery of the online questionnaire.

Research context and sample

A total sample of $N = 189$ Greek Primary School teachers entered the survey and 144 completed it (75.7 % response rate). The age range was from 24 to 60 years old ($M = 42.82$, $SD = 9.55$). All participants indicated their teaching experience (> 20 years, $n = 44$; 10-20 years, $n = 69$; < 10 $n = 31$), and 78.5 % of them responded that they had been teaching for more than 10 years. 69.4 % of the teachers reported they have attended some sort of ICT training. The participants were mainly teachers from Greece ($n = 111$) and Germany ($n = 32$). Those serving in primary schools outside of Greece were on detachment, teaching in Greek-language classes within regular German Primary Schools (Grundschulen) or in bilingual Greek-German Primary Schools in Bavaria. We thoughtfully considered whether this variation in the countries would affect the findings and concluded that among the different groups all the conditions relating to the study were the same: teaching material, distance-learning platforms, school regulations, technical support, and professional development opportunities.

Instrument and validation

The extended TAM scale

To operationalize the theoretical constructs in the study, validated subscales from previous research were employed. The external variable, computer self-efficacy, was measured using eight items that were developed by Vekiri and Shoretsanitou [77] and were reported to have a reliability of $\alpha = .96$. The participants' level of self-efficacy regarding teaching with the use of computers was assessed using a five-point Likert scale ranging from 1 (not at all confident) to 5 (completely confident). The items included in the scale pertained to the ability of the participants to find useful material for lessons on the internet, select appropriate educational software, and install educational software.

For the main TAM variables, the original sub-scales ([19], as cited in [66]) for the main TAM constructs obtained Cronbach alpha reliabilities ranging from $\alpha = .82$ to $\alpha = .97$. Originally designed to examine how primary school teachers, students, and parents in Greece accepted the use of Augmented Reality for teaching and learning, the questionnaire items were modified for the current study to focus on ICT. Measured on a four-point Likert scale (ranging from "strongly disagree" to "strongly agree"), each of the four TAM variables consisted of at least three items [12].

Perceived ease of use was assessed by asking participants if ICT use is clear and easy to understand. Perceived usefulness was measured by investigating whether using ICT during lessons has made it easier for the participating teachers' students to understand certain concepts. Attitude towards technology use included four items, such as whether using ICT makes learning more interesting. Finally, we measured teachers' behavioral intention to use ICT in the future using items such as "*The use of ICT improves the educational process*" and "*I intend to choose ICT in the future for more effective teaching*".

Pilot testing

For the selection of the items, we followed a three-step approach [26]. First, we conducted an expert validation phase survey with an academic who has extensive knowledge of research in this particular area of study. Next, we conducted a think-aloud interview with two graduate students from the field of educational research, as well as a pre-test instrument administration with four teachers. After implementing all suggestions for improvement, the questionnaire consisted of a total of 26 items.

The sub-scales for measuring the TAM variables in the research model (Fig. 1) were translated into Greek for the purposes of previous studies, with only minor changes made to meet the needs of the current study. Specifically, five sub-scales were included: Computer self-efficacy (8 items), perceived usefulness (3 items), perceived ease of use (3 items), attitude toward using a computer (4 items), and intention to use a

computer (3 items).

Data analysis

To investigate the level of technology acceptance among Greek primary school teachers during emergency remote teaching, we conducted descriptive tests (as shown in Table 1) and calculated the means and standard deviations for the five sub-scales of the extended TAM model. In addition, we used the following procedures to analyze the collected data. First, we conducted confirmatory factor analysis (CFA) to confirm the validity and reliability of the measurement scale. We checked for multivariate normality using AMOS by examining the skewness and kurtosis of each variable and selected maximum likelihood estimation because the variables fit the normal distribution [28]. The goodness of fit indices used for this study were the minimum sample discrepancy (CMIN), Tucker-Lewis index (TLI), comparative fit index (CFI), standardized root mean square residual (SRMR), and root-mean-square error of approximation (RMSEA). We then conducted structural equation modeling (SEM) to examine the structural relationships between the five variables in this study.

Results

Preliminary analysis

The descriptive statistics of the constructs are presented in Table 1. All means are above the midpoint of 3.00. The CSE mean has a higher mean value due to the different Likert-scale used (1 = not at all confident, to 5 = completely confident) to measure the sub-construct. The skewness and kurtosis indices are within the acceptable limits for structural equation modeling according to Kline [43]. Teachers reported high levels of self-efficacy in performing computer-related tasks successfully. Over 80% of the teachers reported feeling fairly or completely comfortable in finding useful material for their lessons on the internet and using the computer to teach and present information. However, teachers expressed uncertainty about their ability to select (32.4%) and install (42.3%) educational software appropriate for their lessons and students on their computers. Similarly, teachers reported feeling insecure when using a data processing program (45.9%). However, they felt confident (68.7%) in using a computer in general to create multimedia material for their lessons (e.g., text, images, graphics).

Analysis of the Likert-scale items addressing teachers' perceptions of the usefulness of ICT during school closures revealed that participants questioned the contribution of ICT to students' better understanding (70.8%). However, the majority (95.2%) agreed that ICT is useful in the educational process. Most teachers (>70%) considered the use of technology easy and clear to learn (81.3%), utilize (72.9%), and understand (76.4%). Nearly 90% of the participants agreed that ICT during emergency remote teaching was a good solution for schools, but nearly two-thirds of them experienced stress while teaching with technology. More than 85% of the participants agreed with the statement that technology makes learning more interesting, and 92.3% intend to use ICT in teaching in the future if given the opportunity. Accordingly, 81.5% of the respondents believed that technology improves the educational process, resulting in more effective teaching. Cronbach's alpha was calculated to examine the reliability of the current instrument by sub-constructs [71]. The sub-constructs of perceived ease of use (α=.87) and intention to use (α=.81), demonstrated good reliability. The sub-scale of computer self-efficacy exhibited a very good level of reliability (α=.92). The attitudes towards computer use sub-scale, displayed acceptable reliability levels (α=.76). Finally, the sub-scale of perceived usefulness, also demonstrated acceptable reliability (α=.68).

Table 1
Descriptive statistics primary school teachers' technology acceptance during the pandemic

Construct	Mean	SD	Skewness	Kurtosis
Perceived Usefulness	5.95	1.15	-3.00	.971
Perceived ease of use	8.88	1.78	-.214	.218
Attitudes	9.16	1.64	-.342	.743
Computer self-efficacy	22.81	5.82	-.861	.173
Intention to use technology	9.49	1.60	-.456	1.27

Model assessment

During the confirmatory factor analysis in AMOS, we observed that five factor loadings of the 21 observed variables or items were around 0.50 or had high covariances. Previous literature has suggested that the factor loadings or regression estimates of latent to observed variables should be above 0.50 [27]. Therefore, we dropped two of the observations with loadings between .38 and .48 (PU2, AtU2) and two with high covariances (CS1, CS2). However, we kept item PU1 with a factor loading of 0.4, as there would be only one remaining item to investigate the subconstruct of perceived usefulness otherwise. The remaining number of items for each construct are as follows: Computer self-efficacy (6 items), perceived usefulness (2 items), perceived ease of use (3 items), attitude towards use (3 items), and intention to use (3 items). The loadings of the revised model can be seen in Fig. 2.

We estimated the overall fit model and the five absolute fit indices: χ^2 goodness-of-fit statistic, χ^2/df, Goodness of Fit (GFI), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Standardized Root Mean Square Error of Approximation (RMSEA). Table 2 shows the fit indices for the measurement model. In detail, the GFI and CFI values were 0.87 and 0.94, respectively, which are considered acceptable (e.g., [8,13,23]). The RMSEA value was 0.076, indicating an acceptable fit (e.g., [36,42]). The χ^2/df value was 1.87, and the TLI value was 0.924, which suggests a good fit [42]. The revised 17-item scale showed some improvement in model fit and met the minimum threshold for acceptable model fit.

Structural model and hypothesis testing

Table 3 presents the findings of the hypothesis testing. The results indicated that five out of seven hypotheses were supported by the analysis. However, the data did not support H_1, which proposed that teachers' perceived usefulness of computers is influenced by their perceived ease of use of computers since PEU did not have a significant effect on PU ($\beta = .26, p > .001$). Likewise, H_4 was rejected since CSE did not have a significant influence on PU ($\beta = .15, p > .001$), indicating that teachers' perceived usefulness of computers is not influenced by their computer self-efficacy. On the other hand, hypotheses 2, 3, 5, 6, and 7 were supported for the four endogenous variables.

Path analysis

In path analysis, direct and indirect effects were computed, as indicated by arrows connecting the variables. For example, perceived usefulness has a direct effect on intention to use, but also an indirect effect mediated through the variable of attitude towards use (AtU). The total effect on a given variable is the sum of its direct and indirect effects [74]. Effect sizes were assessed using Cohen's [16] criteria, with values less than 0.1 considered small, those less than 0.3 considered medium, and values of 0.5 or more considered large. Table 4 displays the standardized direct, indirect, and total effects associated with each of the five variables.

Fig. 3 displays the resulting path coefficients of the proposed research model. Computer self-efficacy significantly influences perceived ease of use with the largest effect size in the model ($\beta = .59, p < .001$). The results indicate that perceived ease of use did not significantly influence perceived usefulness ($\beta = .26, p = .008$), and neither did computer self-efficacy ($\beta = .15, p = .128$). Attitudes towards computer use were significantly determined by perceived usefulness ($\beta = .42, p <$

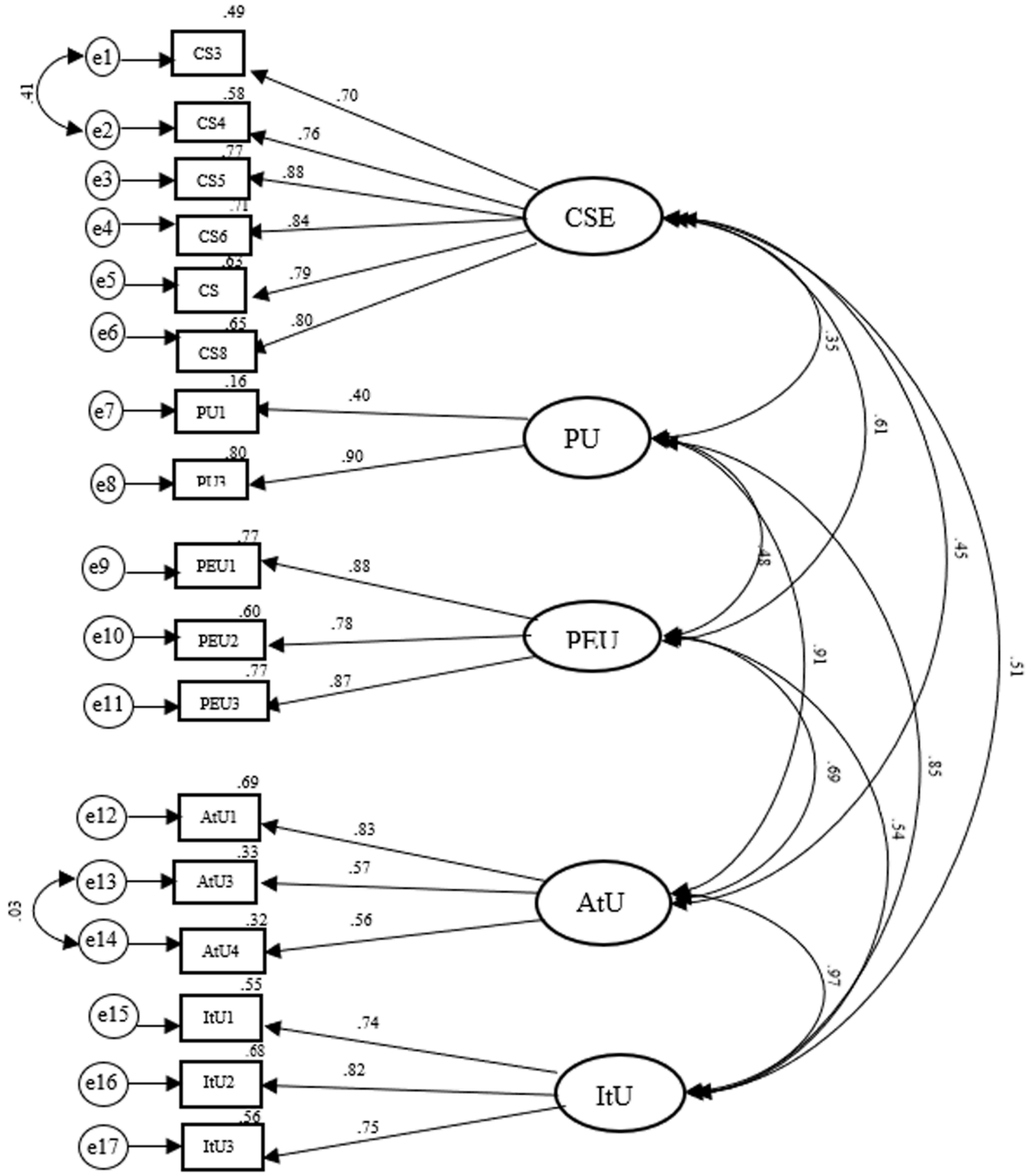

Fig. 2. Factor structure of the TAM, Note. Coefficients are standardized factor loadings.

Table 2
Fit indices for the measurement model

Fit indices	χ^2	*f*	FI	LI	RMR	CFI	RMSEA (90% Confidence Interval)
Structural model	194	07	.87	.924	.049	.94	.076 (.059 ~.93)
Fit criteria	χ^2 /df < 3		.85	.90	< .05	> .90	< .08

.001) and perceived ease of use ($\beta = .47$, $p < .001$). A robust predictor within the model and specifically for teachers' intention to use computer-based technology after the school closures was attitudes towards using ICT ($\beta = .54$, $p < .001$). The analysis indicated that the intention to use technology in the future was also influenced by perceived usefulness, to a small extent ($\beta = .27$, $p < .001$).

Consistent with the findings of major TAM studies, the proposed model of this study demonstrates that the intention to use technology is significantly influenced by PU and AtU ($R^2 = .53$), the latter being significantly influenced by PU and PEU. AtU was significantly determined by PU and PEU, and the percentage of variance explained was

Table 3
Hypothesis testing results

Hypothesis	Path	Standardized Path Coefficient	t-value	Results
H_1	PEU=>PU	0.26	2.6	Not supported
H_2	PEU=>AtU	0.47	7.7	Supported
H_3	PU=>AtU	0.42	6.9	Supported
H_4	CSE=>PU	0.15	1.5	Not supported
H_5	CSE=>PEU	0.59	8.6	Supported
H_6	PU=>ItU	0.27	3.7	Supported
H_7	AtU=>ItU	0.54	7.6	Supported

Table 4
Direct, indirect, and total effects of the research model

Outcome	Standardized Estimates Determinants	Effects Direct	Indirect	Total
Intention to use ICT ($R^2 = 0.53$) PU		0.27	0.23	0.49
	PEU	-	0.38	0.38
	AtU	0.54	-	0.54
	CSE	-	0.30	0.30
Attitude towards computer use ($R^2 = 0.54$)	PU	0.42	-	0.42
	PEU	0.47	0.11	0.58
	CSE	-	0.40	0.40
Perceived ease of use ($R^2 = 0.34$)	CSE	0.59	-	0.59

54% ($R^2 = .54$). That is, the combined effects of PU and AtU explained 54% of the variance of ITU. The predicting variable of computer self-efficacy accounts for 34% of the variation of perceived ease of use ($R^2 = .34$).

Discussion

This study aims to shed light on primary school teachers' intention to integrate technology during emergency remote teaching imposed by COVID-19. Specifically, we explore the relationships between teachers' beliefs in their ability to successfully use technology and their perceptions, attitudes, and intentions towards computer-based technology use during the pandemic. Utilizing the extended technology acceptance model [19], we analyzed the data collected from an online survey of Greek primary school teachers using structural equation modeling to quantitatively investigate their technology acceptance.

Four key findings outline this study. First, our results demonstrate that computer self-efficacy is the most robust driver within the model, with a significant influence on perceived ease of use (β=.59, $p < .001$) and a strong indirect effect on attitudes towards computer use (β = .47, $p < .001$). Primary school teachers who believe in their own abilities to use computer-based technology, find it easy and are planning to keep using ICT in their future practice. These findings are consistent with previous studies indicating that individuals who view themselves as competent computer users tend to use ICT more frequently and report more positive attitudes [29,56].

Second, our results show that perceived ease of use and perceived usefulness are strong predictors of teachers' attitudes towards computer use. In other words, the extent to which teachers believe that using technology will be easy and will enhance their teaching performance directly affects their attitude towards technology. The combined effects of perceived usefulness and perceived ease of use accounted for 53.8% of the variance in attitudes towards technology use. This finding is in line with previous research that supports the link between cognitive responses such as perceived ease of use and perceived usefulness, which in turn influences affective responses such as teacher attitudes towards the use of computer-based technology in their practice [11].

Another major finding of our study is that teachers' intention to continue using technology is primarily determined by their attitudes towards computer use, and to a lesser extent, by the usefulness of computer use. Similar results have been reported in previous studies using the technology acceptance model [11,80], highlighting the impact of attitudes towards computer use on teachers' behavioral intentions to continue using computers in their teaching practice. The small effect observed between computer usefulness and teachers' intention to continue using computers in their teaching practice may be explained by the unexpected nature of teacher's use of technology due to the pandemic. Teachers were required to rapidly adapt to a new online teaching reality where the usefulness of future technology use was not questioned.

An interesting finding of the present study is the rejection of the first and fourth hypotheses, in which perceived ease of use was not significantly associated with perceived usefulness (hypothesis 1), and self-efficacy beliefs were not significantly associated with teachers' perceived usefulness (hypothesis 4). The conflicting role of perceived ease of use in the TAM model has already been reported in several studies (e.g., [37,45]), along with the relationship between self-efficacy beliefs and perceived usefulness. In addition to the existing literature, we believe that the pandemic-imposed emergency, along with teachers' need to quickly adapt to the new remote reality, may have contributed to these findings. Specifically, the fact that technological tools may be easy to use was not a reason for teachers to find them useful in their teaching practice. Teachers did not have the time to properly learn how to incorporate new technologies, even if they were easy to use. Previous research supports this argument and emphasizes that this finding is particularly true for practitioners whose traditional practice routines are

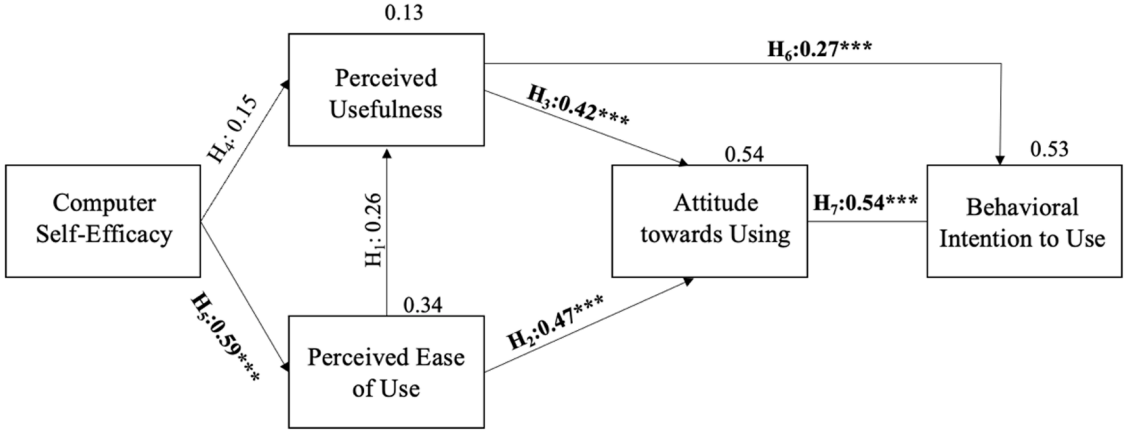

Fig. 3. Path Coefficients of the Proposed Research Model. Note. *** p < .001

disrupted by the adoption and use of technology [6].

The lack of proper preparation, along with the need to use technological tools to ensure education continuity, may explain the absence of associations between self-efficacy beliefs and perceived usefulness. Primary school teachers in Greece and around the world were required to use technology not to improve their task performance or technical skills, but because emergency remote teaching was the only way to continue education. The literature also suggests that self-efficacy beliefs are just one of the potential drivers in the TAM model that may influence future technology use [62]. In our study, it is apparent that believing in one's ability to use technology does not necessarily equate to finding technology useful. This finding is consistent with previous research that explains the role of self-efficacy beliefs as an external variable in the TAM model [78].

Taken together, our findings confirm the puzzling and interesting character of the complex relationships among the TAM variables [33]. Future research may focus on the exploration of different external factors which might drive teachers' intentions to use computer-based technology. Given the necessity to quickly use technological tools during emergency remote teaching and the lack of research on teachers' intrinsic motivation, interest, or enjoyment of technology, future studies could explore the aforementioned external variables in the TAM model. Another suggestion for future research is to examine the proposed model using an experimental design to further validate our results.

Implications

Our study suggests important implications and directions for future research on the use of technology in primary schools, not only during times of disruption but also in normal times. Recently, policymakers and education stakeholders in Greece have proposed an ambitious plan to digitize and modernize Greek schools, including the concept of the flipped classroom. However, this plan requires teachers to possess robust ICT skills and mindset. Our findings suggest that teachers who believe that computer use requires little effort are more likely to develop positive attitudes and use computers in their daily teaching. To achieve low-stress use of technology, ICT training is necessary. Frequent, effective, and stress-free workplace learning opportunities can lead to overall job satisfaction, recognition, work enjoyment, and successful learning [61].

Administrators should create and implement support mechanisms and frameworks that enable ICT workplace learning within schools. Such support can take various forms, such as learning by doing, experimenting, getting ideas from others, and reflecting [32]. Effective technical support, together with an environment where the use of computers is effortless, can develop positive attitudes towards computers which, in turn, will strengthen the intention to use them over time [24].

Our study also highlights that teachers who perceive the integration of ICT in the classroom as useful tend to have positive attitudes towards technology and use it regularly. Therefore, teachers need proof that the use of computers is meaningful and helps them achieve their learning objectives. Technology should be incorporated throughout the curriculum and linked to practice for teachers to be convinced of its usefulness [38,55]. To achieve the same goal, previous work also suggests providing teachers with experiences on how it can be applied to specific content areas [54]. We suggest that building communities of practice within schools can ensure continuous learning opportunities with appropriate support, which may help teachers understand the link between technology integration and successful teaching [44].

Mentoring has been used in the past to persuade teachers about the usefulness of ICT integration, but it has been criticized as time- and money-consuming [15]. Therefore, we would not suggest such an intervention in the case of improving Greek, primary school teachers' perceived usefulness. Instead, we propose building extensive and well-supported communities of practice, avoiding the use of external experts, such as mentors [44]. In summary, providing quality ICT training and lifelong learning opportunities can ensure that Greek primary school teachers use technology to its fullest potential.

Limitations

Generalizations of the findings should be exercised with caution, given that the respondents are exclusively Greek primary school teachers. Important differences in the measurement of the subconstructs of the Technology Acceptance Model may exist across populations and educational systems [79]. This limitation was taken into consideration during the initial steps of the research methodology and for this reason, the subscales used in the instrument had already been administered and validated in Greece. Still, we considered that it is important to gain insight into Greek primary school teachers' perceptions and attitudes towards technology during emergency remote teaching, given the uniqueness of the situation and the country-specific characteristics [68]. It is reported that in Greece, lack of support and lack of equipment are common barriers to the integration of technology in schools [52]. Additionally, the recent announcement of the introduction of the flipped classroom to the Greek educational system makes the need for research on Greek teachers' technology acceptance insistent.

Another limitation refers to the sample size in this study which may be considered small. Although previous studies have indicated that SEM models could be tested with small sample sizes (Hoyle & [35,49]) with $N = 100$ - 150 being the minimum sample size [5,20,70], literature is still inconsistent about the optimal sample size for SEM studies. Nonetheless, future research with a larger sample size is needed to further explore the generalizability of our findings.

Conclusion

Our study provided valuable insights into the attitudes and perceptions of Greek primary school teachers towards computer-based technology during the unprecedented situation of emergency remote teaching. Our findings highlighted the importance of computer self-efficacy beliefs as a driver of teachers' intentions to use technology in their classrooms, and the need to consider the unique circumstances and characteristics of the situation in which technology is used [57]. Our research contributes to the growing body of literature on technology acceptance by exploring the relationships between the TAM variables during an uncharted situation, and provides a foundation for future research to expand on our findings.

Furthermore, our study has practical implications for the design of interventions to promote the use of technology in primary schools, highlighting the need to foster teachers' self-efficacy beliefs in their ability to use technology. The findings also suggest that policy makers should consider providing more support and equipment to schools, especially in countries like Greece where these are common barriers to the integration of technology in education. Overall, our study makes a significant contribution to the field of research and practice by shedding light on the determinants that influence teachers' attitudes towards technology and their intentions to use it, providing insights that can inform the design of effective interventions and policies.

Author contributions

Compliance with Ethical Standards and Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The present study was approved by The Ethics Review Board of the Faculty of Social & Behavioural Sciences at Utrecht University. The participants provided their written informed consent to participate in this study.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The datasets generated for this study are available on request to the corresponding author.

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