


# Promoting the integration of technology in teaching: An analysis of the factors that increase the intention to use technologies among Italian teachers

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## Abstract

**Background:** The rapid spread of COVID-19 forced many countries to adopt severe containment measures, transferring all didactic activities into virtual environments. However, the integration of technology in teaching may present difficulties, especially in some countries, such as Italy. **Objectives:** The present study analyzed how the two main factors of the Technology Acceptance Model (TAM), namely perceived usefulness and perceived ease of use, combined with online teaching self-efficacy, were associated with the intention to use technology to teach. We posited a moderated moderation model in which perceived usefulness represented the main predictor, with self-efficacy and perceived ease of use as moderators of intention to use technology to teach. **Method:** The model was tested through multiple regressions, using the PROCESS macro on SPSS 26 with a sample of 178 upper secondary school teachers in Italy. **Results and conclusions:** Regressions showed that each variable significantly predicted the intention to use technology. In addition, a moderation effect of self-efficacy on the perceived usefulness of using technology was found for medium and high-level of perceived ease of use of technology. **Implications:** The present study provides targeted implications for distance education policy and practice to promote its adoption (or the blended modality) in Italian upper schools.

## KEYWORDS

COVID-19, distance education, online teaching self-efficacy, perceived ease of use, perceived usefulness

## 1 | INTRODUCTION

The widespread occurrence of the new virus “severe acute respiratory syndrome coronavirus 2” (SARS-CoV-2), officially defined by the World Health Organization (WHO) as a pandemic on 11 March 2020, led to the governments of many countries adopting unprecedented actions in order to limit the diffusion of the virus. At the global level, one of the

most dramatic consequences of taking such strong measures was represented by the closure of schools and other educational institutions.

Italy was the first European country to adopt dramatic containment measures such as closure of public and private educational buildings. As consequence, about 12 million learners from pre-primary to tertiary education were not allowed to attend school, forcing classes to an online environment. While people's safety is the priority in the current

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pandemic, it is undeniable that the closure of schools affected students and particularly adolescents (Liang et al., 2020) due to their importance in promoting and supporting student well-being (Skinner et al., 2009).

In the current historical period distance teaching may represent an important resource for continuing the educational path (UNESCO, 2020). Indeed, as reported by the World Health Organization (2001) "among all the sectors that play critical roles in adolescent health, education is key" (p. 8). The aim of the present study was to investigate which factors may support the behavioural intention to use technology for teaching in order to ensure education even when schools are closed or face-to-face lessons are not allowed.

## 1.1 | Distance education

Distance education has been defined as a type of education that uses one or more technologies to give instruction to students who are separated from the teachers and to support regular interaction between the students and the teachers synchronously or asynchronously (Allen & Seaman, 2017; Pedro et al., 2018; Seaman et al., 2018). Initially spread where geographical conditions did not allow easy access to schools, distance education represents today a common practice in many universities worldwide in the form of the blended modality or full-online courses (Kebritchi et al., 2017; Voss, 2013). By contrast, distance education is less common in secondary schools (Demiryörek & Atsan, 2015), even if the rapid spread of the COVID-19 virus has forced many of them to move all teaching activities to virtual environments fairly quickly, as happened in the Italian context (Giovannella, 2021).

In Italy, the Ministry of Education recommended the use of distance education not only to continue the learning path but also to limit the feelings of isolation and demotivation in students (Ministero dell'Educazione, dell'Università e della Ricerca, 2020). However, even if teachers were considered key players in the effective integration of technology in teaching and learning (Teo, 2011; Zhao & Cziko, 2001), research suggested that the acceptance and usage of technology in distance education represented a major challenge both for teachers and educational institutions (Fraillon et al., 2014; Straub, 2009). In addition, the sudden request to implement distance education met specific difficulties in Italy (Pellegrini & Maltinti, 2020). Although the Ministry of Education gave suggestions to deal with distance learning offering a wide choice of online training courses for teachers (Pellegrini & Maltinti, 2020), no specific information on the management of distance education was provided. Besides, most teachers were facing the use of computer-based or web-based educational instruments for the first time, as well as enduring a lack of support from the Ministry, and a paucity of readily available local or cloud Webservices (Giovannella, 2021; Pellegrini & Maltinti, 2020).

## 1.2 | Factors promoting distance education

The Technology Acceptance Model (TAM, Davis et al., 1989) is one of the most cited theoretical models used to explain reasons that may

lead to the use of technology. TAM postulates that technology usage is determined by the behavioural intention to use it. In particular, perceived usefulness and perceived ease of use are of primary relevance for technology acceptance behaviours (Wahid, 2007). Perceived usefulness is defined as the prospective user's subjective probability that the use of a specific application system would increase job performance within an organizational context (Davis et al., 1989), while perceived ease of use refers to the degree to which the potential user expects the target system to be effortless (Davis et al., 1989). Despite several similarities, the influence of perceived usefulness on the behavioural intention to use technology was found to be 50% stronger than that of perceived ease of use (Davis, 1993).

Over the years, the TAM model, with particular attention to perceived usefulness and perceived ease of use, has been tested to predict the behavioural intention to use technology in many different fields such as e-banking, e-commerce, and social networking media (Deng et al., 2005). The TAM model has been applied and validated in predicting the use of technology also in education settings among teachers (Teo, 2011). A longitudinal study of Hu et al. (2003) found that the process of teachers accepting technology was influenced by different factors, but perceived usefulness and perceived ease of use were the fundamental determinants for their continued acceptance.

Besides the two aforementioned factors, self-efficacy in using technology was another key factor in promoting its use (Compeau & Higgins, 1995). The general construct of self-efficacy referred to individuals' beliefs about their capabilities to successfully carry out a specific course of action (Bandura, 1997). In educational research, teachers' efficacy is about their beliefs and confidence to implement good teaching in the classroom (Christophersen et al., 2016), affecting the quality of their instructional practices and student engagement (Chacón, 2005; Graham et al., 2001). In the Italian context, Caprara et al. (2006) found that teachers' self-efficacy significantly predicted students' achievement and job satisfaction while Lent et al. (2011) found that self-efficacy did not relate to job satisfaction directly but indirectly, via work conditions. The concept of self-efficacy has been found to be particularly important for the use of technology among teachers (Fanni et al., 2013; Krumsvik, 2011; Tondeur et al., 2009). Indeed, teachers who have high self-efficacy level on technology integration tend to be more successful in the technology integration process (Wang et al., 2004).

Teaching self-efficacy has been widely studied within the Technological Pedagogical Content Knowledge theory (TPACK, Koehler & Mishra, 2009). Overall, TPACK represents a conceptual model for studying technological knowledge, content knowledge, pedagogical knowledge and their interactions (Koehler & Mishra, 2009; Schmidt et al., 2009). Over the years many studies described the relationship between TPACK, self-efficacy and the integration of technology. Joo et al. (2018) found that pre-service teachers' TPACK affected teacher self-efficacy, perceived ease of use and perceived usefulness, although it did not directly affect their intention to use technology. Moreover, Abbitt (2011) found that knowledge in the TPACK domains was predictive of self-efficacy beliefs about technology integration and Nathan (2009) found a moderate relationship between TPACK and self-efficacy in integrating technology.

At the end, when self-efficacy was referred to online educational settings, two distinct meanings of self-efficacy have been considered (Gudmundsdottir & Hatlevik, 2018; Krumsvik, 2011). The first one represents the general concept of “digital self-efficacy” and the evaluation of one’s capability to use technology as a tool (Compeau & Higgins, 1995). In this meaning, digital self-efficacy is independent from being a teacher and using technology for teaching. The second one, called “online teaching self-efficacy”, is more specifically related to the use of technology for teaching or didactical purposes (Gudmundsdottir & Hatlevik, 2018).

### 1.3 | The current study

The current study aimed to investigate the relationship between the perceived usefulness, online teaching self-efficacy, the perceived ease of use of technology, and the behavioural intention to use technology for teaching among upper secondary school teachers. Our research hypotheses are specified below.

#### 1.3.1 | Direct effects

Hypothesis 1 (H1): the perceived usefulness of technology is positively related to the behavioural intention to use technology for teaching.

Hypothesis 2 (H2): the online teaching self-efficacy in the use of technology is positively related to the behavioural intention to use technology for teaching.

Hypothesis 3 (H3): the perceived ease of use of technology is positively related to the behavioural intention to use technology for teaching.

#### 1.3.2 | Indirect effects

Hypothesis 4 (H4): the online teaching self-efficacy moderates the relationship between the perceived usefulness of technology and the behavioural intention to use.

Hypothesis 5 (H5): the perceived ease of use in technology moderates the relationship between the perceived usefulness of technology and the behavioural intention to use.

Hypothesis 6 (H6): the perceived ease of use moderates the relationship between self-efficacy and the behavioural intention to use technology.

Hypothesis 7 (H7): the perceived ease of use moderates the conditional influence of the self-efficacy in the relationship between the perceived usefulness and the intention to use technology.

In our model we hypothesized that the direct relationship between perceived usefulness and behavioural intention would be moderated by online teaching self-efficacy, and in turn, moderated by perceived ease of use of technology. Indeed, even if other variables were comprised in the TAM model (such as attitudes), perceived usefulness and perceived ease of use were considered the main variables to directly or indirectly explain the intention to use technology

(Marangunic & Granic, 2015). Furthermore, we assumed that the perceived ease of use could moderate the conditional influence of online teaching self-efficacy in the relationship between perceived usefulness and the intention to use technology: the easier a system is to use, the greater will be the user’s perceived self-efficacy regarding their capacity to use the system comfortably (Saadé & Kira, 2007). Finally, the number of hours spent in distance teaching for the week was included into the model as a control variable (Figure 1). Therefore, a theoretical model was hypothesized in which perceived usefulness was the focal predictor, with online teaching self-efficacy the first moderator and perceived ease of use the second moderator on the behavioural intention to use technology (Figure 1).

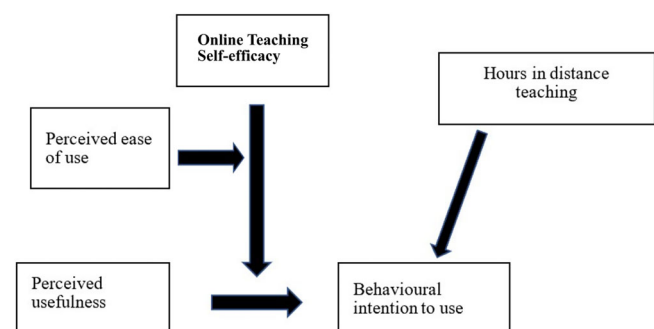
Although both types of self-efficacy played an essential part in predisposing individuals to use technology in teaching (Hammond et al., 2011; Hatlevik, 2017; Teo, 2014; Tilton & Hartnett, 2016), we focused the present study on online teaching self-efficacy as significantly predicted the use of technology among teachers (Hatlevik, 2017) and pre-service teachers (Teo, 2009). In addition, this online teaching self-efficacy is distinctive of teachers’ education while digital self-efficacy can be applied to different fields (Corry & Stella, 2018; Gudmundsdottir & Hatlevik, 2018). From this starting point, we surmised that the degree of online teaching self-efficacy was not a predictor of perceived usefulness but rather a moderator since it could influence the relationship between perceived usefulness and perceived ease of use.

To our knowledge, this is the first theoretical model on the critical factors fostering the adoption of distance teaching during the COVID-19 pandemic, combining the perceived usefulness and the perceived ease of use with teachers’ online teaching self-efficacy in the digital environment.

## 2 | MATERIAL AND METHOD

### 2.1 | Participants and data collection

In the present study, a total of 233 upper secondary school teachers filled out an online questionnaire available on QUALTRICS in a two-



**FIGURE 1** Research model with two moderators. Three-way interaction effect of online teaching self-efficacy (M) and perceived ease of use (W) on the relationship between perceived usefulness (X) behavioural intention to use technologies [Colour figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

month period from 15 May to 10 July 2020, during the school closure period for the lockdown. In order to proceed accurately with statistical analysis, 55 participants were excluded since they had at least one missing answer in the variables of interest. Therefore, the final sample consisted of 178 teachers. Participation was voluntary and respondents were recruited through an invitation by e-mail and through advertising on social platforms.

The sample comprised 70% ( $n = 120$ ) females and 30% ( $n = 51$ ) males. The majority of the sample was from northern-Italy regions ( $n = 124$ , 73%). A smaller proportion ( $n = 33$ , 19%) was from central-Italy regions and a few ( $n = 14$ , 8%) from southern-Italy regions. Concerning age, 6.5% ( $n = 11$ ) of teachers were aged between 21–30 years, 9% ( $n = 15$ ) between 31–40 years, 30% ( $n = 51$ ) between 41–50 years, 38% ( $n = 65$ ) between 51 and 60 years and finally 16.5% ( $n = 28$ ) more than 61 years old (8 responses were missing).

Concerning the subjects taught, literacy ( $n = 37$ , 15%) and foreign language ( $n = 33$ , 14%) were the most represented, followed by maths ( $n = 26$ , 11%) and history ( $n = 25$ , 10.5%). In addition, 129 (72%) teachers reported teaching only one subject, 39 (22%) two subjects, 7 (4%) three subjects and 3 (2%) more than 3 subjects. About the number of classes, the majority of participants taught in more than five classes ( $n = 47$ , 26.5%), 29 (16.5%) participants reported teaching in 5 classes, 40 (22.5%) teachers in 4 classes, 44 (25%) teachers in 3 classes, 12 (7%) in 2 classes and finally just 4 (2.5%) in 1 class (two participants did not answer the question).

## 2.2 | Measures

An online questionnaire was developed to investigate the perceived usefulness in using technologies in teaching, self-efficacy as teacher in digital environment, the perceived ease of use technology, the behavioural intention to use them and the average number of hours spent in distance teaching. We also included a section regarding demographic information. Participants took about 10–15 min to complete the questionnaire (for a full description of the questionnaire see Appendix).

### 2.2.1 | Perceived usefulness

The perceived usefulness was evaluated using a 3-item scale based on the study by Teo (2011). The scale was assessed on a 7-point Likert scale (1 = strongly disagree and 7 = strongly agree). Cronbach's alpha was 0.90.

### 2.2.2 | Online teaching self-efficacy

The online teaching self-efficacy was evaluated using an adaptation of the Teacher Sense of Efficacy Scale (TSES, Tschannen-Moran & Hoy, 2001). The questionnaire was initially designed to investigate self-efficacy of teachers in the classroom and later modified by

Robinia and Anderson (2010) to investigate online teaching efficacy. However, this new questionnaire targeted nurse educators employed in higher education institutions. Thus, we further adapted the questionnaire to address upper secondary school teachers. The final questionnaire consisted of 8 questions. The scale was assessed on a 9-point Likert scale (1 = not at all and 9 = a great deal). Cronbach's alpha was 0.93.

### 2.2.3 | Perceived ease of use

The perceived ease of use was assessed using a 5-item scale derived by Teo (2011). The scale was assessed on a 7-point Likert scale (1 = strongly disagree and 7 = strongly agree). Cronbach's alpha was 0.94.

### 2.2.4 | Behavioural intention to use

The behavioural intention to use technology was assessed using a 3-item scale (Teo, 2011). The scale was assessed on a 7-point Likert scale (1 = strongly disagree and 7 = strongly agree). Cronbach alpha was 0.94.

### 2.2.5 | Hours in distance teaching

Respondents were asked to indicate the average number of hours spent in distance teaching per week during the lockdown, when the school buildings were closed and instruction was moved online. Teachers inserted the number of hours.

## 2.3 | Ethics

Formal approval for the study was provided by the Bioethics Committee of the University of Bologna. In the information statement, participants were informed about the purpose of the research and the procedures; the benefits/risks of participating in this study; the rights to decline to participate and to withdraw from the research without consequences according to the Declaration of Helsinki. Participants did not receive incentives or benefits for their participation.

## 2.4 | Statistical analysis

In order to address the hypotheses related to the direct effects as well as moderation effects, a conceptual model with two moderators was developed (Figure 1). In the model, online teaching self-efficacy in using technologies was the first moderator, while the perceived ease of use represented the second moderator (Figure 1). The analysis relied on the use of the PROCESS macro (Model 3; Hayes, 2013). PROCESS is a computational tool available for SPSS, which estimates

all standard errors, path coefficients, confidence intervals, *t*- and *p*-values, and other statistics useful for moderation analysis. PROCESS uses ordinary least squares regression to estimate the parameters of each of the equations. In addition, it estimates each equation separately, meaning that the estimation of the regression parameters in one of the equations does not affect the estimation of the parameters in any other equations defining a model (Hayes, 2013). In our research, bootstrap resampling (5000 samples) was used to estimate 95% confidence intervals. All analyses included a correction for heteroscedasticity (HC3) (Davidson & MacKinnon, 1993), in line with the recommendations of Hayes and Cai (2007). Variables were centered on having a mean of 0 before the analyses, and the Johnson-Neyman technique was used to compute the range of significance and simple slopes for the interaction analyses (Johnson & Neyman, 1936). We report unstandardized regression coefficients (Hayes, 2017). All analyses were two-tailed and used conventional significance thresholds ( $\alpha = 0.05$ ).

### 3 | RESULTS

The model shown in Figure 1 was significant,  $F(8,169) = 19.48$ ,  $p \leq 0.001$ ,  $R^2 = 0.48$ , and explained 48% of the variability in the data. Hours spent in distance teaching used as a control variable did not show a significant effect on the intended use of technology ( $b = 0.017$ ,  $p = 0.67$ ).

#### 3.1 | Direct effects

As shown in Table 1, the perceived usefulness of technology was positively related to the behavioural intention to use technology in teaching ( $r = 0.60$ ,  $p < 0.001$ ). The existence of this direct effect was supported by the ordinary least squares regression [ $\beta = 0.45$ ,  $t(8, 169) = 6.10$ ,  $p < 0.001$ ; see Table 2]. Also the online teaching self-efficacy was positively correlated with the behavioural intention to use technology ( $r = 0.42$ ,  $p < 0.001$ , see Table 1). The ordinary least squares regression showed that online teaching self-efficacy had a significant direct effect on intentions to use technology in teaching [ $\beta = 0.11$ ,  $t(8,168) = 3.82$ ,  $p < 0.001$ ; see Table 2]. Perceived ease of use of technology was positively correlated with the behavioural

intention to use technology too ( $r = 0.37$ ,  $p < 0.01$ , Table 1), and the existence of this relationship was supported by the ordinary least squares regression [ $\beta = 0.11$ ,  $t(8, 168) = 2.54$ ,  $p = 0.012$ ; see Table 2], revealing its direct effect (see Table 1). Thus, all three research hypotheses (H1, H2, H3) regarding direct effects were confirmed.

#### 3.2 | Indirect effects

The interpretation of the two-way analyses suggested that the relationship between the perceived usefulness of technology and the intention to use was not moderated by the online teaching self-efficacy [ $\beta = -0.012$ ,  $t(8,168) = -1.81$ ,  $p = 0.07$ ; see Table 2] nor by the perceived ease of use [ $\beta = 0.005$ ,  $t(8,168) = 0.42$ ,  $p = 0.67$ ; see Table 2]. In addition, the relationship between the online teaching self-efficacy and the behavioural intention to use technologies was not moderated by the perceived ease to use [ $\beta = 0.07$ ,  $t(8,168) = 1.23$ ;  $p = 0.21$ ; see Table 2]. Therefore, H4, H5, H6 research hypotheses were not confirmed.

A significant three-way analysis was found [ $\beta = -0.002$ ,  $t(8,168) = -2.88$ ,  $p < 0.01$ ; see Table 2], revealing that the perceived ease of use of technologies moderated the conditional influence of online teaching self-efficacy in the relationship between the perceived usefulness and the intention to use technologies (see Table 2). Thus, H7 research hypothesis was confirmed, reaching statistical significance. As shown in Figure 2 the highest scores of the intention to use technology ( $M = 19.33$ ) occurred with higher scores in perceived usefulness, online teaching self-efficacy and perceived ease of use.

Analysis of the simple slopes revealed that the three-way interaction was significant for medium ( $\beta = -0.016$ ,  $p = 0.01$ ) and high levels ( $\beta = -0.027$ ,  $p < 0.001$ ) of perceived ease of use. In these cases the intention to use technology was strongly influenced by the perceived usefulness of technology, with a greater increase from low to high scores ( $\beta = 0.79$ ,  $SE = 0.112$ ,  $p < 0.001$ , see Figure 1) for low levels of self-efficacy. By contrast, when self-efficacy was high, the intention to use technology was not affected by different levels of the perceived usefulness of technology ( $\beta = 0.16$ ,  $SE = 0.125$ ,  $p = 0.195$ ). When the perceived ease of use was low, there was no significant interaction between the perceived usefulness and online teaching self-efficacy ( $\beta = -0.006$ ,  $p = 0.60$ ), revealing that the relationship between perceived usefulness and intention to use technology was

**TABLE 1** Descriptive analyses and correlations for study variables

Variable	Mean	Standard deviation	1	2	3	4
1. Perceived usefulness	12.79	4.98	-			
2. Online teaching self-efficacy	42.79	11.033	0.39***	-		
3. Perceived ease of use	24.32	7.11	0.42***	0.37***	-	
4. Behavioural intention to use	15.72	4.54	0.60***	0.42***	0.37***	-
5. Hours in distance teaching	13.76	8.14	-0.16	0.15	0.02	-0.12

Note: Cell entries are zero-order Pearson correlation coefficients.

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

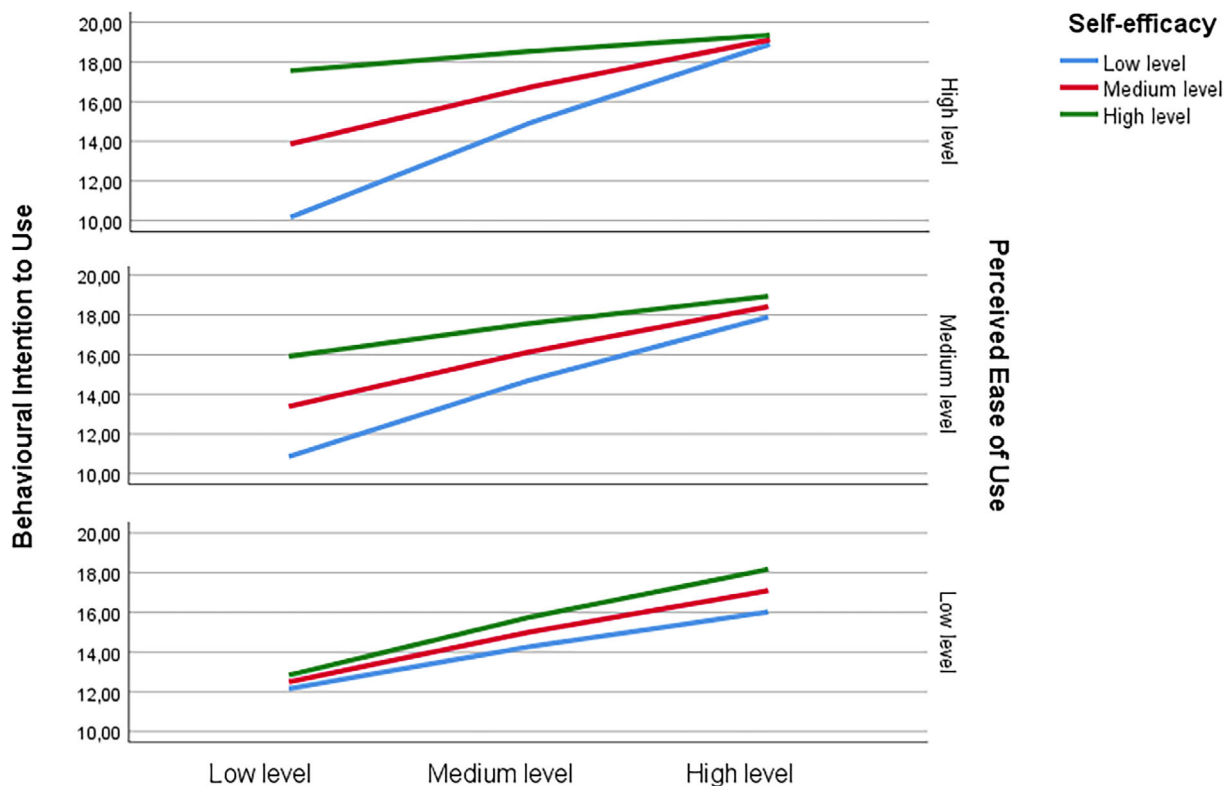
**TABLE 2** Direct and interaction effects between variables

Effect	<i>b</i>	SE	95% CI	
			LL	UL
Perceived usefulness	0.452***	0.074	0.306	0.599
Online teaching self-efficacy	0.111***	0.029	0.054	0.168
Perceived ease of use	0.117*	0.046	0.026	0.209
Perceived usefulness × Online teaching self-efficacy	−0.01	0.006	−0.023	−0.001
Perceived usefulness × Perceived ease of use	0.004	0.010	−0.011	0.028
Online teaching self-efficacy × Perceived ease of use	0.006	0.005	0.002	0.024
Perceived usefulness × Online teaching self-efficacy × Perceived ease of use	−0.002**	0.001	−0.004	0.001

Note: Analyses performed using the PROCESS macro for SPSS (Model 3; Hayes, 2013).

Abbreviations: CI, confidence interval; LL, lower limit; UL, upper limit.

Note: \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .



**FIGURE 2** Three-way interaction of perceived usefulness, online teaching self-efficacy and perceived ease of use. Three-way interaction plot of perceived usefulness, online teaching self-efficacy, and perceived ease of use on behavioural intention to use technology [Colour figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

not affected by different levels of online teaching self-efficacy (low self-efficacy:  $\beta = 0.35$ ,  $SE = 0.154$ ,  $p = 0.023$ ; high self-efficacy:  $\beta = 0.48$ ,  $SE = 0.193$ ,  $p < 0.001$ ) (see Figure 2).

## 4 | DISCUSSION

The spread of COVID-19 highlighted the importance of teachers being ready to implement distance education or a blended teaching

modality (Ward & LaBranche, 2003) in lockdown conditions. Indeed, in the current academic year, new lockdowns, as well as other interruptions to face-to-face learning for entire classes, happened and they cannot be excluded in the next months. The use of technology in education can boost the variety of learning environments and opportunities, and enhance the quality of the learning experience (Azmi, 2017; Zakaria & Khalid, 2016). These findings are in line with European recommendations that support programs to foster digital literacy, skills and learning into reform agendas and education (Pandolfini, 2016;



Salmieri, 2019). Thus, research on the factors that can predispose positive uses of technologies in teaching is essential.

The present research adds new considerations on these predisposing factors, examining the impact of the key elements of the TAM model (Davis et al., 1989), namely perceived usefulness of technology and perceived ease of use of technology, and online teaching self-efficacy (Horvitz et al., 2015) on behavioural intentions to use technology. We found that both perceived usefulness and perceived ease of use of technology were significant predictors of teachers' intentions to use technology. Although these results confirmed other studies (Marangunic & Granic, 2015; Pynoo et al., 2012; Smarkola, 2007), previous research has paid little attention to teachers in upper school levels (De Smet et al., 2012; Kumar et al., 2008). Indeed TAM has been mainly used to investigate the acceptance of technology among higher education teachers or students (Park et al., 2012; Persico et al., 2014) and among pre-service teachers (Acarli & Saglam, 2015; Teo, 2008). In terms of online teaching self-efficacy, we found a significant direct effect on the behavioural intention to use technology in agreement with other studies (Joo et al., 2018; Liaw, 2002; Moreira-Fontán et al., 2019) and as suggested in TPACK framework (Joo et al., 2018). However, our study added the relevant role of online teaching self-efficacy among Italian teachers in secondary education.

The most innovative result of the present study was the interaction between the three variables as it represents the first research in which online teaching self-efficacy was examined in relation to perceived usefulness and perceived ease of use of technologies among upper Italian secondary school teachers. Overall, we think that these results may be particularly interesting in shedding further light on the validity of the TAM model in secondary school teachers (Davis, 1986; Scherer & Teo, 2019) and on the importance of online teaching self-efficacy (Hatlevik, 2017). Although the variables we considered have been widely analyzed, our findings add a new way in which the variables interact in promoting the behavioural intention to use technology in teaching. Indeed, they clearly indicate that when perceived ease of use of technology was middle to high, the intention to use technology was strongly influenced by the perceived usefulness for low levels of online teaching self-efficacy; while high levels of online teaching self-efficacy were an important component per se, revealing that it represented a key factor in disposing teachers to use technology regardless of different levels of perceived usefulness.

The direct effects as well as the triple interaction effect, represent an argument for developing frameworks and approaches to foster the adoption of distance education or blended modality during COVID-19 and beyond. First of all, considering perceived ease of use of technology, there is the need to provide teachers with easy and straightforward technologies through which implementing distance teaching or, in the future, integrating the technology in their classes can be facilitated. The second implication concerns the role of online teaching self-efficacy in using technologies for education. It is important to promote teachers' sense of online teaching self-efficacy through training or interventions focused on enhancing their self-efficacy in this sphere. Strengthening the sense of digital self-efficacy and, at the same time, providing teachers with easy-to-use tools could

already represent a first step towards the successful integration of technology in teaching. However, it is essential to remember that the highest level of intention to use technology was present when all three variables were at high levels. Consequently, the best scenario would be to provide training opportunities for teachers that foster online teaching self-efficacy and point out the technologies' actual usefulness, and so encourage schools to adopt easy technological tools.

#### 4.1 | Implications and future directions

The present study brings important implications that extend beyond the COVID-19 pandemic for promoting the use of technology in Italian schools, suggesting that this should not be a topic to focus on only in this particular period. Indeed, the OECD (2015) and European Commission (2016) stated that digitalization represented a driving force in economic productivity, encouraging member states to foster the development of new digitalized learning environments to ensure national education systems stay up to date (Salmieri, 2019). In addition, several studies have reported that the integration of technology into instruction is an essential ingredient for student success in the 21st-century (Foster et al., 2011; Harter, 2011; Washbon, 2012). In light of this, UNESCO ICT Competency Framework for teachers emphasized the urgent need for teachers to gain knowledge, skills, and attitudes required to integrate modern tools and resources into the learning process (Oddone, 2016). However, surveys on pedagogical innovation and teachers' professional development (OECD PISA, 2010; OECD TALIS, 2013, OECD, 2015) have shown that Italy has been behind most European countries with respect to equipment and usage of technologies in school (Calvani, 2013). In this context, paucity of digital equipment had to be counterbalanced by initiatives leading to new teaching practices, new tools and services, and new models aimed at innovating teaching quality. We believe that our results could represent a first attempt to shed light on what variables and skills may need to be strengthened to promote the adoption of technology by teachers in their classrooms. Indeed, as highlighted by Saadaf and Gezer (2020), it is essential to understand the factors related to teachers' intentions to integrate digital technologies into their classrooms to implement effective strategies in order to better prepare teachers for embracing technology in their teaching.

Concerning future directions, a comparison between teachers of different school grades and pre-service teachers could be helpful in determining whether the model could be extended also to lower school grade teachers. Indeed, it was not clear whether differences in using technology among teachers could emerge according to the grade of school (Antonietti & Giorgetti, 2006) and among pre-service teachers. Previous research has shown that the use of technology in kindergarten differs from its use in higher grades, due to children's limited reading and writing abilities, and learning methods that are based primarily on visual representations and interactive strategies (Magen-Nagar & Firstater, 2019). It follows that kindergarten teachers were less inclined to use computer technology than primary and

secondary school teachers (Cordes & Miller, 2000). In regard to pre-service teachers, who are part of the next generation and who actively use technology in everyday living, a quite positive attitude toward using technology has been found (Okumuş et al., 2013; Şad & Göktaş, 2014). Furthermore, many pre-service teaching education programs have made specific reference to technology, which is increasingly seen as a mandatory component of teacher accreditation requirements (McGarr & Gavaldon, 2018). Thus, future studies may examine our model by comparing pre-service and in-service teachers and different school grades.

## 4.2 | Limitations

The first limitation concerns the sample size. The limited sample size was also reflected in the low triple interactions' beta value, which, although in line with other studies (Gil de Zúñiga et al., 2018; Wieder & Terhune, 2019) could increase with a larger sample. Thus, further analyses could replicate the current study considering a larger sample. The second limitation relates to other important variables considered in the TAM model, such as attitudes toward technologies (Davis, 1986), which was not considered in our study. The third limitation involved the lack of the main components of TPACK as well as their interactions that may shed further light about factors to promote technology among teachers. Indeed, Saudelli and Ciampa (2016) found that a developed pedagogical knowledge was more effective in pushing teachers to integrate technology in their lessons as compared other factors such as technological knowledge. The fourth limitation concerned the demographic composition of the sample since the number of females was greater than males, although this gender composition aligns with the current Italian context where 78% of teachers are women (OCSE TALIS, 2018). Further research should analyse the role of gender since contrasting results have been reported. Yuen and Ma (2002) found that perceived usefulness and perceived ease of use of technology influenced the intention to use computers more for females than males. On the contrary, Ong and Lai (2006) found that men's ratings of perceived usefulness, computer self-efficacy, perceived ease of use, and behavioural intention to use e-learning were higher than those of women. The last limitation was that most of our sample was from northern Italy and a smaller number were from central and southern Italy. Italy has a centralized school system, but some differences between the north and south (Ballarino et al., 2014) could have impacted our findings. Thus, a balanced data collection between Northern and Southern Italy would be helpful in improving the generalizability of our findings.

## 5 | CONCLUSIONS

Existing literature demonstrated that perceived ease of use of technology, perceived usefulness of technology, and online teaching self-efficacy play a crucial role in teachers' acceptance of

technology. However, little was known about their reciprocal relationship and whether they could have a positive predictive effect on the intention of using technology, especially in the context of upper secondary school education in Italy. Our study found a moderation effect when technology was perceived easy to use (medium or high level). The effect of perceived usefulness of technology on the behavioural intention to use technology was particularly strong for low levels of online teaching self-efficacy. On the contrary, no significant effect of the perceived usefulness of technology on the behavioural intention to use technology was present for high levels of online teaching self-efficacy since, in this case, this latter variable represented a key factor in promoting the use of distance teaching per se. In the context of the pandemic, in which new school closures may be necessary, this research provides important targeted implications for the policy and practice of distance education to promote its adoption in primary and secondary schools and not just in university institutions.

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## CONFLICT OF INTEREST

The authors declare no potential conflicts of interest.

## AUTHOR CONTRIBUTIONS

*Conceptualization:* Laura Menabò and Annalisa Guarini. *Data collection:* Laura Menabò and Annalisa Guarini. *Formal analysis:* Laura Menabò. *Writing—original draft:* Laura Menabò. *Writing—review and editing:* Laura Menabò, Antonella Brighi, Alessandra Sansavini, Grace Skrzypiec and Annalisa Guarini. All authors have read and agreed to the published version of the manuscript.

## PEER REVIEW

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## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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## APPENDIX

### Questionnaire

#### Perceived Usefulness (Teo, 2011).

1. Using technology enables me to accomplish tasks more quickly
2. Using technology improves my performance
3. Using technology enhances my effectiveness

#### Online Teaching Self-efficacy (adapted from Tschannen-Moran & Hoy, 2001)

4. How much can you assist families online in helping their children do well in school?
5. How much can you do to motivate students who show low interest in online schoolwork?
6. How much can you do to get students to believe they can do well in online schoolwork?
7. How much can you do to help your students value learning in online activities?
8. To what extent can you use a variety of online assessment strategies?
9. To what extent can you provide online an alternative explanation for example when students are confused?
10. To what extent can you craft good online questions for your students?
11. How well can you implement alternative strategies in your online classroom?

#### Perceived Ease of Use (Teo, 2011)

12. Learning to use technology is easy for me

13. I find it easy to use technology to do what I want to do
14. My interaction with technology does not require much effort
15. It is easy for me to become skilful at using technology
16. I find technology easy to use

**Behavioural Intention to Use** (Teo, 2011)

17. I intend to continue to use technology in the future
18. I expect I would use technology in the future
19. I plan to use technology in the future

**Hours in Distance Teaching**

20. How many hours per week do you use distance teaching?

**Demographic Information**

21. What do you teach in this school year?
22. In how many classes do you teach?
23. Which Italian region are you from?
24. Please, select your age group