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Technology integration in emergency remote teaching: teachers' self-efficacy and sense of success

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Abstract

Sense of success and self-efficacy regarding technology integration in teaching are among the most important factors that influence teachers' well-being and professional development, and may have a substantial impact on student learning. In this quantitative study (N = 735 K-12 teachers in Israel), we explored the factors contributing to sense of success in emergency remote teaching and self-efficacy for integrating technology in teaching following the experience of teaching during COVID-19 days. We use decision-tree models to look at nuanced relations. Overall, our findings highlight the crucial—albeit not surprising—role of experience in teaching with technology as an important factor that promotes sense of success and self-efficacy. Going beyond this factor, we emphasize that emotional difficulties in times of emergency may serve as an important risk factor, and that taking a leading role in school may serve as an important protective factor. We also found an advantage to STEM and Language teachers, compared with Social Sciences and Humanities teachers. Following our findings, we conclude with a set of recommendations that could enhance school-based teaching and learning at large.

Keywords Technology integration in teaching · Self-efficacy · Sense of success · Covid-19 · Emergency remote teaching

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1 Introduction

Teachers' self-efficacy for teaching with technology and sense of success after the fact have long been shown to play an important role in teachers' intended and actual use of technology (Ertmer et al., 2006; Mumtaz, 2000). Moreover, these two variables have impact on teachers' well-being and professional development, and therefore may also impact student learning (Johnson & Birkeland, 2003; Klassen & Tze, 2014; Stronge, 2010). Click or tap here to enter text.Importantly, both these variables may also be affected by personal and vicarious experience and may be affected by various contextual factors (e.g., Holden & Rada, 2014). When the need arises to suddenly use technology in emergency remote teaching (ERT), the importance of these variables may increase significantly.

The COVID-19 pandemic triggered ERT in most education systems worldwide. Past research clearly indicated that teachers and other education stakeholders must work together in order to effectively integrate technology in teaching (Balchin & Wild, 2020; Johnson & Johnson, 2004; Razak et al., 2019). Such an effort is particularly true in the case of remote online teaching, where infrastructures, professional knowledge, school culture, and student preparedness should all be aimed at making it successful (Luu, 2022). This stands in clear contrast to the sudden shift to remote online education that occurred in early 2020. Due to the emergency situation, teachers and school systems were not given the required time and resources for preparation (Babinčáková & Bernard, 2020; Bayrakdar & Guveli, 2020; Trust & Whalen, 2021). Click or tap here to enter text.This situation may affect teachers' sense of success in integrating technology, due to the difficulties they had encountered and their experience of overcoming them, and therefore may also affect their self-efficacy for further technology integration.

The acquisition of skills required for integration of technology in teaching is a process conducted within the context of multiple factors. We take a contextual framework, suggesting that such learning processes occur within a multilevel structure. The relevant levels identified in prior research include the level of the individual, the home, the school and the community (Drossel et al., 2017a; Fraillon et al., 2013). It is important to look at the importance of factors across levels, specifically in the context of COVID-19 ERT. Many studies were already conducted regarding the affordances and barriers that had affected teachers' use of technology for teaching during the pandemic. Such recognized factors were at the level of the individual (e.g., insufficient experience, or attitudes towards distance teaching), school resources (e.g., slow internet connection, or insufficient digital devices) Of course, other factors were related to the very situation of a global pandemic (e.g., sense of safety, or family difficulties) (Gayatri et al., 2020; Karasneh et al., 2021; Le, 2022). However, only few studies investigated the relative role of factors across levels (e.g., Hu et al., 2021). Only by studying multiple factors across levels simultaneously, a wider picture of teacher's realities may be revealed.

Moreover, past studies rarely focused on defining and measuring success of integrating technology in teaching during the pandemic outbreak; of these, we could mention Centeio et al.'s (2021) study of over 4,300 Physical Education teachers from across the US; Kraft, Simon, and Lyon's (2021) study of over 7,800 teachers

from nine US states; and Masry-Herzalah and Dor-Haim's (2022) study of about 380 teachers from Israel – all of which included teachers from across K-12 grade levels. By asking teachers about their sense of success, we can quantitatively estimate the actual success, doing so while implicitly taking into consideration the latent variables that were perceived by teachers as most important for their success. Moreover, past studies did not investigate teacher's self-efficacy for technology integration following that experience. As self-efficacy is an important predictor of future technology integration in teaching, its investigation offers perspective about the long term consequences of the COVID-19 crisis.

Acknowledging the importance of teachers' sense of success and self-efficacy in the context of integrating technology, the current study aims to bridge the gap of lack of research of these variables in ERT. Based on the literature on teaching in routine times, we refer to various teacher characteristics that may affect sense of success and self-efficacy regarding the integration of technology in teaching during ERT; this is another unique contribution of the current study. To that end, we set-up the following research questions: (1) What are the associations between teachers' sense of success in technology integration in ERT and their self-efficacy for technology integration?; (2) What are the relations between teachers' sense of success in technology integration in ERT and variables related to demographics, teaching, and COVID-19?; and (3) What are the relations between teachers' self-efficacy for technology integration and variables related to demographics, teaching, and COVID-19?

2 Literature review

2.1 Factors affecting teaching in emergency remote teaching

Remote teaching in time of emergency is not a new phenomenon. More than that, education has been recognized as the "fourth pillar" of humanitarian aid, along with food and water, shelter and health care (Machel, 2001). In Israel, where the current study was conducted, teachers and students have been experiencing ERT for many decades, mostly when schools closed during war times. Almost 50 years ago, it was already suggested that the education system should get prepared for ERT, in both the organizational and psychological aspects of schooling (Ayalon, 1977). Recently, a literature review of 52 empirical studies of emergency remote teaching in primary and secondary schools was published (Crompton et al., 2021); the papers covered by that review—reporting on studies from 50 different countries—were published between 2010 and 2020, and only a small number of them were related to the COVID-19 days. Overall, the review has found that various types of support are needed for teachers to be prepared for times of emergency, related to technology, pedagogy, and social and emotional factors.

Already in pre-COVID years, teachers started incorporating technology in times of ERT, for the purpose of supporting students academically and emotionally (Rosenberg et al., 2018). This trend was evident to a high extent during the most recent COVID-19 experience, (Sharifian et al., 2021) due to technological advances; as a result, the COVID-19 ERT was heavily situated in a technology-rich context. As the

pandemic has affected millions of students worldwide for a long period of time, we witnessed a dramatic surge of studies of ERT since the early COVID-19 days, and many literature reviews have already been summoned. Therefore, we will focus on factors that were found to be most prominent in ERT during COVID-19 days, beyond demographics.

A first set of relevant factors relates to teaching practices in times of emergency, mostly in a technology-driven manner. In that sense, technological competencies, and specifically experience of teaching with technology become crucial (An et al., 2021; Marshall et al., 2020; Winter et al., 2021). It was also shown that school leadership may have played an important role in the way in which teachers faced the situation (Collie, 2021; Nong et al., 2022).

A second set of relevant factors is directly linked to working conditions in times of pandemics. Many teachers—like other people in the workforce—were challenged to work from their home environment, in order to keep social distancing, and to keep supporting their students not only academically but also emotionally. As has been demonstrated, working under these conditions often hindered teachers' ability to support their students emotionally, which may have negatively affected their students (Crawford et al., 2022; Gałązka & Jarosz, 2022; Hadar et al., 2020); importantly, negative emotional responses of teachers were often a result of health-related concerns of their own or of their loved ones, including, e.g.,, lack of access to personal protective equipment, or exposure to infected pupils, parents or colleagues (Nabe-Nielsen et al., 2021). To these, we add the obvious difficulties that were a result of working from home, namely physical space, technology infrastructure, and responsibility for family members (Clark et al., 2021; Marshall et al., 2020).

2.2 Sense of success in emergency remote teaching

Effective integration of technology into teaching, particularly incorporating online components, requires thorough design and planning (Hodges et al., 2020). However, in times of emergency—as were experienced during the recent COVID-19 pandemic outbreak—a shift to online learning is often done hastily, hence without proper preparation. The term emergency remote teaching (ERT) refers to such situations, in which transition is sudden, and also accompanied by health- and safety-related concerns of both learners and teachers.

During the COVID-19 outbreak, education systems around the world aimed at ensuring students' continuous learning despite the shift from in-person to a massive online remote teaching and learning (Trust & Whalen, 2020; Xie et al., 2021). That is, teachers whose entire pedagogical training was constructed in the context of face-to-face settings, met the reality of teaching online without the necessary skills (Marshall et al., 2020). Teachers were busy rebuilding the curriculum, considering what students needed to learn and why, how to organize teaching, learning and evaluating processes, considering existing curriculum requirements and available resources. Teachers had to fast-track lesson planning for their virtual classrooms: they needed to immediately figure out how to adapt their classroom-based practices into ERT and devise ways to integrate technology with their teaching to maintain students' learning (Arcueno et al., 2021). Some teachers had to adjust the ways they use technology

in classroom instruction, revise student evaluation and assessment, and modify their instructional strategies to address emerging student needs (Arcueno et al., 2021). All of these may have profoundly affected teachers' sense of success. Sense of success among teachers is important for their well-being, professional development, and career choice (Johnson & Birkeland, 2003), which in turn affects student success (Darling-Hammond, 2000; Konstantopoulos, 2006).

Sense of success among teachers—that is, teachers' perceptions of how successful they are in teaching—is a multidimensional construct that has to do with factors such as administrative, professional, and collegial support; classroom climate; workload; and career development (Ávalos et al., 2021; Corbell et al., 2008). Therefore, due to the dramatic impact of the pandemic on various aspects of schooling at large, it is of no surprise that during COVID-19 ERT teachers' sense of success declined, as evident in a large-scale study of US teachers (Kraft et al., 2021). Only some studies were conducted regarding factors that affected teachers' sense of success during COVID-19, and the existing findings from the K-12 schools in the US, Israel, and Japan highlight the important role of technological competency and support from school community (Kraft et al., 2021; Masry-Herzalah & Dor-Haim, 2022; Natalio Que, 2021). Even this short list highlights the uniqueness of integrating technology in ERT, as those factors stand in contrast to findings related to teaching in times of routine. In routine times, successful technology integration was perceived to be most heavily affected by intrinsic factors, such as confidence, commitment, and attitudes (Drossel et al., 2017b; Ertmer et al., 2006; Ottenbreit-Leftwich et al., 2015). In this study, we focus on teacher-related variables.

2.3 Self-efficacy for integrating technology in teaching

The term self-efficacy refers to an individual's beliefs about their capabilities to execute behaviors that exercise influence over events that affect their lives (Bandura, 1994). This subjectively measured construct relates to three steps of achieving a goal: wishing to achieve a certain goal, believing that certain behaviors would lead to the achievement of that goal, and perceiving these behaviors as doable; in a sense, self-efficacy is about personal control and agency in a specific context, hence its most powerful source is performance experience (Maddux & Gosselin, 2013). In the context of technology and teaching, it has been repeatedly shown that self-efficacy beliefs play a key role in teachers' technology integration preparedness, intended use, and actual use (Albion, 1999; Joo et al., 2018; Lailiyah & Cahyono, 2017; Teo, 2009; Tzafilkou et al., 2021; van Acker et al., 2013; Wijnen et al., 2021). Therefore, it is of great importance that teachers' self-efficacy for technology integration could be increased (Kobayashi, 2007; Scholarworks et al., 2019; Wang et al., 2004).

Various variables have been studied with regards to teachers' self-efficacy about technology integration, with the most common ones relate to demographics and experience, as a recent literature review suggests (Corry & Stella, 2018). Gender has shown mixed results, with some evidence suggesting for the advantage of men over women and of younger over older teachers (e.g., Šabić et al., 2022a), and some indicating no such associations (Şen & Yildiz Durak, 2022; e.g., Tweed, 2013). Experience-related variables have also shown mixed results; for example, experience of

teaching with technology was sometimes found to be positively associated with self-efficacy (e.g., Baroudi & Shaya, 2022; Dolighan & Owen, 2021) and sometimes no associations were found (e.g., Tweed, 2013).

However, when facing a sudden shift to an extensive use of technology—like in the context of the recent COVID-19 pandemic outbreak—self-efficacy for integrating technology in teaching may take a unique form. Successful implementation of technology in such settings may lead to a meaningful increase in self-efficacy; on the other hand, failing may lead individuals to blame the technology—and, consequently, may lead to a decrease in their self-efficacy—rather than search for faults in the circumstances which also had implications on students' preparedness towards learning with technology. Indeed, in the context of COVID-19 ERT, it was found that teachers' general self-efficacy—referring to, e.g., students' engagement, classroom management, and instructional strategies—overall decreased (Billett et al., 2022; Cataudella et al., 2021; Pressley & Ha, 2021; Yenen & Çarkit, 2021). However self-efficacy for online teaching was high following the COVID-19 experience. The latter particularly held true for teachers who had previous experience in online teaching, as well as for those who received professional and administrational support (Baroudi & Shaya, 2022; Dolighan & Owen, 2021; Ma et al., 2021). Furthermore, higher levels of online teaching satisfaction were associated with higher levels of online teaching self-efficacy (McInerney & Pritchard, 2021).

3 Methods

3.1 Population

This study was conducted in Israel, where the education system is mostly public, centralized and is typically divided into three school levels: elementary schools (1st -6th grades), middle schools (7th -9th grades), and high schools (10th -12th grades). The school year in Israel begins on September 1st, and ends at the end of June. As in most of the world, the COVID-19 pandemic outbreak has dramatically impacted the education system in Israel, with most schools operating remotely for a period of a few months; middle schools were the ones in which remote teaching was held for the longest time, which is our reason for focusing on them. Our data collection was held a few weeks after most of middle schools had re-opened and teachers and students returned to the physical buildings. Notably, during our data collection, schools across the country had to close again for a few days to a regional military conflict.

The current study included N = 735 teachers from 68 middle schools across Israel. As it is common in Israel to teach in both middle- and high-schools, our inclusion criteria included that at least 50% of the teaching hours were done in middle school grades. In order to survey teachers who had experienced the transition from traditional teaching to emergency remote teaching, another inclusion criteria was teaching during both the 2020/21 school year (when data was collected) and the prior year (i.e., before COVID-19 days).

3.2 Data collection

Data collection was carried out between March and July 2021, starting soon after middle schools re-opened, and ending a few weeks after the beginning of the annual summer vacation. After obtaining approvals from the Israeli Ministry of Education and Tel Aviv University's Ethics Committee, we recruited teachers via the schools they worked in. Schools were recruited using the research team's professional and personal networks, and links to the online questionnaire (in Qualtrics) were then sent via each school's mailing list or WhatsApp group. To increase participation and responses, we directly contacted individual stuff members from each school and asked them to support our data collection. To encourage schools and teachers to participate, we held a raffle, and one participant from each school in which over 10 teachers participated was awarded with a 100 NIS (~30 USD) gift card to a large bookstore chain.

3.3 Variables and instruments

3.3.1 Dependent variables

Perception of Success in Teaching in ERT. This variable measured participants retrospective sense of success in teaching during COVID-19 times, as perceived shortly after the return to face-to-face teaching. We developed a scale comprised of three items, in which the participants self-reported on their experience of teaching in ERT. The items used the same anchor: "During the current school year, I…", and referred to the extent to which participants "successfully transformed from face-to-face to remote teaching", "used technology in the best possible way while remote teaching", and "felt that my remote teaching was successful". Items were ranked on a 5-point Likert scale (from 1 - "Almost Not at All" to 5 – "Almost Always").

Testing for normality, we found that skewness value is -0.51, and kurtosis value is 0.14; considering our population size, these values are enough to determine approximate normality (Kim, 2013). To determine the construct validity of the instrument, we conducted principal component analysis—which resulted in a single factor over eigenvalue of 1, explaining 82.05% of the variance; loadings range was between 0.90 and 0.92. We then ran a reliability test—choosing McDonald's omega, which was suggested as a better alternative to Cronbahc's Alpha (Hayes & Coutts, 2020)—and got a very satisfying resulted of $\omega = 0.89$.

Self-Efficacy Beliefs about Integrating Technology. This variable measured teachers' beliefs in their ability to teach in ERT. We used Wang, Ertmer and Newby's(2004) conceptualization of technology integration as a way to support students' construction of their own knowledge through the completion of authentic, meaningful tasks. Wang, Ertmer, and Newby's unidimensional questionnaire includes 21 items that measure, using a 5-point Likert scale, computer technology capabilities and strategies. We slightly adapted the scale to better reflect today's terms and technology uses., and translated it to Hebrew and Arabic. Sample items include "I feel confident that I understand capabilities of technology [originally 'computer capabilities] well enough to maximize it in my classroom", "I feel confident in my ability to

evaluate technologies [originally 'software'] for teaching and learning.", and "I feel confident about assigning and grading technology-based projects". The full questionnaire is presented in Table 1.

Testing for normality, we found that skewness value is -0.44, and kurtosis value is 0.34; considering our population size, these values are enough to determine approximate normality (Kim, 2013). Since this is an adapted version of a validated tool, we used Confirmatory Factor Analysis for a single-factor model. The resulting model (df=189) had a chi-square value of 1634.29, at $p<0.001$, .i.e., $\frac{2}{df} = 8.65$. We also calculated other fit measures, and got: CFI=0.91, TLI=0.90, and SRMR=0.04. As recommended by Perry et al. (Perry et al., 2015), we additionally conducted Principal Component Analysis—which resulted in a single factor over eigenvalue of 1, explaining 71.78% of the variance; loadings range was between 0.79 and 0.89. We then ran a reliability test, and got a very satisfying result of $\omega=0.98$.

3.3.2 Independent variables

Based on the relevant literature—as described in the Literature Review section—we identified a few teacher characteristics that could be related to *Self-Efficacy for Integrating Technology in Teaching* and to *Success in Teaching in ERT*. Hence, we measured variables in a few categories, as described below. Descriptive statistics for these variables are reported in the Research Population section.

Demographic variables. Participants were asked to report on their *Gender [Men, Women]*, *Age* (by reporting on birth year), and *Mother Tongue [Hebrew, Arabic, Other]*. Our participants included 599 females and 136 males (81% and 19%, accordingly), ranging in age between 21 and 69 years of age (M=44, SD=8.7, N=735). These characteristics are largely aligned with the demographics of the Israeli teaching staff (Central Bureau of Statistics, 2020). Note that we assume normality for the age variable, as tests for skewness and kurtosis resulted with satisfyingly low values of 0.10 and −0.31, respectively. Of the participants, 59% (437 of 735) reported that their *Mother Tongue* was Hebrew, 33% reported on Arabic (246 of 735), other languages were reported to relatively low degrees, hence we grouped them as "Other" (52 of 735, 7%); these ratios are slightly biased towards the Arab-speaking population, as teachers in the Arabic sector in Israel are about 22% of the overall teaching force at secondary education (Central Bureau of Statistics, 2021).

Teaching-related variables. We measured a few variables that helped us distinguish between teachers based on their professional characteristics. Specifically, we measured the following: *Teaching Experience [years]*; *Experience in Teaching with Technology [5-point Likert scale]*; *Leading Role at School [yes/no for each of the following: grade coordinator, domain coordinator, ICT coordinator, counselor, vice principal, principal]* – while processing the data, we aggregated this into a binary variable of managing position [yes/no]; *Teaching Domain [Mathematics; Science; Technology; Language (mother tongue or second language); Humanities; Social Sciences; Arts; Physical Education; Other]* – these values were chosen based on the way the Israeli curriculum is built, however while processing the data, and based on the responses, we defined only three categories: STEM (Science, Technology, Engi-

Table 1 *Self-efficacy beliefs about integrating technology - original* (Wang et al., 2004) *and adapted versions*

Question number	Original	Adapted
1	I feel confident that I understand computer capabilities well enough to maximize them in my classroom	I feel confident that I understand capabilities of technology well enough to maximize it in my classroom
2	I feel confident that I have the skills necessary to use the computer for instruction	I feel confident that I have the skills necessary to use technology for instruction
3	I feel confident that I can successfully teach relevant subject content with appropriate use of technology	I feel confident that I can successfully teach relevant subject content with appropriate use of technology
4	I feel confident in my ability to evaluate software for teaching and learning	I feel confident in my ability to evaluate technologies for teaching and learning
5	I feel confident that I can use correct computer terminology when directing students' computer use	I feel confident that I can use correct terminology when directing students' technology use
6	I feel confident I can help students when they have difficulty with the computer	I feel confident I can help students when they have technological difficulty
7	I feel confident I can effectively monitor students' computer use for project development in my classroom	I feel confident I can effectively monitor students' use of technology for project development in my classroom
8	I feel confident that I can motivate my students to participate in technology-based projects	I feel confident that I can motivate my students to participate in technology-based projects
9	I feel confident I can mentor students in appropriate uses of technology	I feel confident I can mentor students in appropriate uses of technology
10	I feel confident I can consistently use educational technology in effective ways	I feel confident I can consistently use educational technology in effective ways
11	I feel confident I can provide individual feedback to students during technology use	I feel confident I can provide individual feedback to students as they use technology
12	I feel confident I can regularly incorporate technology into my lessons, when appropriate to student learning	I feel confident I can regularly incorporate technology into my lessons, when appropriate to student learning
13	I feel confident about selecting appropriate technology for instruction based on curriculum standards	I feel confident about selecting appropriate technology for instruction based on the curriculum
14	I feel confident about assigning and grading technology-based projects	I feel confident about assigning and grading technology-based projects
15	I feel confident about keeping curricular goals and technology uses in mind when selecting an ideal way to assess student learning	I feel confident about keeping curricular goals and technology uses in mind when selecting an ideal way to assess student learning
16	I feel confident about using technology resources (such as spreadsheets, electronic portfolios, etc.) to collect and analyze data fron student tests and products to improve instructional practices	I feel confident about using technology to collect and analyze data from student tests and tasks to improve instructional practices
17	I feel confident that I will be comfortable using technology in my teaching	I feel confident that I will be comfortable using technology in my teaching
18	I feel confident I can be responsive to students' needs during computer use	I feel confident I can be responsive to students' needs during use of technology

Table 1 (continued)

Question number	Original	Adapted
19	I feel confident that, as time goes by, my ability to address my students' technology needs will continue to improve	I feel confident that, as time goes by, my ability to address my students' technology needs will continue to improve
20	I feel confident that I can develop creative ways to cope with system constraints (such as budget cuts on technology facilities) and continue to teach effectively with technology	I feel confident that I can develop creative ways to cope with system constraints (such as budget cuts or technology facilities) and continue to teach effectively with technology
21	I feel confident that I can carry out technology based projects even when I am opposed by skeptical colleagues	I feel confident that I can carry out technology based projects even when I am opposed by skeptical colleagues

neering, and Mathematics), Humanities and Social Sciences, and Language (either mother tongue of second language).

Our participants had an average *Teaching Experience* of 14.7 years (SD = 8.9, N = 735), with an average index of *Experience of Teaching with Technology* of 3.4 of 5 (SD = 1.1, N = 735). Note that we assume normality for these two variables; tests for skewness and kurtosis for *Teaching Experience* resulted with satisfyingly low values of 0.67 and −0.34, respectively, and for *Experience of Teaching with Technology* they were −0.10 and −0.61, respectively. Of the participants, 32% (238 of 735) had a leading role at school, being part of the management team. Regarding their *Teaching Domains*, we had similar ratios of teachers teaching STEM (33%, 241 of 735), Language (either mother tongue or second language, 30%, 224 of 735), and Social Sciences or Humanities (37%, 270 of 735).

COVID-19-related variables. Finally, we measured a few variables that were unique to the COVID-19 pandemic outbreak. The variable *Risk Group [Yes/No]* indicates whether the participant or one of their household members were defined as being in a risk group for a severe illness from COVID-19; this group includes, among others, pregnant women, people over 60 years old, those who have a background of critical medical condition, and people who live in nursing homes. Additionally, we surveyed for four factors that were perceived as challenging working from home during the COVID-19 pandemic, each of which was ranked on a 3-point Likert scale: *Physical Space Difficulties, Technology Difficulties* (infrastructure-wise), *Familial Difficulties*, and *Emotional Difficulties*.

Of our participants, 24% (177 of 735) were in a *Risk Group for COVID-19*. Regarding the factors that influenced their working from home, *Familial Difficulties* where the most common (M = 1.96, SD = 0.75, N = 714), followed by *Emotional Difficulties* (M = 1.73, SD = 0.68, N = 708), *Physical Space Difficulties* (M = 1.633, SD = 0.73, N = 728), and finally *Technology Difficulties* (M = 1.627, SD = 0.73, N = 724).

3.4 Analysis

While testing for associations between the dependent variables (RQ1), we used correlational analysis. When testing for relations between the dependent and the inde-

pendent variables (RQ2, RQ3), we used t-test (with Cohen's d for effect size in cases of significant difference), two-tailed one way ANOVA (with η^2 for effect size in cases of significant difference), and correlational analysis, as appropriate by the independent variable type. Correlations between the dependent variables and the difficulties-related independent variables, which were ranked on a 3-point Likert scale, were tested using Spearman's ρ, while correlations with the other independent variables were tested using Pearson's r. Normality test was done using skewness and kurtosis; these measures are preferred over Shapiro-Wilk and Kolmogorov-Smirnov tests for large samples (≥300) in which case the tests become unreliable. Considering our population size, it is enough to examine the absolute values of skewness and kurtosis, and there is no need to calculate Z-scores (Kim, 2013). Analyses were conducted using Jasp 0.16.

To attain a nuanced understanding of the relationship between the dependent and the independent variables in a way that is easy to interpret (RQ2, RQ3), we used decision trees. A decision tree is a common prediction procedure where the target variable is predicted by the independent variables (Quinlan, 1986; Witten et al., 2017). In recent years, decision trees have been extensively used in education research (Baker & Siemens, 2014; Peña-Ayala, 2014; Romero & Ventura, 2017). We built two decision trees, using RapidMiner Studio Version 9.10, each predicting one of the two dependent variables, i.e., *Self-Efficacy about Integrating Technology* and *Perception of Success in ERT*. Predicting numerical values, the Decision Tree block in RapidMiner uses least square criterion for splitting. That is, the algorithm chooses the variable for splitting that minimizes the squared distance between the average of values in the node and the true target value. We used pre-pruning as a method for decreasing overfitting of the model; doing so, we can control the tree structure using a few hyperparameters that overall prevent splitting. The available hyperparameters in RapidMiner are the following: maximal depth of the tree, minimal gain for a split, minimal leaf size, minimal node size for split, and number of alternatives upon preventing splitting due to other hyperparameters (RapidMiner, 2022). By tuning such hyperparameters, which have a direct effect on the tree structure, we improve its readability and interpretability, without meaningfully harming its predictive accuracy (Esposito et al., 1997; Mantovani et al., 2016). It was shown that minimal leaf size, minimal node size for split, and tree depth are the hyperparameters to which the model performance is most sensitive (Bahmani et al., 2021; Mantovani et al., 2019; Probst et al., 2018), hence we decided to control them.

To have leaves of a meaningful size that would allow for further statistical analysis, we set the minimal leaf size to 50, and following that, we set the minimal node size for split to twice that number. Additionally, for having a tree that is easy to interpret, we set the maximum depth to 5. For calculating model accuracy, we tested the correlation between the predicted and the actual values, and for being able to measure the level of the model generalizability, we use 10-fold cross-validation (Hawkins et al., 2003; Zhang, 1993). In 10-fold cross-validation, the data is first partitioned into 10 nearly equally sized folds. Then, in each of the 10 iterations, a different fold is held-out for validation and the model is built on the remaining 9 folds. The overall adjustment reliability of the model is the average of the adjustment reliability of the 10 models built and tested during this process.

4 Findings

4.1 Associations between sense of success and self-efficacy (RQ1)

Overall, our participants reported on relatively high values of the two dependent variables. Mean value for *Perception of Success* was 3.73 (SD = 0.81, N = 729), and mean value for *Self-Efficacy for Integrating Technology in Teaching* was 3.57 (SD = 0.57, N = 667). These two variables are strongly positively correlated, with r = 0.75, at $p < 0.001$ (N = 667). However, they are not identical, as dependent sample t-test indicates that *Perception of Success* was statistically significantly higher than *Self-Efficacy*, with t(666) = 7.2, at $p < 0.001$. Hence the importance of using both variables.

4.2 Sense of success in teaching with technology in ERT (RQ2)

We first present relations between *Perception of Success in Teaching in ERT* and each of the demographics, teaching-related, and COID-19-related variables; findings are summarized in Table 2. Then, we present a multivariable decision tree analysis.

4.2.1 Demographics

Gender. We found that *Perception of Success in ERT* was marginally significantly higher for males than for females, with t(727) = 1.77, at p = 0.078, and a low effect size of d = 0.17.

Age. There was no significant association between age and *Perception of Success in ERT*, with r = 0.03, at p = 0.476.

Mother Tongue. Overall, there was a significant difference in Perception of Success in ERT, when compared by mother tongue, with F(2) = 7.19, at $p < 0.001$, with a small effect size of $\eta^2 = 0.02$; the mean for Arabic native speakers was the highest, followed by Hebrew native speakers, and finally the Other group got the lowest mean. Because Levene's test for equality of variances came out significant, with F(2,726) = 6.48, at $p < 0.01$, we did not assume equal variances, therefore used Games-Howell post-hoc test, which fits to the case where group sizes are not equal. This comparison revealed that the differences between the Arabic speakers and the other two groups were significant, while the difference between the Hebrew and the Other groups was not.

4.2.2 Teaching-related variables

Teaching Experience. There was a negligible positive correlation between teaching experience and *Perception of Success in ERT*, with r = 0.09, at $p < 0.05$.

Experience of Teaching with Technology. There was a significant positive correlation between experience of teaching with technology and *Perception of Success in ERT*, with r = 0.42, at $p < 0.001$.

Leading Role at School. We found that participants who had a role in the school's management team scored significantly higher on *Perception of Success in ERT*, com-

Table 2 Relations between sense of success and the indepndent variables

Independent Variable	*Mean* (*SD*)	Test Statistic
Demographics		
Gender	Males ($N=133$), $M=3.85$ (0.78) Females ($N=596$), $M=3.71$ (0.78)	$t(727)=1.77$, 0.078, $d=0.17$
Age		$r=0.03$, $p=0.476$
Mother Tongue	Hebrew ($N=436$), $M=3.67$ (0.81) Arabic ($N=241$), $M=3.89$ (0.75) Other (N=52), $M=3.53$ (0.99)	$F(2)=7.19^{***}$, $\eta^2=0.02$
Teaching-Related		
Teaching Experience		$r=0.09^{*}$
Experience of Teaching with Technology		$\rho=0.71^{***}$
Leading Role at School	Yes ($N=235$), $M=3.96$ (0.78) No ($N=494$), $M=3.63$ (0.80)	$t(727)=5.26^{***}$, $d=0.42$
Teaching Domain	STEM ($N=238$), $M=3.93$ (0.65) Language ($N=223$), $M=3.82$ (0.65) Social/Humanities ($N=268$), $M=3.49$ (0.89)	$(2)=21.12^{***}$, $\eta^2=0.06$
COVID-19-Related		
Risk Group for COVID-19	Yes ($N=176$), $M=3.66$ (0.87) No ($N=553$), $M=3.76$ (0.79)	$t(727)=0.19$, $p=0.19$
Familial Difficulties		$\rho=-0.25^{***}$
Emotional Difficulties		$\rho=-0.32^{***}$
Physical Space Difficulties		$\rho=-0.003$, $p=0.93$
Technology Difficulties		$\rho=0.06$, $p=0.12$

Note. * $p\leq0.05$; ** $p\leq0.01$; *** $p\leq0.001$

pared to those who were not part of that team, with $t(727)=5.26$, at $p<0.001$, and an effect size of $d=0.42$.

Teaching Domain. We found that overall, there was a significant difference in *Perception of Success in ERT* when compared by teaching domain, with $F(2)=21.12$ at $p<0.001$, and a medium effect size of $\eta^2=0.06$. The mean for STEM teachers was the highest, followed by Language teachers—however not significantly—and finally, the Social/Humanities teachers got the lowest mean, which was significantly different from the other groups'. Here too, Levene's test for equality of variances came out significant, with $F(2,726)=16.84$, at $p<0.001$, hence we used Games-Howell post-hoc test, which fits to the case where group sizes are not equal.

4.2.3 COVID-related variables

Risk Group for COVID-19. We found no significant difference in *Perception of Success in ERT* between teachers who was in a risk group for COVID-19 and those who were not, with $t(727)=1.31$, at $p=0.191$.

Familial Difficulties. We found negative correlations between experiencing familial difficulties and *Perception of Success in ERT*, with Spearman's $\rho=-0.25$, at $p<0.001$. That is, the more familial difficulties the teachers experienced, the less success they felt.

Emotional Difficulties. We found a negative correlation between experiencing emotional difficulties and *Perception of Success in ERT*, with $\rho=-0.31$, at $p<0.001$. That is, the more emotional difficulties the teachers experienced, the less success they felt.

Physical Space Difficulties. There was no significant correlation between experiencing physical space difficulties and *Perception of Success in ERT*, with $\rho=-0.003$, at $p=0.93$.

Technology Difficulties. There was no significant correlation between experiencing technology space difficulties and *Perception of Success in ERT*, with $\rho=0.06$, at $p=0.12$.

4.2.4 Decision tree model

The resulting model for *Perception of Success in ERT* is presented in Fig. 1, and has a 10-fold cross validated correlation of 0.54. In this model, *Experience with Technology* is the first splitting variable. Looking at the predicted values on the left sub-tree,

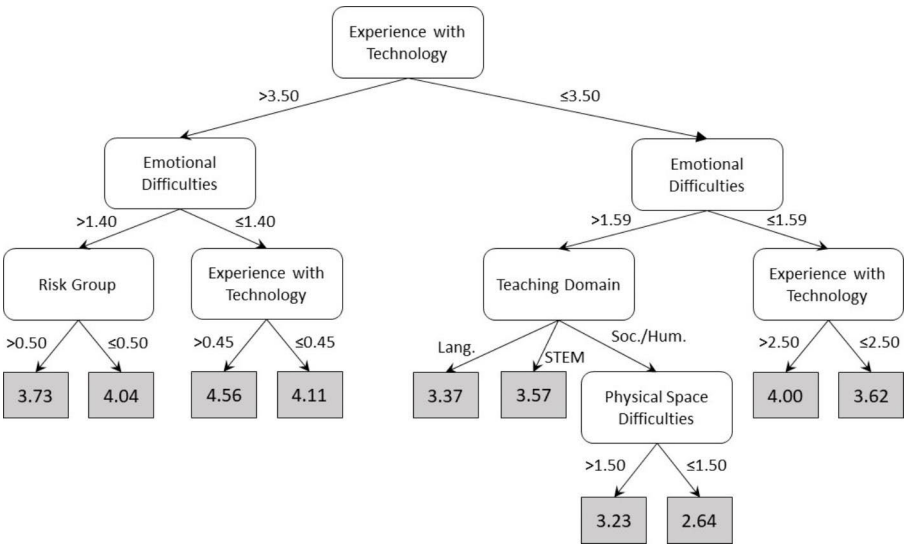

Fig. 1 Decision tree for predicting Perception of Success in ERT

compared with those on the right sub-tree, we observe that overall teachers with a relatively high experience in teaching with technology (4 or 5 on a 5-point Likert scale) are predicted to have higher values of *Perception of Success in ERT* than the others; the only exception on the right sub-tree is the leaf representing teachers with lowest levels of *Emotional Difficulties* (1 on a 3-point Likert scale) and medium experience with technology in teaching (a value of 3); these teachers are predicted to have the highest self-efficacy values in the right sub-tree, which is in the range of the predicted values on the left sub-tree.

The second variable chosen for splitting the case of relatively low experience with technology (i.e., the right sub-tree), is *Emotional Difficulties*. There are some interesting interactions between this variable and others, which help distinguishing between teachers who reported on experiencing affect-related difficulties during the COVID-19 (medium or high degree) to those who reported on a low degree of such difficulties. For those who suffered relatively high affect-related difficulties, Language and STEM teachers are predicted to have higher values of *Perception of Success in ERT* compared with the Social Sciences and Humanities teachers; for Social Sciences/Humanities teachers, *Physical Space Difficulties* is negatively associated with the dependent variables, i.e., the less such difficulties were reported – the higher the value of *Perception of Success in ERT*.

The second variable chosen for splitting on the left sub-tree—which represents teachers with relatively high experience in teaching with technology—is *Emotional Difficulties*. Overall, teachers who experienced some affect-related difficulties are predicted to have lower values of perception of success than those who barely experienced such difficulties. Notably, for teachers who reported some affect-related difficulties, perception of success was negatively associated with being in an increased risk for severe illness from COVID-19, and for teachers with very little affect-related difficulties, perception of success was positively associated with very high experience in teaching with technology. That is, in the left sub-tree, the lowest value of perception of success is predicted for teachers with affect-related difficulties that are in a risk group for COVID-19, and the highest value of perception of success is predicted for teachers with little or no affect-related difficulties who are very highly experienced in teaching with technology.

4.3 Self-efficacy for integrating technology in teaching (RQ3)

We present relations between *Self-Efficacy for Integrating Technology in Teaching* and each of the demographics, teaching-related, and COID-19-related variables; findings are summarized in Table 3. Then, we present a multivariable decision tree analysis.

4.3.1 Demographics

Gender. Self-Efficacy Beliefs about Integrating Technology was significantly higher for male teachers than for female teachers, with $t(665)=2.66$, at $p<0.01$, and a low effect size of $d=0.26$.

Table 3 Relations between self-efficacy and the indepndent variables

Independent Variable	*Mean* (*SD*)	*Test Statistic*
Demographics		
Gender	Males ($N=130$), $M=3.73$ (0.69) Females ($N=537$), $M=3.53$ (0.80)	$t(665)=2.66^{**}$, d=0.26
Age		$r=0.08^{*}$
Mother Tongue	Hebrew ($N=402$), $M=3.48$ (0.79) Arabic ($N=215$), $M=3.78$ (0.67) Other ($N=50$), $M=3.41$ (1.05)	$F(2)=12.37^{***}$, $\eta^2=0.04$
Teaching-Related		
Teaching Experience		r=-0.002, p=0.95
Experience of Teaching with Technology		$\rho=0.42^{***}$
Leading Role at School	Yes ($N=212$), $M=3.79$ (0.75) No ($N=455$), $M=3.47$ (0.78)	$t(665)=5.11^{***}$, $d=0.43$
Teaching Domain	STEM ($N=217$), $M=3.79$ (0.61) Language ($N=208$), $M=3.64$ (0.81) Social/Humanities ($N=242$), $M=3.32$ (0.83)	$F(2)=23.49^{***}$, $\eta^2=0.07$
COVID-19-Related		
Risk Group for COVID-19	Yes ($N=167$), $M=3.52$ (0.79) No ($N=500$), $M=3.59$ (0.78)	$t(665)=0.91$, $p=0.36$
Familial Difficulties		$\rho=-0.21^{***}$
Emotional Difficulties		$\rho=-0.26^{***}$
Physical Space Difficulties		ρ=-0.02, $p=0.68$
Technology Difficulties		ρ=0.007, $p=0.86$

Note. * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$

Age. There was a negligible positive correlation between age and Self-Efficacy Beliefs about Integrating Technology, with r=0.08, at p<0.05.

Mother Tongue. Overall, there was a significant difference in *Self-Efficacy Beliefs about Integrating Technology*, when compared by mother tongue, with, with F(2)=12.37, at p<0.001, with a small-medium effect size of $\eta^2=0.04$; the mean for Arabic native speakers was the highest, followed by Hebrew native speakers, and finally the Other group got the lowest mean of. Here too, Levene's test for equality of variances came out significant, with F(2,664)=8.94, at p<0.001, hence we used Games-Howell post-hoc test, which fits to the case where group sizes are not equal. This revealed that the differences between the Arabic speakers and the other

two groups were significant, while the difference between the Hebrew and the Other groups was not.

4.3.2 Teaching-related variables

Teaching Experience. There was no significant correlation between teaching experience and *Self-Efficacy Beliefs about Integrating Technology*, with r=-0.002, at p=0.95.

Experience of Teaching with Technology. There was a significant positive correlation between experience of teaching with technology and *Self-Efficacy Beliefs about Integrating Technology*, with r=0.52, at p<0.001.

Leading Role at School. Those participants who had a role in the school's management team scored significantly higher on *Self-Efficacy Beliefs about Integrating Technology*, compared to those who were not part of that team, with t(665)=5.11, at p<0.001; this denotes an effect size of d=0.43.

Teaching Domain. We found that overall, there was a significant difference in *Self-Efficacy Beliefs about Integrating Technology*, with F(2)=23.45, at p<0.001, with a medium effect size of $\eta^2=0.07$. The mean for STEM teachers was the highest, followed by Language teachers—however not significantly—and finally, the Social/Humanities teachers got the lowest mean, which was significantly different from the other groups'. Here too, Levene's test for equality of variances came out significant, with F(2,726)=16.84, at p<0.001, hence we used Games-Howell post-hoc test, which fits to the case where group sizes are not equal.

4.3.3 COVID-related variables

Risk Group for COVID-19. We found no significant difference in *Self-Efficacy Beliefs about Integrating Technology*, where the average for teachers who were in a risk group was not significantly different of those who were not in a risk group, with t(665)=0.91, at p=0.36.

Familial Difficulties. We found negative correlations between experiencing familial difficulties and *Self-Efficacy Beliefs about Integrating Technology*, with ρ=-0.21, at p<0.001. That is, the more familial difficulties the teachers experienced, the less self-efficacy they felt.

Emotional Difficulties. We found a negative correlation between experiencing emotional difficulties and *Self-Efficacy Beliefs about Integrating Technology*, with ρ=-0.26, at p<0.00. That is, the more emotional difficulties the teachers experienced, the less self-efficacy they felt.

Physical Space Difficulties. There was no significant correlations between experiencing physical space difficulties and *Self-Efficacy Beliefs about Integrating Technology*, with ρ=-0.02, at p=0.68.

Technology Difficulties. There was no significant correlation between experiencing technology space difficulties and *Self-Efficacy Beliefs about Integrating Technology*, with ρ=0.01, at p=0.86.

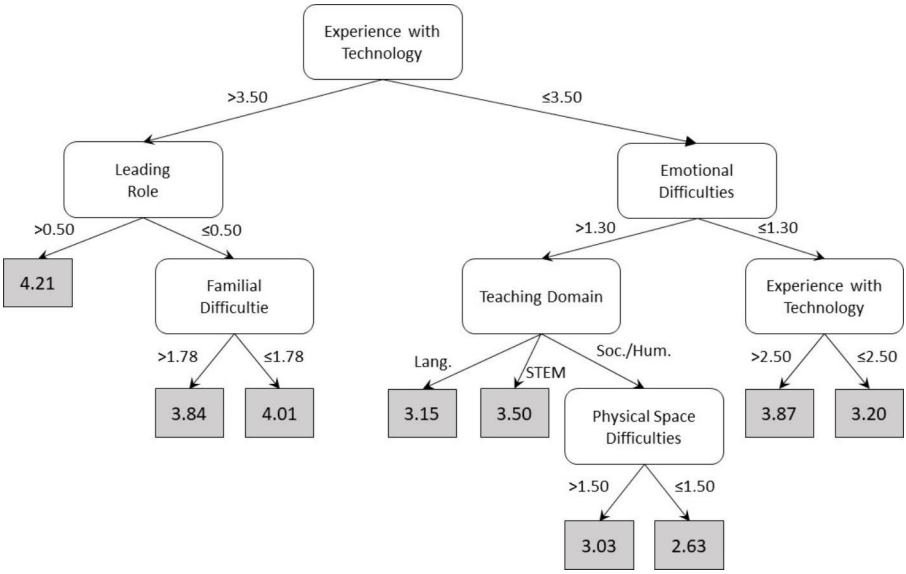

Fig. 2 Decision tree for predicting Self-Efficacy for Integrating Technology in Teaching

4.3.4 RelationsDecision tree model

The resulting model for *Self-Efficacy Beliefs about Integrating Technology* is presented in Fig. 2, and has a 10-fold cross validated correlation of 0.57. In this model too, like in the case of *Perceptions of Success in Teaching in ERT*, *Experience with Technology* is the first splitting variable. Moreover, the structure of this model generally agrees with the structure of the previously described model. Here too, we teachers with a relatively high experience in teaching with technology (left sub-tree, with 4 or 5 on a 5-point Likert scale) are predicted to have higher values of *Self-Efficacy Beliefs about Integrating Technology* than the others; again, the only exception on the right sub-tree is the leaf representing teachers with lowest levels of *Emotional Difficulties* (1 on a 3-point Likert scale) and medium experience with technology in teaching (a value of 3), who are predicted to have the highest self-efficacy values in the right sub-tree, and within the range of the predicted values on the left sub-tree.

Continuing the similarity with the previous model is the structure of the right sub-tree, which holds those teachers who had relatively low experience with technology. Here, the variable first chosen for splitting is *Emotional Difficulties*, and in this sub-tree there are some interesting interactions between it and other variables. Specifically, there is a difference between teachers who reported on experiencing affect-related difficulties during the COVID-19 (medium or high degree) to those who reported on a low degree of such difficulties. For those who suffered relatively high affect-related difficulties, Language and STEM teachers are predicted to have higher values of *Perception of Success in ERT* compared with the Social Sciences and Humanities teachers; for Social Sciences/Humanities teachers, *Physical Space Difficulties* is negatively associated with the dependent variables, i.e., the less such

difficulties were reported – the higher the value of *Self-Efficacy Beliefs about Integrating Technology*.

The second variable chosen for splitting on the left sub-tree—which represents teachers with relatively high experience in teaching with technology—is *Leading Role at School*. Teachers who are part of the school management team are predicted to have the highest value of self-efficacy, and for those who do not hold a management role, those who experienced some family-related difficulties are predicted to have lower levels of self-efficacy than those who barely experienced such difficulties.

4.4 Summary of findings

We found that both *Perception of Success in Teaching in ERT* and *Self-Efficacy for Integrating Technology in Teaching* were medium-high, and the former was significantly higher than the latter.

Looking at associations between the dependent variables and each of the independent variables separately, we found that both variables took higher values for:

- Men, compared with women;
- Arabic native speakers, compared with Hebrew native speakers;
- Members of the school's management team, compared with non-members;
- STEM/Language teachers, compared with Humanities/Social Sciences teachers.

We found positive correlations of both variables with experience of teaching with technology; and negative correlations with familial difficulties, emotional difficulties. No meaningful associations were found with age, teaching experience, COVID-19 risk, physical space difficulties, technology difficulties.

Looking at more nuanced relations between the dependent variables and the independent variable, we further highlight the key role of experience with technology (positive impact) and of emotional difficulties (negative impact). We also place focus on the advantage of STEM or language teachers over Humanities/Social Sciences teachers. We also found that emotional difficulties and COVID-19 risk were mostly harmful for Perception of Success in ERT; and that having a leading role in school may compensate for familial difficulties in the case of Self-Efficacy for Integrating Technology in Teaching.

5 Discussion

In this quantitative study (N = 735), we investigated the associations between teacher characteristics and their self-efficacy for teaching with technology and sense of success following the experience of teaching during COVID-19 pandemic outbreak. That time of emergency remote teaching (ERT) was characterized by distance teaching and by a massive use of technology in the interest of online learning, hence it is unique compared with our participants' previous experience. Furthermore, the sudden shift to this form of teaching posed a number of unique challenges when compared to previous instances of technology integration (Hossain et al., 2020; Rajkumar, 2020),

and hence negatively affected teachers' well-being, as well as their personal and professional behaviors (Botvin et al., 2022; Pokhrel & Chhetri, 2021; Pressley, 2021).

On the other hand, it appears that the massive, continuous use of technology during the COVID-19 ERT—albeit being forced upon teachers—overall increased their technology competency and positively affected their beliefs about integrating technology in teaching (Beardsley et al., 2021; Ma et al., 2021; Winter et al., 2021). This is also evident in our population; despite suffering from familial, emotional, physical, and technological difficulties to medium-high degrees during the ERT times, our participants demonstrated relatively high values of sense of success in teaching in ERT and of self-efficacy for integrating technology in teaching. This finding may be seen as good news. The extensive experience of intensely using technology in teaching could have established negative attitudes toward technology integration by forming an identification between technology integration and the less-than favorable conditions during the pandemic. Instead, that experience has positively contributed to teachers' attitudes towards technology integration. Indeed, other studies have found that the COVID-19 ERT experience has led to insights about using technology in teaching that may be here to stay (Beardsley et al., 2021; Farrell, 2021; Kilcoyne, 2021; Yu et al., 2021). Those positive perceptions of- and beliefs about using technology for teaching may serve as an important drive to such uses in the future (Mumtaz, 2000).

5.1 Demographics: RelationsImportance of gender, sector

Our study suggested that some sub-populations demonstrated higher values of both Perception of Success in Teaching in ERT and Self-Efficacy for Integrating Technology in Teaching, two of which are characterized by demographic variables, i.e., gender and mother tongue.

5.1.1 Males scored higher than females

The advantage of male over female teachers is adding to the growing literature of gender-driven technology use; mostly, it adds to the mixed results which have been accumulated over the last decades. A recent meta-analysis of fifteen studies found no significant difference between males and females in technology use and skills (Qazi et al., 2022), and a literature review found contradicting evidence for gender-based differences in technology adoption (Altaqqi & Shaouf, 2018).

5.1.2 Arab teachers scored higher than others

The findings related to mother tongue—i.e., that Arabic native speakers scored higher than Hebrew native speakers on both dependent variables—may seem counterintuitive, as the Arab population in Israel is disadvantaged compared to the Jewish (Hebrew-speaking) population in most socio-demographic and well-being indicators, including education and access to technology (Central Bureau of Statistics, 2022). Indeed, an earlier study of Jewish and Arab teachers' sense of success in online teaching during COVID-19 showed an advantage to the Jewish over the Arab sub-

populations (Masry-Herzallah & Stavissky, 2021); however, as that study used data collected at the very beginning of the COVID-19 days (May 2020), it is possible that its findings may serve as an explanation to our findings, which are based on retrospective self-examination. That is, we may have observed the Arab teachers' sense of overcoming the extreme challenge they had faced. Note that age and teaching experience were not found to be associated with sense of success or self-efficacy, in line with previous studies (Šabić et al., 2022b; Tweed, 2013).

Another possibility may have been scale-use tendencies. Past studies established that individuals in inter-dependent cultures, are more likely to agree with statements within a questionnaire. This acquiescence may be a result of focus on harmony and similarity among group members, rather than self-expression and uniqueness (Smith et al., 2016). Thus, it is possible that within the Arab schools, report of perceived success and self-efficacy stemmed from identification with the school and community. To understand the reasons for the superiority of the Arab population, it is recommended to further study its behavior during and after COVID-19; more generally, this issue could be tested in other disadvantage sub-populations.

5.2 Teaching-related variables: importance of experience with technology, taking a leading role at school, subject matter

5.2.1 Advantage of experience of teaching with technology

Regarding teaching-related variables, we found, that experience with technology was correlated with both sense of success and self-efficacy, which highlights the importance of continuously integrating technology in teaching (Jelińska & Paradowski, 2021). Recall that self-efficacy in general is mostly affected by first-hand and vicarious experience (Maddux & Gosselin, 2013); in the context of technology in teaching, previous experience has long been suggested as the most important factor for an effective use (Mumtaz, 2000), a finding that was corroborated in a recent literature review (Spiteri & Chang Rundgren, 2020).

Indeed, previous experience with technology has been commonly found as predicting self-efficacy or success in teaching with technology during COVID-19 times (Abid et al., 2021; Baroudi & Shaya, 2022; Marek et al., 2021). It may be suggested that teachers who had previous experience were better prepared for online teaching during COVID-19, and were not experiencing the same difficulties described before, of rebuilding their set of skills and curriculum from the start. Moreover, teachers who had experience in using technology may have held, to begin with, more positive attitudes toward the integration of technology, which are strong predictors for technology use, self-efficacy for using technology, and technology integration in teaching (Blank & Lutz, 2016; Mota & Cilento, 2020). Such attitudes are strong predictors of technology integration and self-efficacy (Milbrath et al., 2000; Wang et al., 2014). As studies have repeatedly shown, integration of technology in teaching requires ongoing professional development (Engelbrecht & Ankiewicz, 2016; Fernández-Batanero et al., 2022; Higgins & Spitulnik, 2008; Lawless & Pellegrino, 2007), therefore experienced teachers have a clear advantage over inexperienced ones. They acquired the

skills in the past, and practiced them, and thus can bring this knowledge into fruition fast in the ERT situation.

5.2.2 Advantage of taking a leading role at school

We also found that teachers who took a leading role in their school scored higher on both dependent variables, compared with those teachers who did not take a leading role. This finding echoes Barth's (2001) notion of teacher leadership, which may positively affect students, schools, and teachers themselves, and hence emphasizes the need to let teachers make happen what they believe in. Management role may also be associated with sense of agency. ERT may involve loss of control over one's professional environment, as regulations may change rapidly, and one's experience may become partly irrelevant. Indeed, it was found that a clear agenda by school leadership was an important factor positively affecting teachers' coping during COVID-19 (Delcker & Ifenthaler, 2021). Leaders in the school may have at least partial control on such policies, as they take part in decisions making regarding implementation of ERT within the school environment; this sense of agency may increase the sense of well-being.

5.2.3 Advantage of STEM/Language teachers

We found that STEM and Language teachers scored higher on both dependent variables than Humanities/Social Studies teachers. This finding resonates Hew and Brush's (2007) notion of how subject culture—that is, the general set of institutionalized practices and expectations that define a school subject as a distinct area of study—is indirectly influencing technology integration in school via teachers' attitudes and beliefs. By their very nature, some STEM subject matters are technology-oriented, which may attract teachers who are technology savvy. Indeed, a study of students' preferences for technology by major, found that Engineering and Life/Physical Sciences majors had demonstrated higher preferences for technology use than Social Sciences/Humanities majors (Kvavik, 2005). Another explanation for the subject matter importance in teachers' sense of success and self-efficacy may be that upon difficulties, STEM and non-STEM teachers focus on different aspects of teaching and schooling; while STEM teachers focus on professional development, autonomy in teaching, and student behavior, non-STEM teachers focus on their ability to be part of the conversation about school policies; (Wang et al., 2018); therefore, it is possible that during COVID-19, when teachers were more autonomous and when policies have frequently changed, this gap between STEM and non-STEM teachers increased.

5.3 COVID-19-related variables: importance of familial, emotional difficulties

Finally, regarding COVID-related variables, we found that familial difficulties and emotional difficulties were negatively related with the dependent variables. Teachers have experienced high levels of anxiety, depression and stress during COVID-19, as recent literature reviews suggest (Ma et al., 2022; Ozamiz-Etxebarria et al.,

2021). As our findings suggest, these difficulties may have been more meaningful than physical- and technology-related difficulties; this may be explained by the fact that physical and technological difficulties are relatively easy to overcome in the face of prominent health concerns and emotional stress.

5.4 A multivariable view

Integrating technology in teaching is a multi-faceted process, affected not only by individual factors, but also by home-, school-, and community-related factors. Therefore, we also studied this phenomenon in a multivariate method, for better understanding—the nuanced relations between teacher characteristics and the dependent variables. We found some striking similarities between the prediction models of these dependent variables. Here we will discuss these similarities, as well as the differences between them.

5.4.1 Prominence of experience of teaching with Technology and the role of subject matter when it is low

We found that the most powerful predictor, positively associated with the dependent variables was previous experience with technology. Following our discussion above, this is not surprising. Interestingly, we found that even medium levels of experience with technology can contribute to sense of success and self-efficacy when facing emotional difficulties, which highlights the importance of such experience; although technology use in teaching is often accompanied by anxiety among teachers (Al-Fudail & Mellar, 2008; Fernández-Batanero et al., 2021), acceptance of technology during COVID-19 days was found to be positively associated with positive mental health, which may explain this findings (Wahyuni et al., 2021).

Additionally, our findings suggest that with low experience of teaching with technology, and amid facing emotional difficulties – there is an interesting distinction between teachers' self-efficacy and sense of success based on the discipline they teach, with advantage to STEM and Language teachers compared with teachers in the Social Sciences or Humanities; this advantage should be further studied – it may be explained by the ways in which teachers use technology in different disciplines, or to personal characteristics of teachers based on discipline. Interestingly, physical space, being in a COVID-19 risk group, or facing familial difficulties had only limited negative impact on sense of success and self-efficacy.

5.4.2 Negative impact of emotional difficulties on sense of success

For sense of success only, emotional difficulty was found to be the second most powerful predictor, with a negative impact regardless of level of technology experience. This echoes Masry-Herzalah and Dor-Haim's (2022) finding about the mediating role of emotional factors in technological success during COVID-19. As it turns out, for teachers with relatively high experience with technology in teaching we find one supporting factor for self-efficacy for integrating technology in teaching, namely, having a leading role at school. This highlights the need in strengthening professional and

personal relationships between teachers and management teams, especially in times of emergency (Molise & Dube, 2020).

5.4.3 The non-impact of technological difficulties

An important finding is that technological difficulties (infrastructure-wise) were not predictive of neither sense of success or self-efficacy in our models. Despite the fact that appropriate infrastructure is a prerequisite for technology integration, and despite being suggested as an important factor in promoting online learning in the post-COVID era (e.g., García-Morales et al., 2021), technological difficulties did not enter our models as neither promoting or hindering perceptions of technology integration. This means that at time of emergency, other factors become more substantial, which is of important contribution to both theory and practice. It also bears the potential to promote technology integration in routine times as well, e.g., by encouraging teachers to take leading roles in school, support female teachers and teachers of disciplines other than STEM and Language, and paying ongoing attention to emotional difficulties. Generally, it is suggested to study whether which factors may help in overcoming technology difficulties in teaching at large, and how that knowledge can be used to support teachers.

5.5 Limitations

As with any study, the present study is not without its limitations. Its main limitation lies in the fact that it was conducted in a single country, characterized by a specific culture of education and technology, and by specific ways in which COVID-19 had affected the population; moreover, we cannot assure that our research population is representative of the teacher population in the country. Furthermore, relying on an online questionnaire may have been more inviting to teachers with technical abilities to respond, hence this may somewhat bias to the findings. Therefore, our findings should be validated by similar studies in other contexts. Still, our advanced analysis and findings may be useful to the general population, especially due to contemporary issues raised because of COVID-19 and its implications.

6 Conclusions and recommendations

Taken together, our study highlights the crucial role of experience in teaching with technology as an important factor that promotes sense of success and self-efficacy among teachers in ERT. Going beyond this factor, we emphasize that emotional difficulties in times of emergency may serve as an important hindering factor, and that taking a leading role in school may serve as an important protective factor. We also found an intermediate effect of the subject matter taught, with an advantage to STEM and Language teachers over Social Sciences and Humanities teachers. Following these findings, we suggest the following recommendations that would help teachers and schools to appropriately prepare for future ERT scenarios, and may also promote their routine use of technology for teaching.

6.1 Continuously promote and practice using technology

As our findings suggest, previous experience with integrating technology in teaching is still the most important factor in promotive positive teachers' beliefs about their capability of use of technology. Therefore, it is recommended to continuously promote and practice various digital pedagogies. Beyond its importance for ERT, this will help teachers in diversifying and enhancing their ongoing teaching practices, therefore may promote their professional development and may in turn improve student learning.

6.2 Support teachers emotionally

Regarding our findings about the negative impact of emotional difficulties, we recommend to always keep in mind that not only students need socio-emotional support, but educational teams need it as well. Offering emotional support to teachers can be done within the school staff, either professionally by school counselors or collegially by other team members. This kind of support will help teachers overcome difficulties, and may have a broader impact on the formation of a supportive school community.

6.3 Offer teachers further responsibility in school

Following our findings regarding the importance of taking a leading role in school, we recommend suggesting various leading roles for teachers within the school community. Teachers can lead in different aspects of schooling, taking roles related to pedagogy, content, technology, student learning, etc. In addition to improve teaching and learning, this may have a positive contribution to school climate, and may promote an inclusive school culture that will positively affect the rest of the school team.

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

Declarations

Compliance with Ethical Standards Participants gave informed consent to take part in this research.

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