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Teaching in Times of COVID-19: Determinants of Teachers' Educational Technology Use*

Matthias Dincher† and Valentin Wagner‡

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Abstract

We conduct a large and nationwide survey among German teachers to investigate the determinants of teachers' adaption to an increased use of educational technology during the COVID-19 school closures. We find that higher levels of technical affinity and higher perceived learning effectiveness of distance teaching are positively associated with using at least one (new) educational technology solution while teachers' age and the digital infrastructure of the school have no predictive power.

Keywords: School closures, educational technology, COVID-19, technical affinity

JEL codes: I21

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1 Introduction

In the past years, governments have increasingly started to put the digital transformation of the education sector on the political agenda, leading to a sharp increase in expenditures on computer-based learning technologies, i.e., digital infrastructure as well as software solutions. Specifically, in the US, average school district-level expenditures for ICT supplies and services as well as technology-related equipment almost quadrupled from $77,657 in 2015 to $300,336 in 2017 (Cornman et al., 2020), and the COVID-19 crisis is expected to be a catalyst for future investments into educational technology. However, there is mixed evidence on the impacts of ICT investments (Falck et al., 2018; Fairlie and Robinson, 2013; Fairlie and London, 2012; Leuven et al., 2007; Machin et al., 2007) and computer-aided instructions (Bettinger et al., 2020; Ma et al., 2020; Rouse and Krueger, 2004; Banerjee et al., 2007; Angrist and Lavy, 2002) on educational outcomes.[1] Equipping schools with educational technology alone does not seem to improve students' achievements, instead teachers practical utilization of the technology can be a decisive factor for its effectiveness (Comi et al., 2017). In the International Computer and Information Literacy Study (ICILS) only less than half of the teachers—on average across countries—reported daily use of ICT when teaching (Fraillon et al., 2018), indicating varying rates of adoption of digital tools utilized for in-class teaching. While digital teaching solutions are increasingly available for teachers, little research into distance teaching exists so far. To the best of our knowledge, no study has investigated teachers' implementation of web-based teaching technologies in distance teaching versus using "established" teaching practices (e.g., paper-based assignments). Moreover, little is known about the relationship between individual teacher characteristics and the willingness to adopt web-based teaching technologies in distance teaching.

The worldwide COVID-19 pandemic had considerable effects on educational systems, e.g., nationwide school closures and subsequently a sharp increase in distance teaching. Thus, it is a unique setting to study changes in teaching practices. School closures affected 94% of learners worldwide in mid-April 2020 (United Nations, 2020) and urged educators of all levels of education to find remote teaching solutions "overnight". Importantly, remote teaching technologies varied markedly among teachers, e.g., Grewenig et al. (2020) report evidence from an online survey—conducted during the first school closures caused by COVID-19—where parents of schoolchildren recounted that 53% of teachers used educational videos several times a week and 43% recounted the use of educational software by their children's' teachers several times per week. Thus, only about half of the teachers used educational technologies daily or several times a week, mirroring the average pre-COVID-19 findings of the ICILS. This heterogeneity in educational technology use implies the need to better understand the underlying drivers of teachers' willingness to use web-based teaching technologies.

We exploit data from Germany to analyze the determinants of teachers' willingness to use educational technologies for remote teaching during the COVID-19 school closures. Specifically, we analyze the predictive power of teachers' technical affinity (which is constructed from scales measuring teachers' technology acceptance, ICT skills, and technophobia) for the choice of established and web-based teaching technolo-

[1] See also the literature reviewed in Bulman and Fairlie (2016), Cheung and Slavin (2013), and Escueta et al. (Forthcoming).

gies. Compared to other countries participating in the ICILS[2], Germany is characterized by a rather low percentage of teachers having used ICT for work-related purposes before the crisis, i.e., only about every fourth to fifth teacher (Fraillon et al., 2018). In 2019, the German government committed to invest 5 Billion Euros into the digital infrastructure of German schools—equaling an investment of on average 120.000 Euros per school.[3] In response to the school closures caused by the COVID-19 crisis, the German government added an additional 1.5 billion Euros for IT administration, creating digital content, and mobile devices for students and teachers.[4] However, only a small fraction of the funds (15.7 million Euros by June 2020) has been retrieved by the federal states, indicating slow drawdown of the available funds. A recent survey among teachers in Germany, Austria, and Switzerland is in line with this observation. 56% of German teachers disagreed with the statement that the technical capacities in the school are sufficient for web-based formats whereas in contrast, only 18% of teachers in Switzerland and 27% of teachers in Austria disagreed (Huber and Helm, 2020).

In our online survey, teachers reported on their current teaching practices, available ICT equipment at their school, and a rich set of teacher characteristics including their level of technology acceptance, technophobia, ICT skills, personality traits, economic preferences, and the organizational climate. Our final sample consists of 2,610 teachers in 12 (out of 16) federal states in Germany and was conducted between May and September 2020 (details on the procedures can be found in Section 2).

We find that teachers with a higher affinity for digital technologies and a higher perceived learning effectiveness of digital distance learning are significantly more likely to use web-based teaching technologies. Additionally, female teachers and teachers with a higher job motivation also show a significantly higher propensity to use web-based teaching technologies. In contrast, teachers' age and the degree to which educational technology is available at the teachers' school have no significant effect in regard to the usage of web-based teaching technologies.

Our results contribute to a small and recently emerging literature examining shifts to online teaching during nationwide school closures in the COVID-19 crisis (Grewenig et al., 2020; Johnson et al., 2020; Crawford et al., 2020; Mseleku, 2020). These studies predominantly report evidence on tertiary education while, to our knowledge, there is only one study examining the link between teacher characteristics and changes in teaching practices (König et al., 2020). König et al. (2020) find, among a sample of early career teachers in Germany, that teachers' digital competence and teacher education opportunities to acquire digital competence are instrumental in adapting to online teaching during COVID-19 school closures.

[2] Chile, Denmark, Finland, France, Germany, Italy, Kazakhstan, the Republic of Korea, Luxembourg, Portugal, the United States, and Uruguay

[3] https://www.digitalpaktschule.de/de/was-ist-der-digitalpakt-schule-1701.html

[4] https://www.digitalpaktschule.de/de/was-ist-der-digitalpakt-schule-1701.html

2 Methods

2.1 Data

We use data from a survey we conducted in Germany during the COVID-19 school closures. Headmasters and teachers were recruited in a two step procedure. Firstly, we approached the educational authorities of the 16 federal states in Germany to ask for approval for our study; 12 responded positively. The federal states of Bavaria, Hamburg, Mecklenburg-Western Pomerania, and Saarland did not give their consent. Secondly, we sent out invitation emails including a link to our questionnaire to all headmasters asking them to participate in our study and to forward our request to all teachers of their school. Reminders were sent out two weeks later. Data were collected between the end of May and the end of September. Data collection usually lasted for four weeks, but in some states the data collection period was extended due to the summer break. Before answering the questionnaire, participants had to sign a data privacy declaration.

Questionnaire Completing the questionnaire took the participants on average about 20 min. They could pause and either return to or exit the questionnaire at any time.[5] Furthermore, they could withhold their answer on any survey item. The survey data provides a rich set of information about teacher characteristics as well as their experience and attitude toward digital teaching technologies. These data allow us to identify determinants of teachers' technology use during the school closures while including various controls. The survey was conducted online[6], with the questionnaire containing seven separate sections measuring (i) teachers' background characteristics and types of teaching technologies used during the school closures, (ii) ICT skills (van Deursen et al., 2014), (iii) technophobia (Khasawneh, 2018), (iv) technology acceptance (Davis et al., 1989), (v) the Big Five personality traits (Gerlitz and Schupp, 2005), (vi) the organizational climate of the school (Litwin and Stringer, 1968), and (vii) time and risk preferences (Falk et al., 2018).

The outcome variable of interest is whether teachers used web-based teaching technologies during the school closures. In the survey, we presented eight different established as well as web-based teaching technologies to teachers and asked them to indicate which ones they had used (multiple answers were possible). The eight options were: (i) sending paper-based assignments, (ii) phone calls with students, (iii) sending assignments via email, (iv) providing students with links to digital learning material of third parties, (v) recording learning videos, (vi) uploading learning material via a digital platform, (vii) live teaching via a video conference (e.g., Zoom, Microsoft Teams), and (viii) recording audio messages. We classify paper-based assignments, calling students, and assignments via email as established teaching technologies and refer to web-based teaching technologies for the remaining options. The outcome variable of interest is therefore a dummy variable taking on the value 1 if teachers used web-based teaching technologies and the value of 0 otherwise.

Participants Overall, we contacted approximately 76% of all schools in Germany. In total, 3,673 teachers answered the survey, i.e., they reached the last page of the questionnaire. As participants were not forced

[5]Headmasters and teachers answered the same questionnaire.
[6]The questionnaire was programmed in "LimeSurvey".

to answer questions, we collected data from 2,610 participants who answered all items used in our preferred regression specification (the possibility to skip any question was a prerequisite of school authorities). On average, participants had 15.85 years of working experience; 72% were female. The number of participants per school ranged from 1 to 23 teachers (right-skewed distributed) and 27% of participants were headmasters; 34.19% of the survey answers stem from teachers in primary schools.

2.2 Analysis

We estimate probit and linear models of the following form:

$$
\begin{aligned}
digital_i = \beta_0 + \beta_1 TechnicalAffinity_i + \beta_2 DigInfrasSchool_i + \beta_3 LearningEff_i + \\
\beta_4 LikesJob_i + \beta_5 female_i + \beta_6 experience_i + \beta_7 BigFive_i + \beta_8 RiskAndTime_i \\
+\gamma Covariates_i + SchoolType_n * \mu_{(1-s)} + Weeks_j * \theta_{(1-m)} + States_k * \delta_{(1-l)} + \epsilon_i
\end{aligned} \quad (1)
$$

where i denotes an individual survey participant and ϵ_i is the error term. $TechnicalAffinity_i$ measures individuals' technical affinity as the sum of three sub-scales: technology acceptance, ICT skills and technophobia (technical affinity = technology acceptance + ICT skills - technophobia). The three sub-scales are (i) the quantification of the Technology Acceptance Model (Davis et al., 1989) which measures an individual's perceived usefulness and perceived ease of use of technology, (ii) ICT skills based on van Deursen et al. (2014) which capture the "information communication technology skills" by asking ten questions regarding the everyday usage of digital technology, and (iii) the technophobia scale as developed by Khasawneh (2018) measuring technophobia in five dimensions: techno-paranoia, techno-fear, techno-anxiety, techno cybernetic revolt, and techno-communication device avoidance.[7] $DigInfrasSchool_i$ is a dummy variable which takes the value of 1 if the school is equipped with digital technologies and 0 otherwise, $LearningEff_i$ measures teachers' perceived learning effectiveness of educational technologies, $LikesJob_i$ measures how much teacher i likes her job, $female_i$ takes the value of 1 if teacher i is female and 0 otherwise, and $experience_i$ is the number of years teachers have already spent in their job. Moreover, $BigFive_i$ are the big five personality traits (conscientiousness, agreeableness, extraversion, neuroticism, and openness), $RiskAndTime_i$ measure risk and time preferences as in the Global Preference Survey (Falk et al., 2018), and $Covariates_i$ is a vector of further control variables regarding teacher's i background characteristics and school characteristics (i.e., being a headmaster, the organizational climate, whether teachers have access to WiFi at school, and whether WiFi at school is accessible for all including students). Furthermore, we included dummies for the school type, the week participants answered the survey, the federal state of the school, and control for the quality of the broadband as well as mobile phone network quality in the school's district.

We first provide descriptive information on the type of teaching technologies used by teachers for distance teaching. Thereafter, we present the regression results on factors that determine whether teachers used at

[7] A description as well as the wording of all scales and control variables can be found in the Supplementary Online Material.

least one web-based teaching technology. In a subsequent regression, we analyze what determines the number of different web-based teaching technologies used. The dependent variable for the first analysis is a dummy variable ($digital_i$) that takes the value 1 if survey participant i used at least one of the five web-based teaching technologies, and 0 otherwise. The dependent variable for the second analysis represents a count variable that takes values between 0–5 and indicates how many different web-based teaching technologies teachers used during the school closures. For this purpose, we estimate a linear regression model (OLS) controlling for the same factors as in equation (1). Throughout the paper, we report standardized coefficients and standard errors that are robust to heteroskedasticity and clustered at the school level.

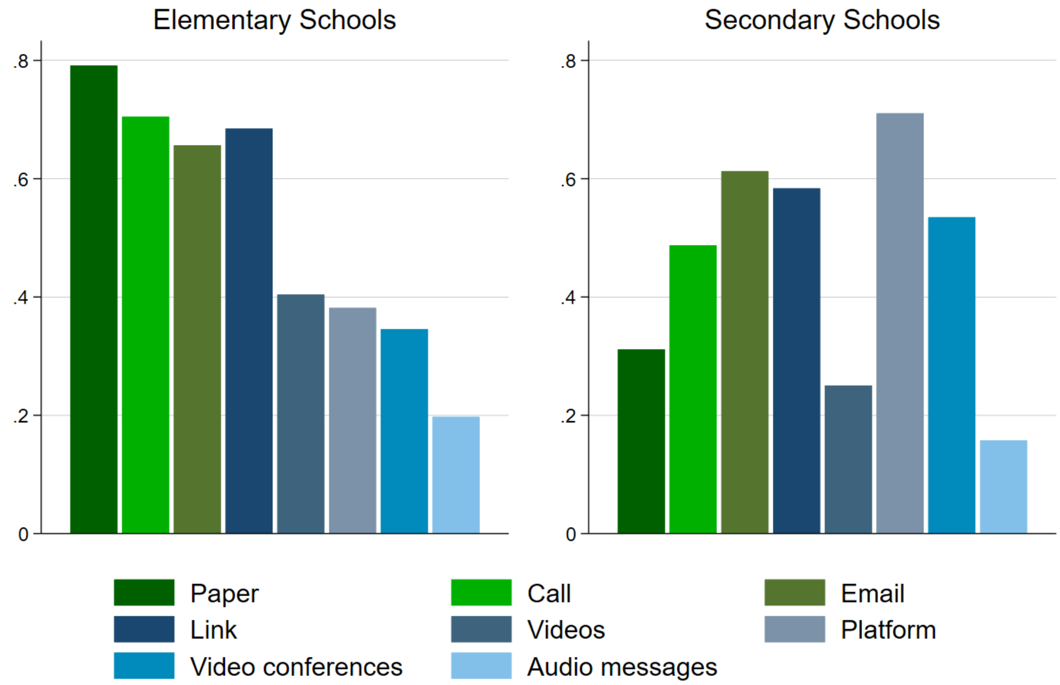
3 Results

3.1 Teaching practices (descriptive)

Figure 1 shows the types of teaching technologies used by teachers for distance teaching by their own admission. The left panel presents the results for elementary school teachers, the right panel for secondary schools teachers. Overall, we observe that elementary teachers use mainly established technologies—paper-based assignments, phone calls, and emails—while the picture in secondary schools is more diverse. Strikingly, 79.12% of elementary teachers used paper-based assignment whereas only 31.3% of secondary school teachers used this format.

The other two established teaching technologies were also heavily used among elementary school teachers (more than 60%) while among the web-based teaching technologies, elementary teachers predominantly chose to send a link to third party learning content (68.46%) whereas the other web-based teaching technologies were not popular (used by less than 40% of teachers). In secondary schools, teachers heavily relied on web-based teaching technologies, such as digital platforms to share learning material with their students (71.21%). Other frequently used ways of teaching were emails (61.17%), links to third party content (58.27%), and video conferences (53.59%).

Figure 1: Teaching technologies used by school types



Note: This graph shows the share of teachers using the respective type of teaching technology during the school closures separately for elementary and secondary schools. Teachers could give multiple answers. *Paper:* teachers prepared paper-based assignments; *Call:* teachers called their students; *Email:* teachers sent assignments via email; *Link:* teachers sent link to third-party learning content to students; *Videos:* teachers recorded learning videos and shared them with students; *Platform:* uploading learning material via a digital platform; *Video conferences:* live teaching via video conferences (e.g., Zoom, MS Teams); *Audio messages:* teachers recorded audio assignments and shared them with students.

3.2 Regression results

We now turn to the question what predicts the use of web-based teaching technologies during the school closures. Table 1 presents the results (standardized coefficients) on the relationship between teachers' characteristics and having used at least one web-based teaching technology during the COVID-19 school closures. Higher levels of technical affinity, perceived learning effectiveness of digital technologies, and extraversion all significantly increased the probability that teachers used at least one web-based teaching technology. Technical affinity (0.053 SD) has the largest effects on the usage of web-based teaching technologies followed by the perceived learning effectiveness (0.032 SD). These effects are robust against controlling for a large set of control variables capturing teacher characteristics as well as the available technical equipment in schools. Interestingly, teachers' gender and age (years in the job) as well as risk and time preferences do not predict teachers' usage of web-based teaching technologies. Moreover, conscientious teachers are associated with a lower probability of using web-based teaching technologies.

Table 1: Determinants of using a web-based teaching technology (probit)

	(1)	(2)	(3)	(4)
Technical Affinity	0.053***	0.048***	0.051***	0.053***
	(0.01)	(0.01)	(0.01)	(0.01)
Digital Infrastructure School		0.002	0.001	0.000
		(0.01)	(0.01)	(0.01)
Learning Effectiveness		0.032***	0.032***	0.032***
		(0.01)	(0.01)	(0.01)
Teacher likes her job		0.002	0.004	0.007
		(0.01)	(0.01)	(0.01)
Female		0.008	0.007	0.007
		(0.01)	(0.01)	(0.01)
Experience		-0.004	-0.001	0.002
		(0.01)	(0.01)	(0.01)
Conscientiousness			-0.014**	-0.013**
			(0.01)	(0.01)
Agreeableness			-0.004	-0.002
			(0.01)	(0.01)
Extraversion			0.013**	0.014**
			(0.01)	(0.01)
Neuroticism			0.011	0.009
			(0.01)	(0.01)
Openness			0.001	-0.000
			(0.01)	(0.01)
Risk			0.005	0.004
			(0.01)	(0.01)
Time			-0.001	-0.001
			(0.01)	(0.01)
Further Controls	No	No	No	Yes
Broadband & mobile phone network	No	No	No	Yes
School Type	Yes	Yes	Yes	Yes
Week	Yes	Yes	Yes	Yes
State	Yes	Yes	Yes	Yes
Adj. Pseudo R2	0.066	0.077	0.076	0.079
Observations	2581	2581	2581	2581

Note: This table present standardized coefficients of a probit regression (in marginal units). The dependent variable is a dummy that takes the value of 1 if teachers used at least one of the five web-based teaching technologies during the school closures and 0 otherwise. *Further Controls:* dummy of being a headmaster, organizational climate, teachers have access to WiFi at school, WiFi at school is accessible for all (incl. students). Standard errors given in parentheses and clustered at the school level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Number of web-based teaching technologies used

Teachers could have used multiple established and web-based teaching technologies during the school closures. We now investigate what factors predict the number of web-based teaching technologies used. Overall, 22%

used one, 22.71% two, 24.76% three, 10.81% four, 4.27% five, and 10.43% use none of the web-based teaching technologies. Moreover, 12.6% of the teachers used exclusively web-based teaching technologies, 9.6% used exclusively established teaching technologies, and 77.8% used a mixture of established and web-based teaching technologies. Table 2 shows the results of linear regression estimations (standardized coefficient) on which factors, e.g., teachers' technical affinity, predict the number of different web-based teaching technologies used. As above, higher levels of technical affinity, perceived learning effectiveness, and extraversion have a positive and significant association with the number of web-based teaching technologies used. Additionally, the coefficients on teachers' job satisfaction and gender are also positive and significant. Both, an increase of one standard deviation of a teachers' job satisfaction as well as being female are associated with an increase of the number of web-based teaching technologies teachers use (0.071 SD and 0.037 SD respectively). Furthermore, teachers with higher levels of neuroticism and openness as well as more risk loving teachers use a significantly higher number of different web-based teaching technologies. In contrast, teachers with higher levels of agreeableness are significantly associated with using fewer web-based teaching technologies. As above, the digital infrastructure of schools and teachers' age have no predictive power. All the results are robust controlling for a large set of teacher and school characteristics.

Table 2: Determinants of the number of web-based teaching technologies used

	(1)	(2)	(3)	(4)
Technical Affinity	0.295***	0.269***	0.273***	0.277***
	(0.02)	(0.02)	(0.02)	(0.02)
Digital Infrastructure School		0.022	0.021	0.016
		(0.02)	(0.02)	(0.02)
Learning Effectiveness		0.115***	0.111***	0.108***
		(0.02)	(0.02)	(0.02)
Teacher likes her job		0.056***	0.064***	0.071***
		(0.02)	(0.02)	(0.02)
Female		0.047**	0.041**	0.037*
		(0.02)	(0.02)	(0.02)
Experience		-0.036*	-0.035*	-0.025
		(0.02)	(0.02)	(0.02)
Conscientiousness			-0.004	-0.002
			(0.02)	(0.02)
Agreeableness			-0.040**	-0.037*
			(0.02)	(0.02)
Extraversion			0.035*	0.036*
			(0.02)	(0.02)
Neuroticism			0.057***	0.055***
			(0.02)	(0.02)
Openness			0.049**	0.045**
			(0.02)	(0.02)
Risk			0.037*	0.036*
			(0.02)	(0.02)
Time			0.006	0.003
			(0.02)	(0.02)
Further Controls	No	No	No	Yes
Broadband & mobile phone network	No	No	No	Yes
School Type	Yes	Yes	Yes	Yes
Week	Yes	Yes	Yes	Yes
State	Yes	Yes	Yes	Yes
Adj. R2	0.136	0.153	0.160	0.165
Observations	2610	2610	2610	2610

Note: This table present standardized coefficients of a linear regression (OLS). The dependent variable is the number of web-based teaching technologies teachers used during the school closures. *Further Controls:* dummy of being a headmaster, organizational climate, teachers have access to WiFi at school, WiFi at school is accessible for all (incl. students). Standard errors given in parentheses and clustered at the school level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4 Discussion

In March 2020, the novel COVID-19 virus caused nationwide school closures forcing teachers to resort to remote teaching until the closures were revoked. We use data from a nationwide survey conducted in Germany to examine what (digital) teaching technologies were used for distance teaching and to identify the determinants of using web-based teaching technologies.

We find that 9.6% of the teachers used exclusively established teaching technologies, while most teachers (77.8%) complemented established with web-based teaching technologies, e.g., learning platforms or live online teaching. Furthermore, while paper-based assignments and phone calls were most frequently reported by teachers in elementary schools, teachers in secondary schools predominantly used learning platforms and emails for distance teaching. Interestingly, a school's digital technology infrastructure has no predictive power in explaining whether teachers used web-based teaching technologies. This is in line with a large body of literature demonstrating that investments into ICT infrastructure in schools have no effect on students' attainment (Bulman and Fairlie, 2016; Escueta et al., Forthcoming). One potential reason could be that the teaching technologies needed for distance teaching differs from educational technology installed in schools, e.g., smartboards and projectors. This finding indicates that the actual practice which teachers make of educational technology could be important for adopting web-based teaching technologies for distance teaching.

It is important to note that we cannot contribute to the discussion which teaching technologies—established or web-based—are (more) effective in enhancing educational attainment, since we do not have data on students. However, we shed light on which of the teachers' individual characteristics are associated with using web-based teaching technologies at all and if so, how many of them teachers used during the school closures in the COVID-19 crisis. Our results show that teachers' technical affinity and the perceived learning effectiveness of educational technology are strongly associated with using web-based teaching technologies. In addition, female teachers and teachers with high job satisfaction use multiple web-based teaching technologies in their distance teaching. These results are particularly important in the light of the ongoing digital transformation of the educational sector. The adoption and implementation of (web-based) educational technologies crucially depends on teachers' willingness to acquire the necessary skills and an open mindset to actually use them. Accordingly, policy-makers should not limit their efforts on the mere provision of educational technology but should equally invest in training and information about the potential benefits of educational technology.

Declaration of Competing Interest

We have no conflicts of interest to declare.

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A Supplementary Online Material

Survey Items

Dependent Variables

- *Paper-based assignments:* Teachers sent paper-based assignments to students.
- *Calling students:* Teachers called students or their parents during the school closures.
- *Assignments via email:* Teachers sent assignments to students via email.
- *Link to third party material:* Teachers sent students a link to third party educational content.
- *Recording videos:* Teachers recorded learning videos and sent them to students.
- *Platform:* Teachers used an e-learning platform to upload learning material and to chat with their students.
- *Video conferences:* Teachers taught "live" via video conferences (e.g., via Zoom or Microsoft Teams).
- *Audio messages:* Teachers recorded audio messages and sent them to students.

Technical Affinity The variable Technical Affinity is constructed by using the answers to three scales: technology acceptance, technophobia, and ICT skills. Technical Affinity is the sum of the three scales whereas we subtract technophobia. Hence, Technical Affinity = technology acceptance + ICT skills - technophobia.

Technology Acceptance Model (TAM): Teachers could answer each question on a scale from 1 (do not agree) to 7 (fully agree). Our measure for technology acceptance used in the regressions is the sum of the following questions.

1. With the newly introduced e-learning platforms and digital communication, I can complete my tasks faster.
2. Learning platforms and forms of digital communication have improved the quality of my work.
3. Thanks to learning platforms and digital communication options, I get my schoolwork done faster.
4. Learning platforms and digital communication options are useful in my "job" at school.
5. It was easy for me to learn how to use learning platforms and digital communication options.
6. I find it easy to deal with learning platforms and digital communication options in such a way that they do what I want.

Technophobia: Teachers could answer each question on a scale from 1 (do not agree) to 7 (fully agree). Our measure for technophobia used in the regressions is the sum of all questions.

1. I'm afraid that third parties will use technology (e.g. software programs) to see and hear everything I do.
2. I'm afraid that in the future, technologies will change the way we live, communicate, love, and even judge others.
3. I'm scared of new technologies because one day they will make us (humans) redundant.
4. I fear that one day new technologies will take over my job.
5. I feel insecure when I have to use a new communication device.
6. I feel insecure when I have to learn to use a new computer operating system (e.g. switching from Windows 7 to Windows 10 or a new IOS version).
7. I'm scared that technology will take control of my personal life (and I'll lose my sense of reality).
8. I am afraid of eating genetically modified foods.
9. I'm afraid of new technologies because if something goes wrong (if for some reason it stops working) we go back to the Stone Age.
10. I'm scared of using search engines like google.
11. I am concerned every time I use a new program.
12. I'm afraid someone could track my surfing behavior when I'm connected to the internet.
13. I'm afraid robots could take over the world.
14. I try to avoid new technologies like smartphones whenever possible.

ICT Skills: Teachers could answer each question on a scale from 1 (do not agree) to 7 (fully agree). Our measure for ICT skills used in the regressions is $ICT = \sum_1^9 item_i + (8 - item_{10})$.

1. I know how to use keyboard shortcuts (e.g. Ctrl-C to copy, Ctrl-S to save).
2. I know how to open websites directly without using a search engine like google.
3. I can fill out online forms.
4. I can create a website.
5. I know how to adjust privacy settings.
6. I know how to avoid computer viruses.
7. I can download / save a picture that I found online.

8. If I encounter a technical problem while using the internet, I usually know how to fix it.
9. I usually have no problem finding my way around a website.
10. Sometimes I end up on websites without knowing how I got there.

Teacher likes her job Teachers were asked to disagree or agree on a scale from 0-4 to the statement *"I enjoy my job as a teacher"*.

Digital infrastructure school Teachers were asked whether their school is equipped with digital technologies, e.g., beamer, smartboards, or learning software. Teacher could answer yes or no.

Learning effectiveness On a scale between 0-200, teachers were asked to rate the learning effectiveness of remote teaching. A value of 100 is equivalent to the statement that learning effectiveness is seen equally high for remote teaching and in-class teaching. A value below 100 indicates that teachers think that learning effectiveness is higher for in-class teaching and a value above 100 is equivalent to the statement that learning effectiveness is higher for remote teaching.

Big five personality traits To obtain measures of the Big Five, we used the inventory which is used in the German Socio Economic Panel (Gerlitz and Schupp, 2005). Each personality trait (conscientiousness, agreeableness, extraversion, neuroticism, and openness) is constructed from three items answered on a scale ranging from 1 (do not agree) to 7 (fully agree).

Risk preferences

- *Self-assessment:* Please tell me, in general, how willing or unwilling you are to take risks. Please use a scale from 0 to 10, where 0 means "completely unwilling to take risks" and a 10 means you are "very willing to take risks". You can also use any numbers between 0 and 10 to indicate where you fall on the scale.
- *Interdependent choices:* Please imagine the following situation. You can choose between a sure payment of a particular amount x of money, or a lottery, where you would have a 50% chance of getting amount y or a 50% chance of getting 0 Euro. We will present to you five different situations. Please indicate whether you prefer to receive the sure payment of x or to play the lottery (the precise sequence of questions was given by the "tree" logic in Figure S2 in the Online Appendix of Falk et al., 2018).
- Individual-level risk index: 0.4729985 × Interdependent risk choices + 0.5270015 × Self-assessment risk.

Time preferences

- *Self-assessment:* How willing are you to give up something that is beneficial for you today in order to benefit more from it in the future? Please use a scale from 0 to 10, where 0 means "completely unwilling to give up something today" and a 10 means you are "very willing to give up something today". You can also use any number between 0 and 10 to indicate where you fall on the scale.

- *Interdependent choices:* Suppose you were given the choice between receiving a payment today or a payment in 12 months. We will now present to you five situations. The payment today is the same in each of these situations. The payment in 12 months is different in every situation. For each of these situations we would like to know which one you would choose. Please assume there is no inflation, i.e, future prices are the same as today's prices. Please consider the following: Would you rather receive 100 Euro today or x Euro in 12 months? (the precise sequence of questions was given by the "tree" logic in Figure 1 in the Online Appendix of Falk et al., 2018).

- Individual-level time index: 0.7115185 × Interdependent time choices + 0.2884815 × Self-assessment time.